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RECORD No. 1962/46

PELICAN CREEK 9.0M, AND BROKEN RIVER 3.0M AND 4.8M DAM SITES GEOPHYSICAL SURVEYS, QUEENSLAND 1960

by

P.E. Mann

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CONTENTS

ILLUSTRATIONS

SUMMARY

This Record describes seismic refraction surveys at a dam site on Pelican Creek and two dam sites on Broken River, near Collinsville in Queensland, made at the request of the Irrigation and Water Supply Commission of Queensland. The seismic velocities are tentatively interpreted in geological terms, and the results are plotted in the form of cross-sections showing the depth and velocity of the various layers.

On the north bank of the Pelican Creek site the seismic results are interpreted as indicating a shear zone with an east-north-easterly strike. On the south bank the seismic profile crossing a knoll is complex and the depth to bedrock is about 90 ft.

At the two Broken River sites, special attention should be given to rocks with seismic velocities about 9000 ft/sec, which are interpreted as moderately weathered bedrock. Depending on the type of dam to be designed, these may be suitable as foundation rock.

Young's modulus for the bedrock was determined from the measurement of longitudinal and transverse wave velocities at two dam sites, and from an empirical formula at each site.

It is recommended that some drilling be done to comtrol the seismic results. Drilling sites are given for each dam site.

1. INTRODUCTION

To meet the growing demand for electricity, the Queensland Government is considering developing a thermal power station using coal from the Collinsville coalfield, near Collinsville, Queensland. The Irrigation and Water Supply Commission (IWSC) is investigating a number of dam sites on the Bowen River and its tributaries for a dam to supply water to the station. They requested that the Bureau of Mineral Resources make a geophysical survey to determine the nature of the bedrock and overburden and depth to bedrock at two sites on Broken River and one site on Pelican Creek. The sites selected for geophysical investigation were the Pelican Creek 9.0M site and the Broken River 3.0M and 4.8M sites; their approximate co-ordinates are respectively 592423, 641393, and 644394 on the Bowen sheet of the Australian 4-mile map series.

Regional geology of the area has been described by Isbell (1955). A geological investigation of the dam sites has been made by the Commission (Dunlop, 1960).

The Bureau geophysical party consisted of P.E. Mann (geophysicist and party leader), D.J. Harwood (geophysicist), and J.P. Pigott (geophysical assistant). Four field assistants were supplied by the Commission. Field work at the Broken River sites lasted from 30th August to 21st September 1960, and at the Pelican Creek site from 23rd to 29th September 1960.

The assistance of the Commission in doing the topographical surveying of the sites and providing gelignite, detonators, and some supplies for the party, is acknowledged.

The seismic refraction method was used at each site. The magnetic method also was used on part of the traverses on the left bank (looking down-stream) of the Broken River 4.8M site.

Locations on the surveyed area are indicated by referring to the traverse symbol and the station number, e.g. X7 means Traverse X, station 7.

2. METHODS AND EQUIPMENT

A general description of the seismic refraction method and the technique of the 'method of differences' used on this survey has been given by Polak and Mann (1959).

The equipment used on the present survey was a twelve-channel portable seismograph designed for shallow reflection and refraction seismic methods, manufactured by the Midwestern Geophysical Laboratory of Tulsa, Oklahoma; Brush geophones with a natural frequency of about 20 c/s were used to detect the vertical motion of the ground.

The following types of geophone spread, based on the 'method of differences', were shot:

(a) Normal spreads - the geophones were spaced 50 ft apart in a straight line, and shots were fired 50 and 200 ft beyond each end of, and in line with, the spread. On some spreads additional shots were fired 400 ft beyond each end of the spread.

(b) Weathering spreads - these spreads were used to obtain the thickness and velocity of the soil and near-surface layers, from which an apparent velocity (Va) between the highest-velocity refractor and the surface may be calculated. Va is used in calculating the depth to bedrock. The geophone interval was 10 ft, and shots were fired at distances of 10, 50, and 200 ft beyond each end of, and in line with, the spread. On some spreads additional shots were fired 400 ft beyond each end of the spread. On several occasions a shot was placed in the centre of a normal spread to provide additional information on the seismic velocity and thickness of the near-surface layers.

Experience has shown that the accuracy of depth determination with the seismic refraction method is usually within ± 20 per cent.

3. SEISMIC VELOCITIES

Table 1 lists in geological terms the interpretation of seismic velocities for the three dam sites, based on a knowledge of the exposed rocks in the area and on previous experience in other areas.

