COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS

RECORDS

1951/51

GEOPHYSICAL SURVEY OF THE SPENCER'S CREEK AREA, NEW SOUTH WALES

by

O. Keunecke

RECORDS 1951, No. 51.

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ILLUSTRATIONS

1. INTRODUCTION

The geophysical survey described in this report was undertaken at the request of the Snowy Mountains Authority for the purpose of investigating possible sites for the proposed Spencer's Creek dam. The area surveyed is about two miles above the junction of Spencer's Creek with the Snowy River, about six miles east of the summit of Mt. Kosciusko, and at an average elevation of about 5,700 feet above sea level. The road from Jindabyne to Mt. Kosciusko crosses the area about one mile from the Kosciusko Chalet.

Some years before the present survey, six bore holes were put down on a line across the creek (this line of holes coincides with geophysical traverse A) to obtain information on the depth and nature of the bedrock and the characteristics of the overburden at a site referred to as Site No.1 (see Plates 1 and 2). However, selection of the most suitable position for the dam required more extensive investigations and it was for this purpose that a geophysical survey was requested. The specific information sought by the survey comprised the following :-

(1) Depth and nature of the bedrock.

(2) Contours of the bedrock surface.

(3) Nature of the overburden and, in particular, any variations in physical properties occurring either horizontally or vertically.

The seismic refraction method was used in the survey. The field work was done between November, 1950, and April, 1951, with an interval of about five weeks in December and January. The field party consisted at first of D.F. Urquhart and O. Keunecke (geophysicists) and later of S. Gunson and I. Mumme (geophysicists). P.B. Tenni (cadet geophysicist) and B.J. Reid (student) assisted for several weeks.

The pegging and levelling of the traverse lines, except for the eastern part of traverse E, were undertaken by officers of the Snowy Mountains Authority, which also provided the necessary field assistants. Thanks are due to the Authority, in particular to D.G. Moye, Head of the Engineering Geology Branch, for the

co-operation and assistance extended to the field party.

2. GEOLOGY

The basement rock in the Spencer's Creek area is granite. It is covered with a mantle of morainal material, granitic soil or peaty swamp. Numerous large granite boulders occur on the surface. Granite boulders, probably of fluvio-glacial origin, occupy the valley floor of Spencer's Creek, particularly downstream from the dam site. The right abutment is generally thought to be granite weathered in situ and the left abutment a moraine, known as the David Moraine.

The six bore holes which were previously put down along a line across the creek all reached granite bedrock as shown in the section along traverse A (Plate 3). The bores showed the bedrock to be overlain by soil and decomposed granite ranging from 8 to 100 feet in thickness. An examination of the material struck in the bores may have been useful in connection with the geophysical survey, but this was not possible as the cores were no longer available.

3. SEISMIC REFRACTION METHOD

(a) Outline of the Method.

The seismic method of exploration depends on variations in the elastic properties of the subsurface materials, which govern the velocities of propagation of seismic energy. The method consists essentially of generation of seismic waves by means of an explosion and measurement of the time taken by the seismic waves to travel from the shot point to each of a series of detectors (geophones).

In the seismic refraction method, which is used for shallow exploration work, the time interval between the shot instant and arrival of the first impulse at each geophone is measured. A photographic recorder gives an accurate record of these events and enables the travel times of the seismic disturbances to be measured in milliseconds.

A necessary condition for the application of the refraction method is that the seismic velocities should increase with depth. When the recorded travel times are plotted against the distances of the geophones from the shot point, a time-distance graph is obtained, from which it is possible, in general, to determine the velocities of the different subsurface strata and the depths to the interfaces. To increase the depth of the investigation it is necessary to increase the distance between the shot point and the geophone spread so as to ensure that seismic waves refracted at the deeper interfaces will be recorded as first arrivals.

Seismic measurements can be expected to give reliable depth determinations if the geological strata are horizontal and the boundaries sharply defined. On the other hand, if the strata are inclined or undulating, or the boundaries not well defined as, for example, in the zone of weathering of bedrock, the interpretation of the results is more difficult and the accuracy of the depth determinations is reduced.

In the survey of the Spencer's Creek area, a particular application of the refraction method was employed. This, the "method of differences", is particularly suitable for the determination of depths to an irregular bedrock surface, the arrangement of the survey being such that the depth is determined below each geophone position (Edge and Laby, 1931).

(b) Field Operations.

The first tests were made along traverse A (Plate 3), where the information from the existing bore holes provided a guide as to the most suitable layout of geophone spreads and shot points. The bore data also provided a useful check on the seismic results and particularly on the seismic velocities in the layers overlying the bedrock. The accurate determination of these velocities is essential for the calculation of depths to bedrock. The results obtained along traverse A are discussed in Section 4.

The complete survey comprised ten traverses, A, A-B, A-C, B, C, D, E, F, G and H, located as shown in Plate 2. The geophones were usually spaced at intervals of 50 feet but in a few places, where exceptionally long-distance shots were necessary to obtain sufficient depth penetration, the intervals were increased to 100 feet. In general, satisfactory refractions were recorded from the bedrock and, with a few exceptions, the data were adequate for the calculation of the depth to bedrock at each geophone position.

4. RESULTS AND INTERPRETATION

(a) Individual Traverses.

Sections showing the results along the ten seismic traverses are given in Plates 3 to 12. Each section shows the bedrock profile and is accompanied by a table of the depths to bedrock for all points where these depths were calculated.

Traverse A (Plate 3):

The survey was started on traverse A, which was sited so as to cross the creek along the line of existing bore holes. Comparison of the seismic results with the bore data showed that the method was capable of giving the required information regarding the bedrock.

The following geological strata were identified from the observed seismic velocities :-

(i) Earth and granitic sand. The velocity ranges from 1,500 to 3,000 feet per second and depends largely on the moisture content. Hence, the level of the ground-water table is an important factor, and the velocity increases below this level.

(ii) Decomposed granite with a velocity between 5,500 and 6,000 feet per second.

(iii) Granite bedrock. The ~~fresh~~ unweathered granite has a velocity of about 13,000 to 13,500 feet per second.

These velocities have been used in the calculation of the depths to bedrock shown on Plate 3.

The geophysical results are in close agreement with the bore results except at Bore No.5, where the seismic depth of 64 feet to bedrock

~~of 64 feet~~ is 43 feet less than the depth apparently found in the bore hole. However, some doubt is felt with regard to the bore data, which ~~was~~ were recorded as follows :-

0-69 feet, earth.

69-107 feet, decomposed granite.

107-152 feet, granite.

This is the only one of the six bore logs which refers to three different strata. The others refer to two strata only, the first consisting of "earth and decomposed granite" and the second of "granite", while for Bore No.5 the first stratum has been subdivided to show earth with the extraordinary large thickness of 69 feet and then decomposed granite. It seems possible that the "decomposed granite" recorded in the log at 69 feet is the same material as that which, in the interpretation of the seismic results, is considered to be ~~fresh~~ unweathered granite occurring at about 64 feet.

No results were obtained in Spencer's Creek itself, as the deep water did not allow measurements to be made. The profile suggests that the deepest part of the bedrock lies not under the creek, but to the east, between Bores No. 2 and 3.