TABLE 1

Seismic velocity (ft/sec)	Description of Rocks
1000 to 3000	Soil, clay, silt, sand, gravel, including eluvium and alluvium, and scree material, dry to moist, not water-saturated.
3000 to 4000	Water-saturated alluvium and eluvium, predominantly clay and silt.
4000 to 5500	Water-saturated alluvium, predominantly sand and gravel.
3500 to 6500	Very weathered to weathered rocks.
6500 to 9000	Weathered to moderately weathered, jointed or sheared rocks.
9000 to 13,000	Moderately to slightly weathered, jointed volcanic rocks and sediments.
13,000 to 20,000	Slightly weathered, jointed volcanic rocks to silicified volcanic rocks; unweathered sedimentary and metamorphic rocks, unweathered granite porphyry.

Research by the Caterpillar Tractor Company in U.S.A. (Anon., 1959) has shown that seismic velocity can be used to indicate the ease of excavating sub-surface material, i.e. whether it can be ripped or whether the use of explosives is required. This depends to some extent on the composition of the rock and size of the ripping equipment. As a general guide for rocks likely to be found in the Pelican Creek and Broken River areas, it is very probable that rocks with seismic velocities up to 4000 ft/sec can be easily ripped. Between 4000 and 5500 ft/sec, ripping may or may not be feasible depending on the rock type; e.g. water-saturated sand and gravel could be ripped, whereas it is doubtful whether weathered bedrock with velocities in this range could. If the velocity exceeds about 5500 ft/sec, explosives will probably be required.

Experience has shown that seismic velocities can give some indication as to suitability for dam foundations. This again depends to some extent on the composition of the rocks. While it is not possible to quote definite figures, as a general guide it may be taken that rocks with velocities below 7000 ft/sec are unsuitable as foundations; between about 7000 or 8000 and 11,000 or 12,000 ft/sec they are probably suitable for an earth dam. For a concrete dam, rocks with velocities of 11,000 to 12,000 ft/sec or higher are probably required. Seismic indications should, however, be confirmed by drilling and testing, particularly in marginal cases.

4. PELICAN CREEK 9.0M DAM SITE (Plates 2 and 3)

Geology

The geology of the dam site is given by Dunlop (1960).

The right (northern) bank of the site is very steep and rises to a bluff approximately 150 ft above the stream bed. The left bank slopes gently upward to a height of 95 ft, then falls approximately 15 ft to form a long saddle before rising to approximately 120 ft above the stream bed. No water flowed in the creek during the survey.

The geological units at the site are Lower Bowen volcanic rocks of Permian age and alluvium of Quarternary age. The Lower Bowen volcanic rocks consist of interbedded tuff and agglomerate flows of rhyolite and andesite. The strata strike approximately NNW and dip 5^{o} to the west. An irregular flow structure is common in the volcanic rocks. The principal outcrops and the majority of floaters on the surface are rhyolite. The spacing of the joints in the rhyolite ranges from 2 in. to 3 ft. Fluidal rhyolite crops out at the base of the right bank slope (near X7) to approximately 20 ft above the creek bed. The andesite rock in comparison with the rhyolite rock is less resistant to chemical weathering, and outcrops are rare.

The fine to coarse-grained agglomerate of the area is tightly welded. On the left bank, very weathered andesitic tuff and agglomerate flows are exposed in a small gully up-stream from Traverse X. The right bank bluff is capped with a 15-ft thick layer of very hard, slightly jointed agglomerate of rhyolite.

The alluvium at the dam site consists of the stream bed and flood terrace deposits. The stream bed, 250 ft wide, contains clean, medium to coarse, sub-angular sand, and pockets of gravel and cobbles. The left bank flood terrace deposit, approximately 30 ft wide, consists of fine, light brown sand.

A dark brown to greyish brown plastic clay or soil, containing numerous angular fragments of rhyolite and some andesite, covers the left bank slope and saddle area. The bedrock of the left bank and saddle area is probably andesitic rock, which may be deeply weathered. Grey to pink rhyolite agglomerate boulders and a brown sandy soil containing numerous angular rock fragments, probably form a thin cap on the left bank knoll.

Results

With the aid of Table 1, the cross-sections of Plate 3 can be interpreted in geological terms. A further detailed discussion is not necessary, but attention will be focused on a few points that may otherwise lead to ambiguous or faulty interpretations.

North of X5 and Y5 the seismic velocity of the bedrock is 8000 ft/sec, considerably lower than generally found in this area. This suggests a shear or fault zone with east-north-easterly strike. This shear zone seems to form the boundary of the bluffs, north of Traverses X and Y.

In the creek area, on Traverse AA, the material covering bedrock is interpreted as gravel and sand deposits near AA2, and as alluvial clay and silt deposits near AA12. It is possible that weathered bedrock also occurs under AA2, but the depth to this cannot be estimated.

Near Y13, a layer with a seismic velocity of 8000 ft/sec, interpreted as weathered bedrock, was found at 19 ft depth. This layer lies above a bedrock with a seismic velocity of 14,000 ft/sec, which is probably unweathered volcanic rock. The quality of the 8000-ft/sec layer may be good enough to be used for the foundation of an earth dam, depending on the actual material forming the layer. The extent of this weathered bedrock along Traverse Y is not known (indicated by question marks on Plate 3).

The zone between X30 and X43, coinciding with a knoll, shows a very complex structure. The layer with a seismic velocity of 10,000 to 11,000 ft/sec probably represents a slightly weathered volcanic rock. The depth to this layer was measured at X33, X36, X39, and X43, and the broken lines indicate the interpolated depths between these points. The maximum depth to this layer is relatively large (87 ft) and forms an unfavourable feature of this dam site.

The bedrock shows velocity anisotropy at the intersections of Traverses AA, and X, AA and Y, and Y and C, but the anisotropy has not been interpreted as having major geological significance.

Elastic properties

A value of Poisson's ratio (σ) can be calculated from the longitudinal and transverse wave velocities (Polak and Mann, 1959). To obtain these figures a spread with geophones which detect the horizontal movement of the ground, instead of the normal geophones which detect the vertical movement of the ground, was laid out between stations Y12 and Y21, and shots were fired 250 ft beyond each end of, and in line with, the spread. The transverse wave velocity V_s of the bedrock deduced from this spread is about 6900 ft/sec, and from the normal spread at these stations the longitudinal wave velocity (V_p) of the bedrock is 14,000 ft/sec.

Now $(V_p/V_s)^2 = (\sigma - 1)/(\sigma - \frac{1}{2})$

therefore $\sigma = 0.34$, probably accurate within 10 per cent.

With a longitudinal wave velocity of 14,000 ft/sec and a density of 2.6 g/cm^3 (0.094 lb/in.^{3}) Young's modulus determined by a dynamic method (seismic wave propagation) is 6.5 x 10^6 lb/in.^{2}. This is usually larger than Young's modulus determined by a static method (Judd and Huber, 1961).

The value of Young's modulus can also be obtained from the empirical formula

$$E = V_p^{2.34} \times 10^{-3} \text{ lb/in}^2.$$

in which V_p is in ft/sec, and E is Young's modulus determined by a dynamic method, accurate within 30 per cent. A graphical presentation of this formula is included at the back of this Record (Fig. 1). For bedrock with compressional wave velocities of 10,000 to 16,500 ft/sec, Young's modulus ranges from 2.7 to 7.5 x 10^6 lb/in^2.

Conclusions and recommendations

The seismic refraction survey provided information on the nature of the rocks and depth to the bedrock at the Pelican Creek 9.0M site. North of Pelican Creek, a shear zone with ENE strike forms the southern boundary of a bluff. A complex rock structure is located between X33 and X43. The maximum depth to rock that is probably good foundation rock is about 87 ft, near X36 and X38.

It is recommended that some test drilling be done as a control on the interpretation of the seismic data. The locations suggested for test drilling are :

(1) Near X4, a vertical hole to test the soundness of rock in the shear zone.

(2) Near X37, vertical and angled holes, to test the depth to bedrock and the layered structure of the left bank knoll.

(3) Near X47 and X65, vertical holes to test the soundness of the rock in the proposed spillway area.

(4) Near Y13, to test the rock with a seismic velocity of 8000 ft/sec.

5. BROKEN RIVER 3.0M DAM SITE (Plates 4 and 5)

Geology

At the dam site the river flows through a gorge approximately 250 ft wide and 45 ft deep. The left bank rises steeply to about 100 ft above the river bed to a terrace. The right bank, separated from the river by bedrock outcrops, also rises steeply to about 100 ft above the river bed. A flood channel is located between the right bank and the river bed.