Traverse A-B (Plate 4):

The seismic observations indicate that the bedrock is at shallow depth along this traverse. This result could be expected, as the traverse is situated on the slope of the hill where granite crops out.

Traverses B, E, F and G.(Plates 5, 6, 7 and 8):

These are parallel traverses, 200 feet apart, which cross Spencer's Creek at Dam Site No. 2. The bedrock is at shallow depth along the north-eastern parts of these traverses and continues at shallow depth under the creek. West of the creek, however, there is a steady increase in the thickness of overburden and the undulations of the bedrock surface are more pronounced. The greatest thickness of overburden, about 300 feet, was observed at the intersection of traverses B and C on the David Moraine.

South-west of the creek, along traverse B, the survey

not only indicated the depths to the granite bedrock, but also indicated that the overburden probably consists of two different strata, as two different velocities were obtained for the material overlying the bedrock. The velocity in the upper of these two strata is between 5,000 and 6,000 feet per second, and intermediate between this velocity and the velocity of 13,000 feet per second characteristic of granite, a velocity of 7,000 to 8,000 feet per second was observed and must be attributed to a second morainal stratum. The higher velocity in the lower part of the moraine may be due to the presence of a greater number of granite boulders or to a higher degree of consolidation brought about by the pressure of the overlying material.

In the section along traverse E (Plate 6), some depth values are marked as doubtful, as the records were not clear enough to permit reliable interpretation.

Traverse C (Plate 9):

This traverse crosses the David Moraine. In the central part of the traverse, the depths shown are mainly those to the second morainal stratum. The great thickness of overburden in this area was not expected at first, and in the earlier work, the distances between shot point and geophone spreads were not large enough to allow bedrock refractions to be recorded between 100N and 700N. However, it is certain that the depths to bedrock are not less than about 240 feet, otherwise the tests would have picked up the high velocity in granite. Later work gave the depths to bedrock at the intersection of traverse C with traverses E and G, and it seems very likely that between 100N and 700N on traverse C the depth to bedrock is between 240 feet and 270 feet.

Traverse A-C (Plate 10):

This traverse is situated on the hillside to the west of Spencer's Creek. Near the intersection of traverse A-C and traverse A, the bedrock is very shallow; elsewhere along traverse A-C the depth to bedrock does not appear to exceed 100 feet.

Traverse D (Plate 11):

Traverse D runs from east to west across the surveyed area, but only the part west of Spencer's Creek was surveyed.

The results show that the bedrock approaches the surface at the creek and also towards the western end of the traverse near the intersection with traverse C.

The two values, 142 feet and 210 feet, given for the depth to bedrock at 800W were derived independently from two different but overlapping geophone spreads. The discrepancy is probably due to the effect of a steep escarpment which must exist in the bedrock near this point. It is considered that the actual depth is between the two values given, but if any further drilling is carried out in this part of the area, it would be useful to clear up the discrepancy by means of a test hole at this point.

Traverse H (Plate 12):

This traverse crosses the creek at Site No. 3 in the northern part of the area. The cross-section is similar to that along traverse A, the greatest depth to bedrock occurring on the eastern side of the creek.

(b) General Discussion of Results.

The bedrock profiles shown in Plates 3 to 12 give in detail the results of the seismic depth determinations along the ten traverses. By using these results and interpolating between traverses, the contours of the bedrock surface have been drawn as shown in Plate 13. The contour plan represents the general picture of the topography of the granite basement as indicated by the seismic survey. Plate 2 shows the surface contours for the same area.

The most important information obtained from the survey is probably the configuration of the bedrock beneath the hill of the David Moraine. There, the bedrock does not approach the surface as it does further north on both sides of the creek but, on the contrary, dips towards the south-west and the overburden of morainal material reaches the large maximum thickness of 300 feet.

Furthermore, in the southern part of the area and west of Spencer's Creek, where the overburden is very thick, two different velocities were observed in the overburden, indicating the existence of two strata with different physical properties. Hence it is concluded that there are two different morainal strata, the

lower one having a higher velocity which may be due to a greater content of granite boulders and/or a higher degree of consolidation. However, it was not always possible to distinguish between the two strata with certainty.

The bedrock contour plan shows that there is a trough or channel which, in the southern part of the area, is to the south-west of the creek and roughly parallel to it. North of traverse D the trough strikes north and crosses the creek and, although it then broadens out, probably continues as far as traverses A and H, in both of which the deepest part of the bedrock is to the east of the creek.

5. TESTING

(a) Site No. 1.

Reference has already been made to the earlier bore holes situated on traverse A at Dam Site No. 1. The available data from these holes are indicated on the section shown in Plate 3, and in Table 1 below, the depths to bedrock from bore hole data are compared with the corresponding depths determined by the seismic survey.

Table 1. Drilling and seismic results, Dam Site No.1.

Bore No.	Depth to bedrock	
	Bore data	Seismic results
1	72 feet	67 feet (interpolated)
2	81 "	80 "
3	102 "	102 " (interpolated)
5	107 " (?)	64 "
6	8 "	9 "

The geophysical results show good agreement with the bore data except for the large discrepancy at Bore No. 5. However, as explained earlier, there is some reason to doubt the bore log data for this hole. Additional testing would be required on this part of traverse A to decide whether the discrepancy is due to an error in the seismic interpretation or to inaccuracy of the bore hole data.

(b) Site No. 2.

Test drilling in the Spencer's Creek area was commenced by the Snowy Mountains Authority in December, 1950. The drilling results which were available by mid-August 1951, i.e. for Bores No. 1-9 on Site No.2, are discussed below in relation to the results of the seismic survey.

The positions of the test bores are shown on Plate 1, and in Table 2 the depths to bedrock as shown by drilling are compared with those calculated from the seismic survey. The table shows the location of each bore hole referred to the S.M.A. co-ordinate system and also to the seismic layout, the depth to bedrock from seismic results at points closest to the bore hole, and under the heading of drilling results, the depth to bedrock (where obtained) and total depth of the bore.

Three of the bores, Nos. 1, 2 and 3, did not reach solid bedrock and bottomed in weathered granitic material; bores No. 6 and 7 give only a check on depths obtained by interpolation from the seismic results. However, it may be said that the drilling, for the most part, confirms the seismic results. Bore holes Nos. 4 and 7 are, however, exceptional in that they apparently show large errors in the seismic depths.

Bore No.4 revealed mainly weathered granitic material down to 145 feet, then 10 feet of slightly weathered to fresh granite, followed by more weathered granitic material but with two more occurrences of fresh to slightly weathered granite (6 feet and 5 feet thick), before the true bedrock was reached at 183 feet. If, as seems very likely, the seismic method has detected the first occurrence of slightly weathered granite intersected in the bore at 145 feet, then the depth calculated from the seismic survey, viz. 150 feet, agrees fairly well with the bore hole data.

In Bore No. 7, bedrock was encountered at a depth about 50 feet less than would be expected by interpolating between the seismic depths at 50 feet on either side of the hole. There is no obvious explanation for this discrepancy. However, the hole confirms that the overburden tends to increase in thickness towards the south-west, as would be expected from the calculated profile.

(c) Applicability of the Method.

In general, the depths to bedrock from the seismic survey compare favourably with the test data available to date and the comparison supports the view that the seismic survey has given a reliable overall picture of the bedrock configuration.

The bedrock surface has been shown to be undulating with fairly high relief, and it should be pointed out that the seismic depths are probably more accurate where the bedrock level changes gradually than in places where there are sudden changes in bedrock level and consequently in the overburden thickness. The accuracy of the seismic depths is also likely to be impaired by any irregular variations in the composition of the overburden.

6. SUMMARY AND CONCLUSIONS

The geophysical survey of the Spencer's Creek area was carried out for the Snowy Mountains Authority. The survey aimed at ~~softening~~ obtaining information on the bedrock topography and the nature of the overburden, such information being required in the selection of a suitable site for the proposed Spencer's Creek Dam. The refraction seismic method was employed.

The depths to the granite bedrock were determined along ten traverses and from these results a contour plan of the bedrock was drawn, showing a detailed picture of the bedrock topography.

The thickness of the overburden varies considerably and, generally speaking, is greater in the southern part than in the northern part of the surveyed area. The bedrock rises towards both ends of traverses A and H, which cross Spencer's Creek in the northern half of the area. Further south, for example along traverses B, E, F and G, the bedrock rises going north-east from the creek but falls towards the south-west, and there the overburden formed by the David Moraine reaches a thickness of about 300 feet.

Over parts of the moraine, two different velocities were observed in the overburden and it is concluded that the moraine is not uniform in composition but varies vertically and contains two different morainal strata.

The survey has shown that the seismic refraction method can be successfully applied to the investigation of bedrock depths in connection with dam sites and allied projects in the Snowy Mountains region, and that the bedrock configuration can be determined with a completeness that could be achieved only by a very detailed and lengthy drilling programme.

7. REFERENCE

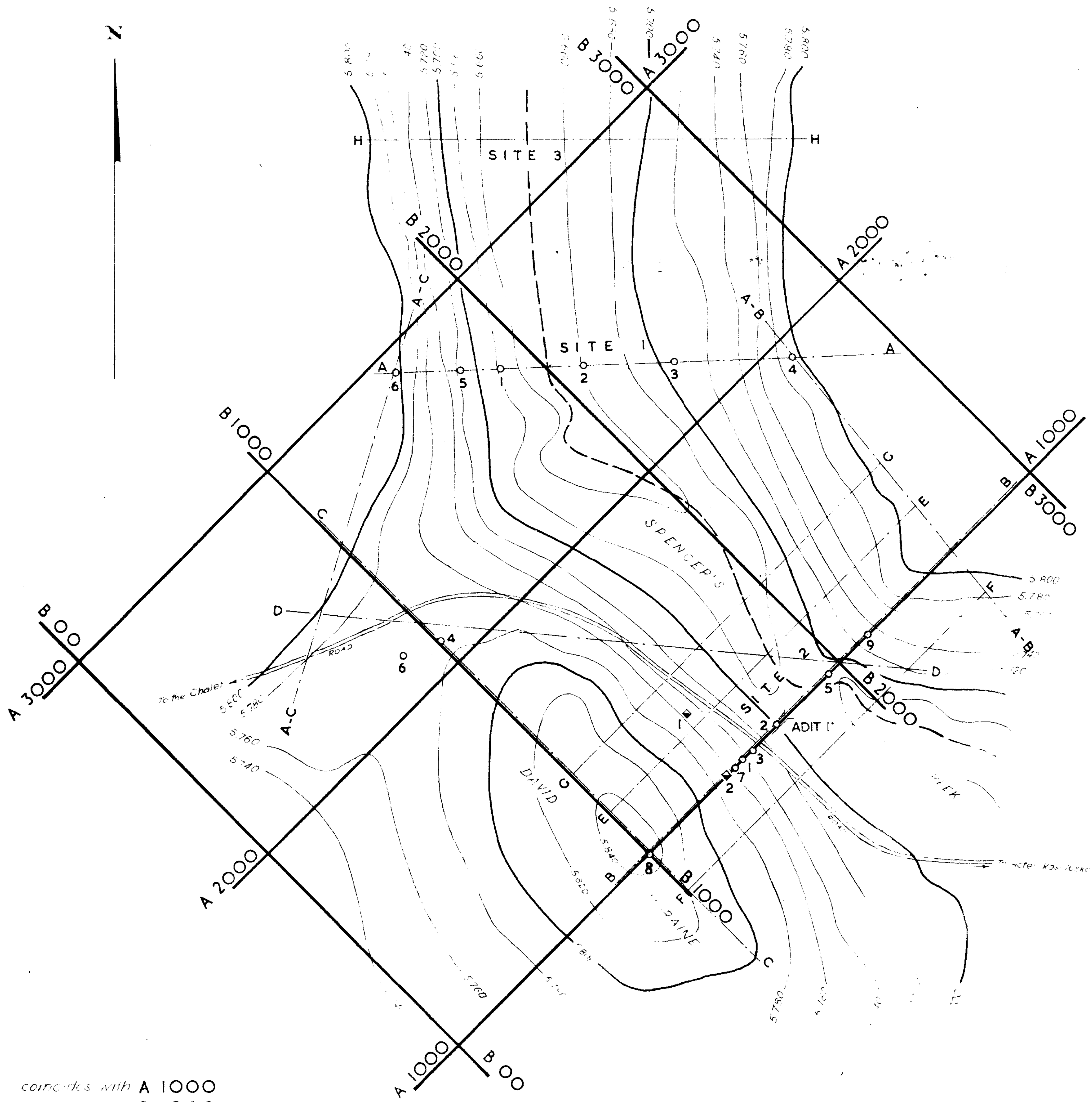
Edge, A.B. and Laby, T.H., 1931 - THE PRINCIPLES AND PRACTICE OF GEOPHYSICAL PROSPECTING. Cambridge University Press.

Table 2. Drilling and Seismic Results, Dam Site No.2.

Bore No.	Position		Depths to bedrock from seismic survey	Drilling results		Remarks
	Referred to S.M.A.co-ords.	Referred to seismic traverses		Depth to bedrock	Total depth of hole	
1	A 1001.5 B 1494.1	B 1106	207 feet at B 1100 212 " " B 1200	-	114 feet	Drilling stopped before reaching bedrock
2	A 1002.5 B 1677	B 923	88 " " B 900 100 " " B 1000	-	76 "	" " " "
3	A 1006.2 B 1542.3	B 1058	100 " " B 1000 207 " " B 1100	-	93 "	" " " "
4	A 2096 B 998	C 1096	152 " " C 1050 150 " " C 1100	183 feet	186 "	Slightly weathered to fresh granite at 145 ft. may be reason for seismic result.
5	A 1003 B 1952	B 648	20 " " B 600 62 " " B 650	55 "	100 "	Seismic depth agrees with bore data
6	A 2167 B 887	113 ft. SW of C 1167	118 " " C 1150 70 " " C 1200	92 "	125 "	Seismic depth consistent with bore data
7	A 1002 B 1442	B 1158	207 " " B 1100 212 " " B 1200	162 "	213 "	Bore data confirms increase in overburden thickness to SW, but actual depth less than predicted by seismic survey.