The geological units at the site are Lower Bowen volcanic and sedimentary rocks of Permian age, and 'older' alluvium of Quarternary age. The volcanics are interbedded with sandstone, siltstone, and shale. At the gorge the strike of the beds is north-westerly, parallel to the gorge, and the dip is 45° to 50° south-west. The sediments are jointed, the spacing between joints being generally less than 2 in. The volcanics consist mainly of andesitic lava flows and tuff.

On the left bank, andesitic flows crop out up the cliff face about 75 ft above the river bed. Below this level, outcrops of sediments have been exposed by erosive action of the river. The alluvium on the left bank terrace consists of granitic sand, clay, and pebbles.

In the river bed, approximately 180 ft wide, three thin resistant rock strata crop out through the clean sand. The right bank of the stream channel is formed by a bedding plane with a 50° dip slope.

The right bank is separated from the river by an irregularly serrated rock outcrop about 300 ft wide and about 40 ft above the river bed. The irregular surface is caused by the differential weathering of the sediments derived from the Lower Bowen volcanic rocks.

At this site the term 'overburden' will be used for alluvium and very weathered to weathered rock with seismic velocities of 6000 ft/sec or less. The term 'bedrock' will refer to rocks with seismic velocities greater than 6000 ft/sec. Bedrock includes partly or moderately weathered, as well as unweathered, rocks.

Results

With the aid of Table 1 the seismic velocities on the seismic cross-sections of Plate 5 can be interpreted in geological terms. The description in the following paragraphs is suggested as the most probable interpretation.

On the left bank, on Traverses X and Y close to the river, the depth to bedrock is less and the seismic velocity of the bedrock is greater than at places farther from the river. Very weathered bedrock is found to a depth of 112 ft near X44.

In the river bed, near X32 and X34, alluvial deposits apparently lie on unweathered bedrock. Near X28 and Y28, rock probably suitable for foundations is found at about 14 to 18 ft depth. Near X23 and Y23 a layer with a seismic velocity of 7000 ft/sec, interpreted as weathered rock, may be of suitable quality and should be tested by drilling. Near X17 a slightly weathered bedrock occurs at a depth of about 17 ft, but its extent along Traverse X is not known and should be checked by drilling. At Y12 and Y18 the depth to moderately weathered bedrock is about 34 to 35 ft, but the extent is unknown. Near Y2, the depth to a slightly weathered bed with a seismic velocity of 10,000 ft/sec is 35 ft, but the extent is unknown. Between Y2 and Y18 an interpolated boundary for rock with seismic velocity greater than 7000 ft/sec probably represents weathered rock that may be suitable for dam foundations, subject to further testing.

A comparison between the seismic cross-sections of Traverses X and Y suggests that the location of Traverse Y is more suitable for a dam site than that of Traverse X, especially if the low-velocity layer near X42, which is probably very weathered bedrock, is considered.

To investigate any possible structural relation, the seismic velocities of the deepest refractors are indicated on the traverse plan on Plate 4. It may be observed that the distribution of the seismic velocities forms a zonal arrangement. The areas between X43, Y47, Y36, X37, and X17, Y17, Y7, X10 form high-velocity zones with north-westerly strike, which may be interpreted as silicified volcanic rocks or metamorphosed sedimentary rocks.

Elastic properties

The value of Young's modulus was calculated by measuring the longitudinal and transverse wave velocities of the deepest refractor with a three -component geophone.

The results are shown in the following table:

Location	Poisson's ratio	Young's Modulus (lb/in^2)
Between X22 and X31, perpendicular to strike	0.30	5.6×10^6
Between X22 and Y23, parallel to strike	0.21	4.75×10^6

(Longitudinal wave velocity : 15,000 to 16,000 ft/sec)

(Adopted specific gravity : 2.5)

The value of Young's Modulus derived from the empirical relation shown in Fig. 1 is 6.0 to 7.0 x 10^6 lb/in^2.

Conclusions and recommendations

Of the two sites covered by Traverses X and Y, the latter is probably more suitable for dam foundations, because of the higher seismic velocity of the layer above the bedrock. As drilling targets for further investigation the following locations are suggested :

(1) Near Y56 amd Y46, to test the properties of rocks with seismic velocities of 6000 and 7000 ft/sec.

(2) Near Y28, to determine the extent of the layer with a seismic velocity of 10,000 ft/sec.