Bore No.	Position		Depths to bedrock from seismic survey	Drilling results		Remarks
	Referred to S.M.A. co-ords.	Referred to seismic traverses		Depth to bedrock	Total depth of hole	
8	A 1000 B 1000	B 1600	305 feet at B 1600	291 feet	330 feet	Seismic depth in fairly good agreement with bore data.
9	A 1000 B 2157	B 443	27 feet at B 400 29 feet at B 450	29 feet	48 feet	Seismic depth agrees with bore data

PLATE 131



DAM SITE 1 BORE HOLES				
No	DISTANCE IN FEET FROM No 6	RL IN FEET	DEPTH TO BED-ROCK	
			RL	IN FEET
1	368	5.680	5.608	72x
2	700	5.661	5.580	81x
3	1030	5.703	5.601	102x
4	1484	5.796	5 787	9x
5	254	5 709	5.601 5.640	108xx 69°
6	0	5.808	5 800	8x

x Earth and decomposed rock
xx Decomposed rock
o Earth

DAM SITE 2 BORE HOLES				
No	POSITION	RL IN FEET	DEPTH	
			RL	FEET
1	A 1001 B 1494	5.742	5.628	114
2	A 1002 B 1677	5.696	5.620	76
3	A 1006 B 1542	5.728	5.635	93
4	A 2096 B 998	5.773	5.587	186
5	A 1003 B 1952	5.693	5.593	100
6	A 2167 B 887	5.770	5.645	125
7	A 1002 B 1442	5.753	5.540	213
8	A 1000 B 1000	5.844	5.514	330
9	A 1000 B 2157	5.729	5.681	48
SHAFT 1	A 1253 B 1458	5.757	5.720	37
SHAFT 2	A 1001 B 1399	5.765	5.749	16
ADIT 1	A 975 B 1710	5.681		DISTANCE 10

NOTE
B-B coincides with A 1000
C-C coincides with B 1000

REFRACTION SEISMIC SURVEY SPENCER'S CREEK. N.S.W.
PLAN SHOWING
LOCATION OF EXPLORATION WORK CARRIED OUT BY S.M.A.

SCALE

400 0 400 800 1200 Feet

REFERENCE

Seismic traverses shown thus — · — · —

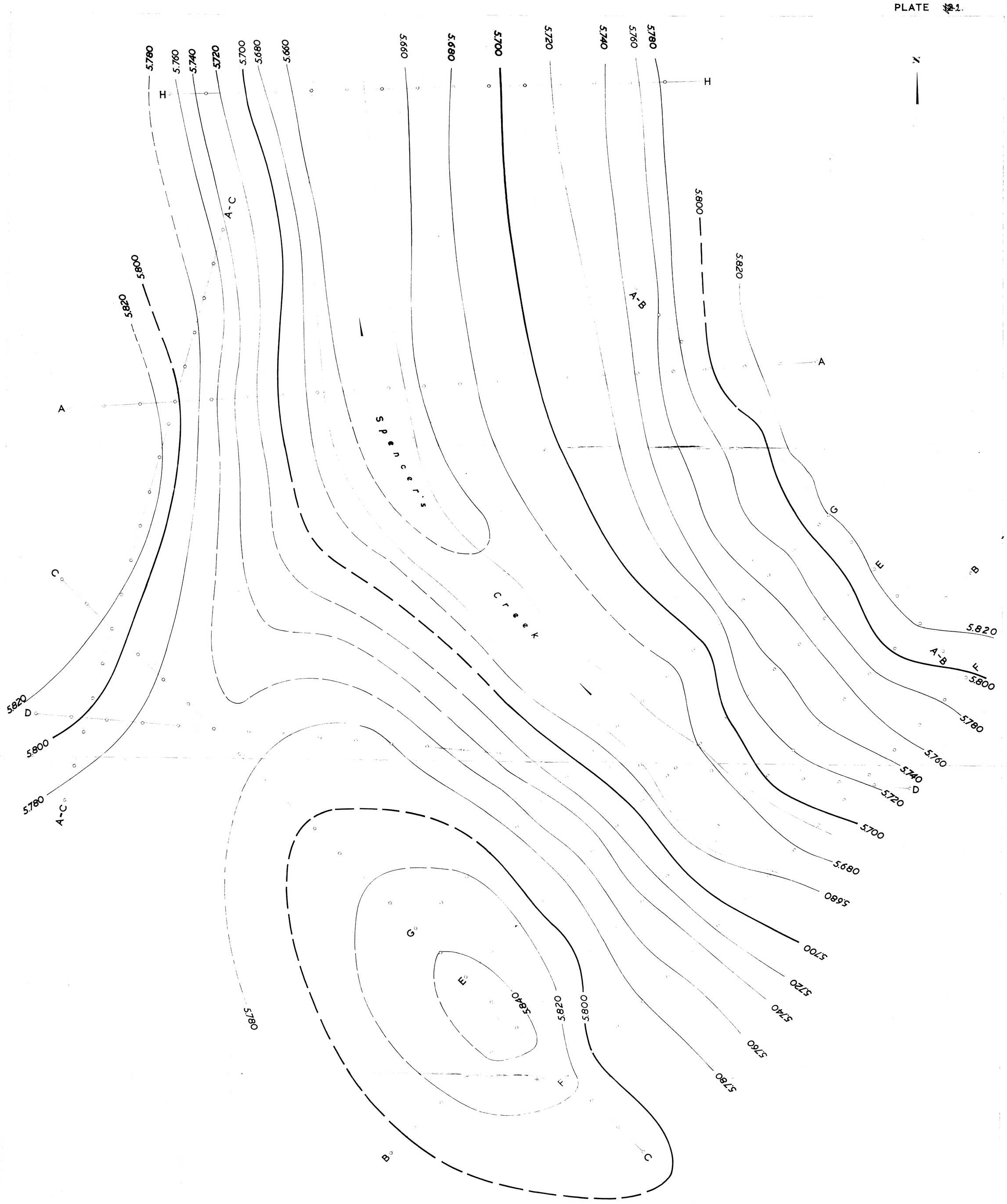
S.M.A. coordinate system shown thus ———

Geophysicist

D.A. Holenutsky

G 90 - 23

PLATE 21.



SCALE

100 0 100 200 300 400 feet

REFRACTION SEISMIC SURVEY
SPENCER'S CREEK . N.S.W.

PLAN SHOWING

POSITION OF SEISMIC TRAVERSES AND SURFACE CONTOURS

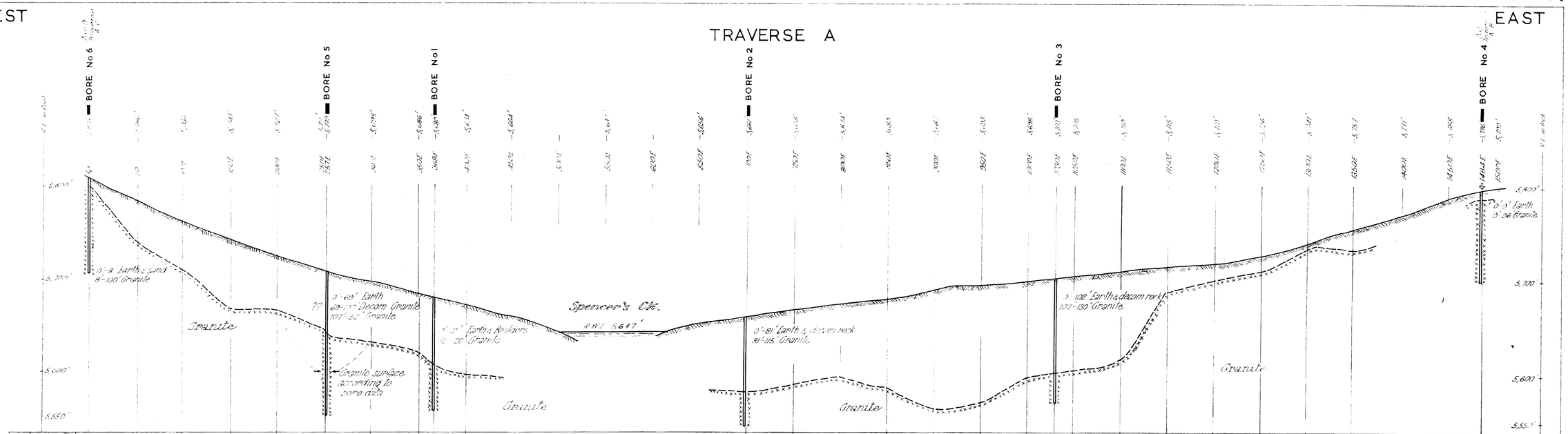
G 90 - 21

PLATE 13

WEST

EAST

TRAVERSE A



BED-ROCK (GRANITE)			
From seismic results	Depth (From surface)	R.L. (Feet)	Depth (From Bore Data)
R.L. (Feet)			
5,792	9'	5,800	8
5,747	45'		
5,739	53'		
5,788	15'		
5,740	60'		
5,647	64'	5,604?	107?
5,633	65'		
5,637	63'	5,608	72'
5,638	76'		
5,581	80'	5,580	81'
5,588	80'		
5,596	79'		
5,583	97'		
5,662	125'		
5,668	125'		
5,636	103'		
5,634	101'	5,700'	102'
5,695	35'		
5,689	27'		
5,691	18'		
5,710	16'		
5,727	4'		
5,732	25'	5,787'	9'

SCALE

HORIZONTAL 0 50 100 150 200 250 FEET

VERTICAL 0 50 100 150 200 250 FEET

Geophysicist.

REFRACTION SEISMIC SURVEY
SPENCER'S CREEK, N.S.W.

SECTION ALONG TRAVERSE A
SHOWING
SEISMIC RESULTS & BORE DATA

G 90-3

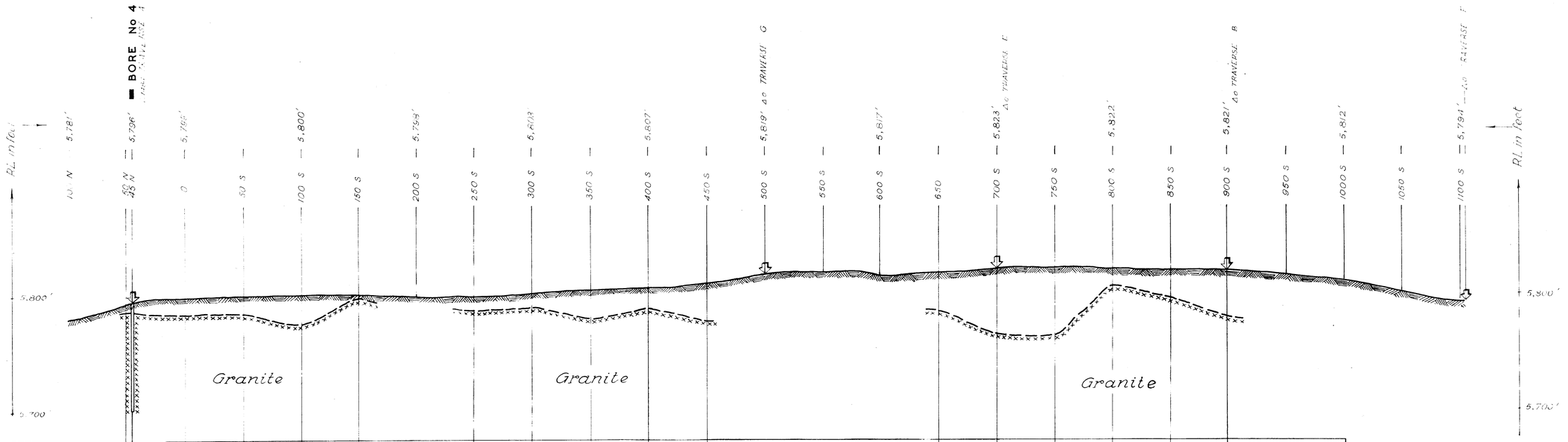
Geophysical Section, Bureau of Mineral Resources, Geology & Geophysics

PLATE 14.

NW

TRAVERSE A-B

SE



BED – ROCK (GRANITE)	50 N	45 N	0	50 S	100 S	150 S	200 S	250 S	300 S	350 S	400 S	450 S	500 S	550 S	600 S	650	700 S	750 S	800 S	850 S	900 S	950 S	1000 S	1050 S	1100 S
from bore data: depth from surface			0																						
from bore data: RL (feet)			5,787																						
from seismic results: depth from surface					13'		16'		14'		24'		1'		13'		13'		25'		18'		34'		
from seismic results: RL (feet)					5,784'		5,783'		5,786'		5,776'		5,786'		5,787'		5,790'		5,780'		5,789'		5,779'		
from seismic results: depth from surface	13'		16'		14'		24'		1'		13'		13'		25'		18'		34'		33'		56'		56'		13'		22'		39'	
from seismic results: RL (feet)	5,784'		5,783'		5,786'		5,776'		5,786'		5,787'		5,790'		5,780'		5,789'		5,779'		5,787'		5,767'		5,766'		5,809'		5,798'		5,782'	

SCALE

HORIZONTAL 0 50 100 150 200 250 FEET

VERTICAL 0 50 100 150 200 250 FEET

Geophysicist

REFRACTION SEISMIC SURVEY
SPENCER'S CREEK, N.S.W.

SECTION ALONG TRAVERSE A-B
SHOWING
SEISMIC RESULTS & BORE DATA

Geophysical Section, Bureau of Mineral Resources Geology & Geophysics

G 90 – 4a

PLATE 15

Station	Second Moraine: Depth from Surface	Second Moraine: R.L. in Feet	Bed Rock (Granite): Depth from Surface	Bed Rock (Granite): R.L. (in Feet)
1			39	5,782'
2			38	5,775'
3			8	5,797'
4			27	5,765'
5			70	5,709'
6			66	5,697'
7			56	5,697'
8			31	5,714'
9			27	5,710
10			29	5,700'
11			20	5,700'
12			22	5,689'
13			20	5,683'
14			62	5,629'
15			88	5,602'
16	48	5,655'		
17	54	5,662'	46 + 54	5,616'
18	90	5,639		
19	99	5,643'	108 + 99	5,535'
20	126	5,628'		
21	169	5,598'	43 + 169	5,555'
22	140	5,640'		
23	117	5,676'	110 + 117	5,566'
24	75	5,728'		
25	93	5,719'	118 + 93	5,601'
26	98	5,735'	125 + 98	5,609'
27	115	5,724'		
28	135	5,709'	70 + 135	5,539
29	110	5,733'		
30	111	5,731'	145 + 111	5,586'
31	86	5,746'	147 + 86	5,599'
32	83	5,742'		
33	80	5,739'		
34	78	5,736'		
35	83	5,723'		

Geophysicist

Horizontal / Vertical scale: 50 0 50 100 150 200 250 feet

REFRACTION SEISMIC SURVEY
SPENCER'S CREEK N.S.W.