(3) Near Y23, Y18, and Y7, to test the properties of rocks with seismic velocity of 7000 to 8600 ft/sec.

6. BROKEN RIVER 4.8M DAM SITE (Plates 6 and 7)

Geology

The steep right bank rises sharply to at least 400 ft above the river bed. The bedrock crops out on the right bank and across part of the river channel. A young alluvial terrace of river sand and gravel, approximately 350 ft wide, occurs at the base of the left bank. The left bank shows a much gentler slope than the right bank and rises about 100 ft above the river bed in a series of narrow alluvial terraces separated by cobble and boulder-strewn slopes. The higher alluvial deposits are classed as 'older alluvium' (Dunlop, 1960).

The bedrock outcrop in the river bed consists of granite porphyry with aplite and quartz-porphyry veins, and dolerite dykes of varying width, all striking 165° to 180°. The observed dips are close to the vertical.

On the left bank a major dolerite dyke partly covered by boulders and some soil is exposed in a gully between Traverses X and Y.

A highly polished surface has been formed on fresh and slightly weathered bedrock outcrops in the river bed, because the river has scoured out all the loose and weathered rock.

The term 'overburden' will refer to soil, alluvium, eluvium, and weathered or decomposed rock with seismic velocity of 7500 ft/sec or less; 'bedrock' will refer to rocks with velocity exceeding 7500 ft/sec.

Results

With the aid of Table 1, the seismic velocities on the cross-sections of Plate 7 can be interpreted in geological terms. The cross-sections are self explanatory. However, some points that may lead to ambiguous interpretation will be briefly discussed.

On the right bank, near Y3, a 9000-ft/sec layer between surface scree material and unweathered bedrock may be good enough as a foundation rock, but this should be checked by drilling.

Between X21 and X27 the interpretation shows three layers above bedrock; the layer with 2000 to 2500-ft/sec velocity lenses out to the south-east and west.

On the left bank, along Traverses X, Y, Z, and B, the cross-sections show an intermediate layer of varying thickness with velocities between 4000 and 7500 ft/sec. This intermediate layer most probably represents a weathered bedrock with a varying degree of weathering and fracturing. It is unlikely that this layer would be strong and impermeable enough to serve as a foundation for a dam. However, it is just possible that some areas in the higher velocity range, say between 6500 and 7500 ft/sec, would be suitable. If this site is selected for a dam, this intermediate layer should be further investigated by drilling.

The value of Young's modulus may be estimated from the recorded seismic velocities with the aid of Figure 1, as mentioned in describing elastic properties at the Pelican Creek site.

On the left bank some experimental magnetic traversing was done to measure the anomaly over the known dolerite dyke, and to try to detect the presence of other dykes. Although a small anomaly was recorded at B6 near the outcrop and at Z14, there is little evidence to suggest that other major dolerite dykes occur on the surveyed parts of Traverses B, X, Y, and Z. The magnetic profiles are not presented in this Record.

Conclusions and recommendations

The seismic refraction survey provided information on the depth to the unweathered bedrock, and the thickness and nature of the surface and intermediate layers.

It is recommended that some test drilling be done as a control on the seismic interpretation, more specifically to check the properties of the intermediate layers mentioned in 'Results'.

Positions suggested for test drilling are:

(1) Near X24, to test the 4500-ft/sec layer and check the depth to unweathered bedrock.

(2) Near X47, to test the 5800-ft/sec layer and check the depth to unweathered bedrock.

(3) Near Y3, to test the 9000-ft/sec layer.

(4) Near Y30, to test the 6500-ft/sec layer and check the depth to unweathered bedrock.

(5) Near Z11, to test the 4750-ft/sec layer and check the depth to unweathered bedrock.