SECTION ALONG TRAVERSE B
SHOWING
SEISMIC RESULTS

G90 – 5a

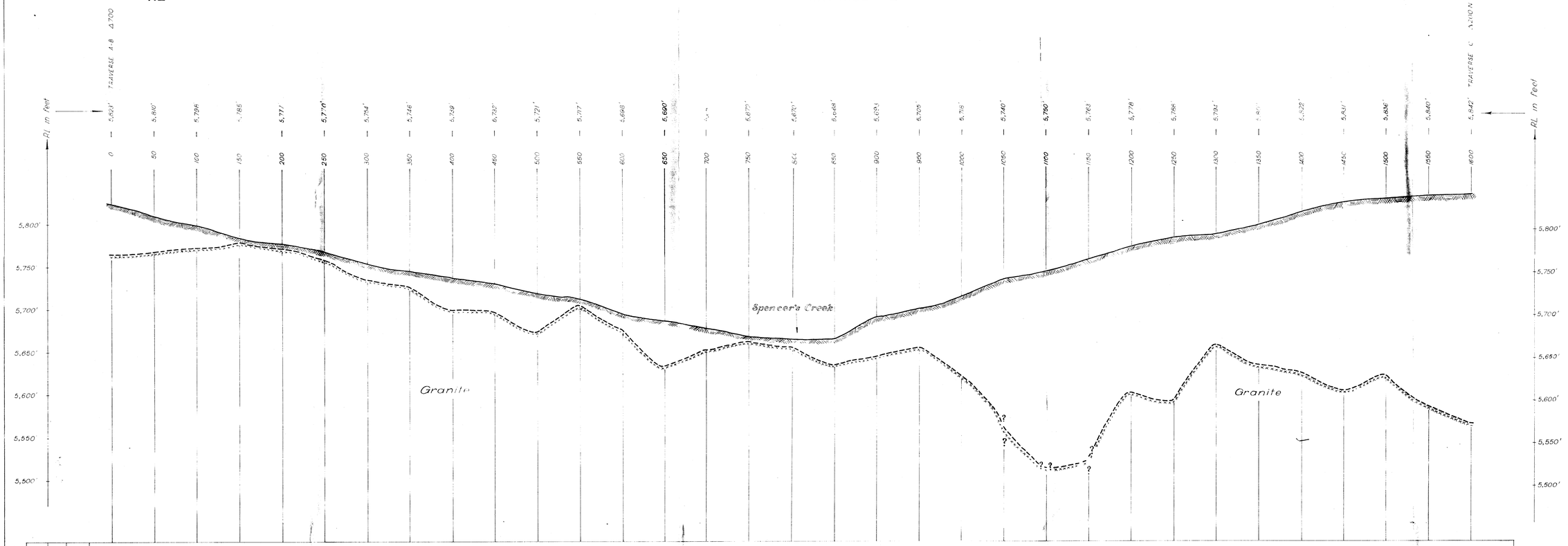
Geophysical Section, Bureau of Mineral Resources, Geology & Geophysics.

PLATE 16.

NE

TRAVERSE E

SW



BED-ROCK (GRANITE)		
From seismic results		
RL (Feet)	depth from surface	
5,767	56	
5,770	40	
5,773	26'	
5,782	3'	
5,774	3	
5,760	10	
5,737	17'	
5,729	17'	
5,702	37'	
5,700	32	
5,676	45'	
5,709	8'	
5,680	18'	
5,637	53'	
5,656	25'	
5,667	5'	
5,660	[illegible]	
5,638	30'	
5,648	45'	
5,660	45'	
[illegible]	30'	
[illegible]	? 170'	
[illegible]	? 230'	
? 5,501	? 233'	
5,608	170'	
[illegible]	190'	
5,665	129'	
5,642	165'	
5,632	90'	
[illegible]	220'	
[illegible]	217'	
5,704	246'	
5,574	268'	

SCALES

HORIZONTAL 0 50 100 150 200 FEET

VERTICAL 0 50 100 150 200 FEET

GEOPHYSICIST

REFRACTION SEISMIC SURVEY
SPENCER'S CREEK, N.S.W.

SECTION ALONG TRAVERSE E
SHOWING
SEISMIC RESULTS

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PLATE 47.

BED - ROCK (GRANITE) from seismic results																																
depth from surface	20	31'	49'	42'	45'	57'	30'	66'	71'	88'	53'	42'	29'	38'	58'	54'	[illegible]	90'	[illegible]	130'	177'	169'	177'	223'	238'	240'	215'	188'	224'	210'	190'	240'
RL (feet)	5,774'	5,753'	5,732'	5,732'	5,725'	5,704'	5,716'	5,672'	5,660'	5,634'	5,659'	5,659'	5,657'	5,640'	5,621'	[illegible]	[illegible]	[illegible]	5,605'	[illegible]	[illegible]	[illegible]	5,573'	5,546'	5,536'	5,543'	5,574'	5,605'	5,573'	5,590'	[illegible]	5,585'

SCALES

HORIZONTAL 50 0 50 100 150 200 FEET
VERTICAL 50 0 50 100 150 200 FEET

REFRACTION SEISMIC SURVEY
SPENCER'S CREEK, N.S.W.

SECTION ALONG TRAVERSE F
SHOWING
SEISMIC RESULTS

GEOPHYSICIST

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BED-ROCK (GRANITE) from seismic results: depth from surface	11'	20'	6'	11'	[illegible]	43'	45'	81'	78'	45'	48'	42'	35'	39'	37'	42'	47'	48'	66'	60'	87'	151'	232'	237'	176'	168'	144'	160'	168'	[illegible]	221	[illegible]	[illegible]
BED-ROCK (GRANITE) from seismic results: RL (feet)	5,796'	5,776'	5,780'	5,761'	5,767'	5,714'	5,703'	5,653'	5,640'	5,657'	5,644'	5,639'	5,638'	5,631'	5,632'	5,618'	?	5,629	5,624'	5,641'	5,628'	5,578'	5,514'	5,522'	5,599'	5,617'	5,655'	5,651'	5,653'	5,613'	5,612'	5,608'	5,590'

SCALES

HORIZONTAL 50 0 50 100 150 200 FEET
VERTICAL 50 0 50 100 150 200 FEET

GEOPHYSICIST

REFRACTION SEISMIC SURVEY
SPENCER'S CREEK, N.S.W.

SECTION ALONG TRAVERSE G
SHOWING
SEISMIC RESULTS

Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics

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PLATE 39

Second Moraine (from Seismic Results): Depth from Surface	Second Moraine: R.L. (in Feet)	Bed-Rock (Granite): Depth from Surface	Bed-Rock (Granite): R.L. (in Feet)
69	5,737'		
66	5,742'		
69	5,741'		
66	5,749'		
66	5,750'	133 + 66	5,617'
92	5,733'	140 + 92 240	5,593' 5,585'
105	5,726'		
129	5,709'	149 + 129	5,560'
128	5,713'		
135	5,709'	175 + 135	5,534'
117	5,730'	181 + 117	5,549'
123	5,722'		
111	5,732'	(268)	5,574'
96	5,745'		
87	5,753'		
90	5,745'	(245)	(5,590')
98	5,734'		
111	5,716'		
96	5,737'		
105	5,714'		
108	5,702'	113 + 108	5,589'
106	5,700'		
121	5,681'	71 + 121	5,610
101	5,696'		
79	5,713'	103 + 79	5,610
71	5,712'	109 + 71	5,603'
60 ?	5,718'	92 + 60	5,626'
50 ?	5,724'	100 + 50	5,624'
45 ?	5,725'	73 + 45	5,652'
40 ?	5,727'	30 + 40	5,697'
30 ?	5,741'	67 + 30	5,674'
30 ?	5,745'	71 + 30	5,674'
30 ?	5,749'	57 + 30	5,692'
30 ?	5,755'	33 + 30	5,722'
30 ?	5,761'	28 + 30	5,733'
		70	5,747'

SCALE
Horizontal / Vertical: 50 0 50 100 150 200 250 Feet

Geophysicist

REFRACTION SEISMIC SURVEY
SPENCER'S CREEK N.S.W.

SECTION ALONG TRAVERSE C SHOWING SEISMIC RESULTS

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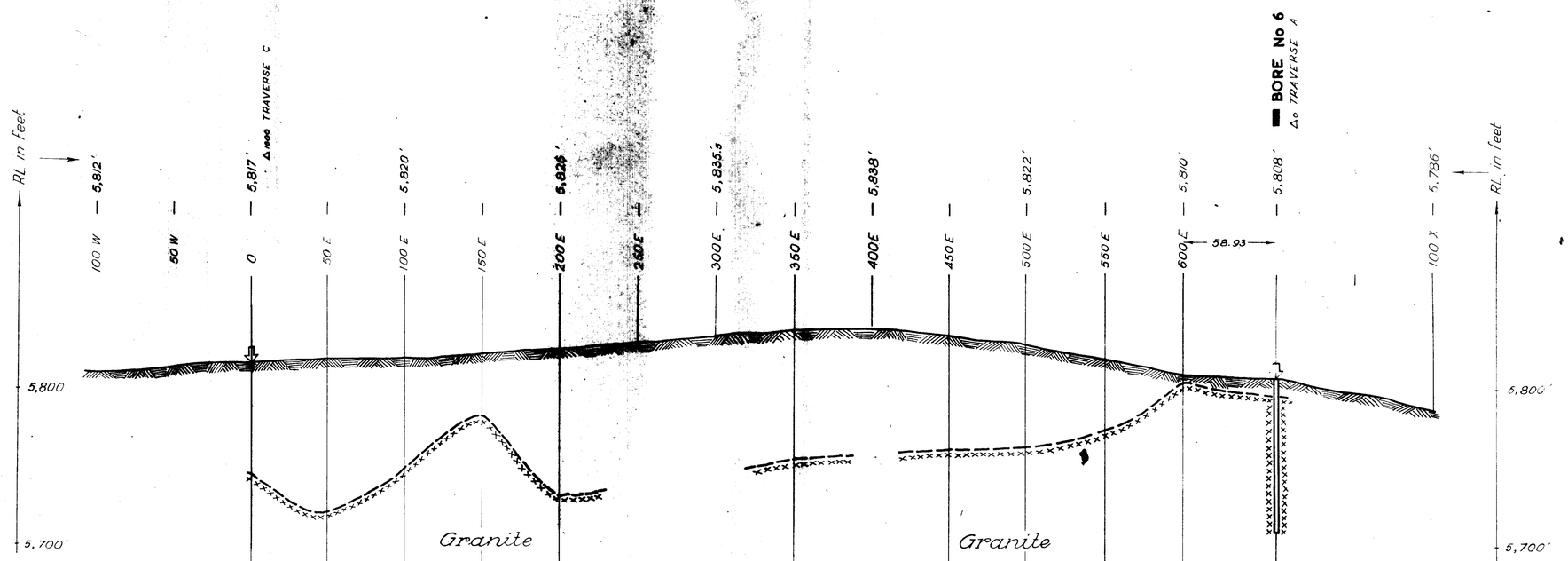
Geophysical Section, Bureau of Mineral Resources, Geology & Geophysics

PLATE 10

W

TRAVERSE A-C

E



BED – ROCK (GRANITE)		0	50 E	100 E	150 E	200 E	250 E	300 E	350 E	400 E	450 E	500 E	550 E	600 E	BORE No 6
from seismic results	depth from surface	70'	96'	70'	40'	95'		80'		66'	67'	40'	4'	9'	
	RL (feet)	5,747'	5,722'	5,750'	5,783'	5,731'		5,757'		5,763'	5,765'	5,776'	5,806'	5,799'	
from bore data	depth from surface														8'
	RL (feet)														5,800

SCALE

HORIZONTAL 0 50 100 150 200 250 FEET

VERTICAL 0 50 100 150 200 250 FEET

REFRACTION SEISMIC SURVEY
SPENCER'S CREEK, N.S.W.

SECTION ALONG TRAVERSE A-C
SHOWING
SEISMIC RESULTS & BORE DATA

Geophysicist

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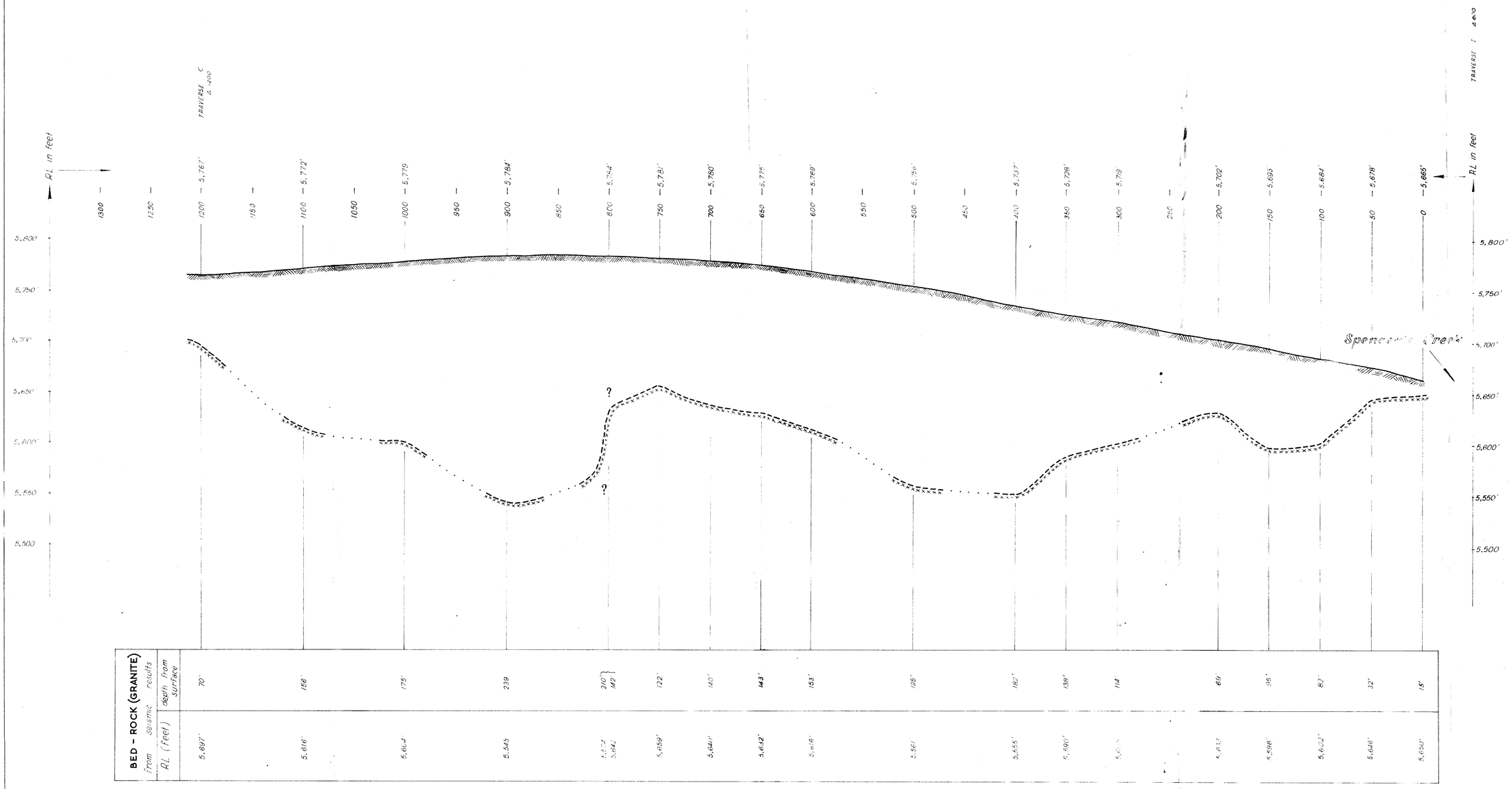
PLATE 11

WEST

TRAVERSE D

EAST



BED - ROCK (GRANITE)																					
from seismic results	depth from surface	70'	156'	175'	239	210' 142'	122'	140'	143'	153'	185'	182'	138'	114		69	95'	82'	32'	15'
RL (Feet)		5,697'	5,616'	5,614	5,549	[illegible] 5,642	5,659'	5,641'	5,632'	[illegible]	5,561	5,555'	5,590'	[illegible]		[illegible]	5,598'	5,602'	5,646'	5,650'

SCALES

HORIZONTAL 50 0 50 100 150 200 FEET

VERTICAL 50 0 50 100 150 200 FEET

GEOPHYSICIST

REFRACTION SEISMIC SURVEY
SPENCER'S CREEK, N.S.W.

SECTION ALONG TRAVERSE D
SHOWING
SEISMIC RESULTS

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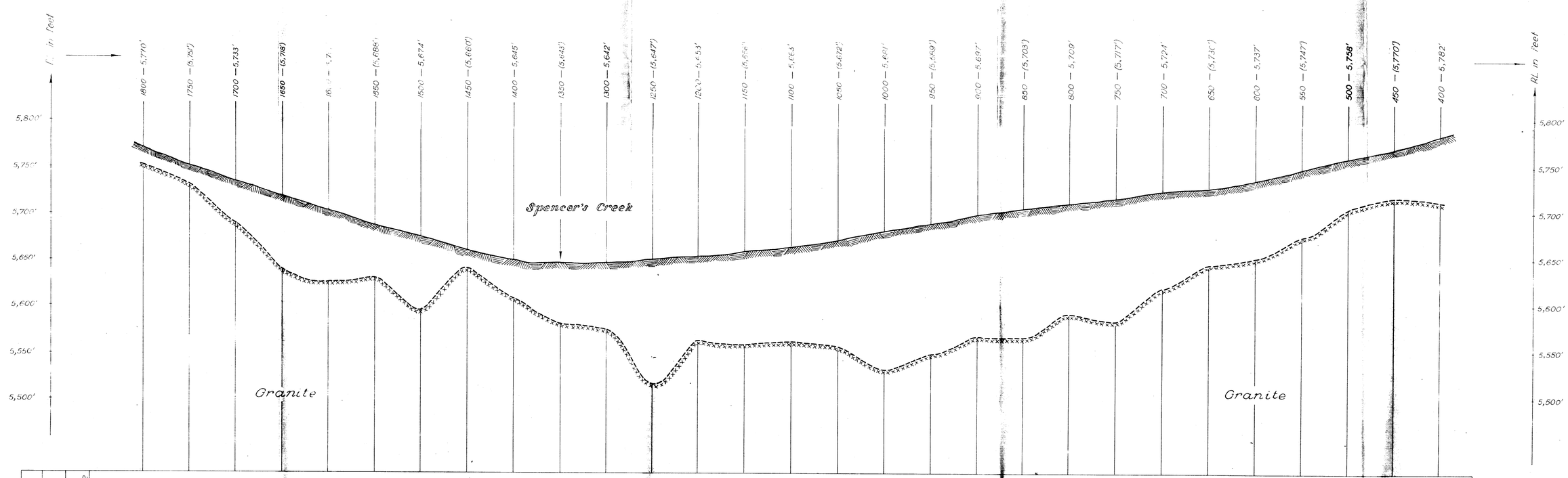
Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics

PLATE 12

WEST

TRAVERSE H

EAST



BED-ROCK (GRANITE) from seismic results	1800	1750	1700	1650	1600	1550	1500	1450	1400	1350	1300	1250	1200	1150	1100	1050	1000	950	900	850	800	750	700	650	600	550	500	450	400
depth from surface	15'	19'	44'	79'	75'	57'	78'	18'	37'	61'	67'	124'	89'	100'	101'	116'	149'	144'	131'	137'	118'	138'	105'	86'	86'	74'	54'	54'	71'
RL (feet)	5,755'	5,732'	5,699'	5,640'	5,627'	5,631'	5,596'	5,642'	5,606'	5,582'	5,575'	5,517'	5,564'	5,556'	5,562'	5,556'	5,532'	5,545'	5,566'	5,566'	5,591'	5,579'	5,618'	5,644'	5,651'	5,673'	5,704'	5,716'	5,711'

SCALES

HORIZONTAL 50 0 50 100 150 200 FEET

VERTICAL 50 0 50 100 150 200 FEET

GEOPHYSICIST

REFRACTION SEISMIC SURVEY
SPENCER'S CREEK . N.S.W.

SECTION ALONG TRAVERSE H
SHOWING
SEISMIC RESULTS

Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics

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PLATE 17

SCALE IN FEET

100 0 100 200 300 400

GEOPHYSICIST : D. Hockeny

REFRACTION SEISMIC SURVEY SPENCER'S CREEK N. S. W.

PLAN SHOWING

BEDROCK CONTOURS FROM SEISMIC SURVEY

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