7. REFERENCES

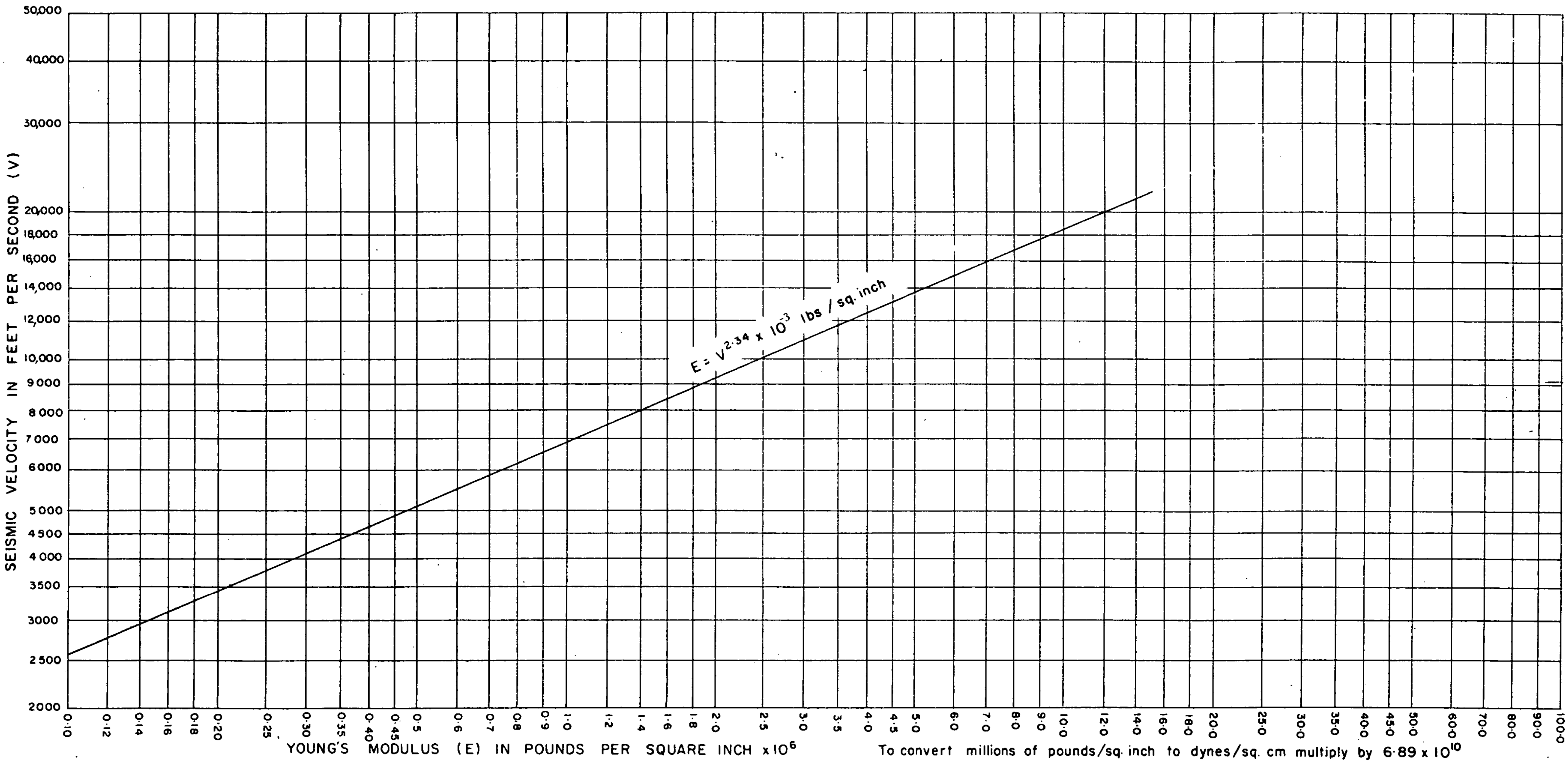
ANONYMOUS 1959 Seismic analysis aids in overburden removal. Mining Engineering, 11,803.

DUNLOP, R.A. 1960 Geology of Pelican Creek and Broken River dam sites, Collinsville power project. Memorandum to the Senior Planning Engineer, Irrigation and Water Supply Commission, Queensland (Unpublished).

ISBELL, R.F. 1955 The geology of the northern section of the Bowen Basin. Univ. of Q'ld. Papers 4, 11.

JUDD, W.R., and HUBER, C. 1961 Correlation of rock properties by statistical methods. International Symposium on Mining Research Vol.2. Univ. of Missouri, and United States Department of the Interior, Bureau of Mines.

POLAK, E.J., and MANN, P.E. 1959 A seismic refraction survey at the Moogerah dam site near Kalbar, Queensland. Bur. Min. Resour. Aust. Rec. 1959/62 (unpubl.).



The values of Young's Modulus may be considered to have a maximum error of ± 30 %
The above relationship is approximately correct for most rock types, other than salts

FIGURE 1. EMPIRICAL RELATION BETWEEN YOUNG'S MODULUS AND THE COMPRESSIONAL WAVE VELOCITY IN ROCKS

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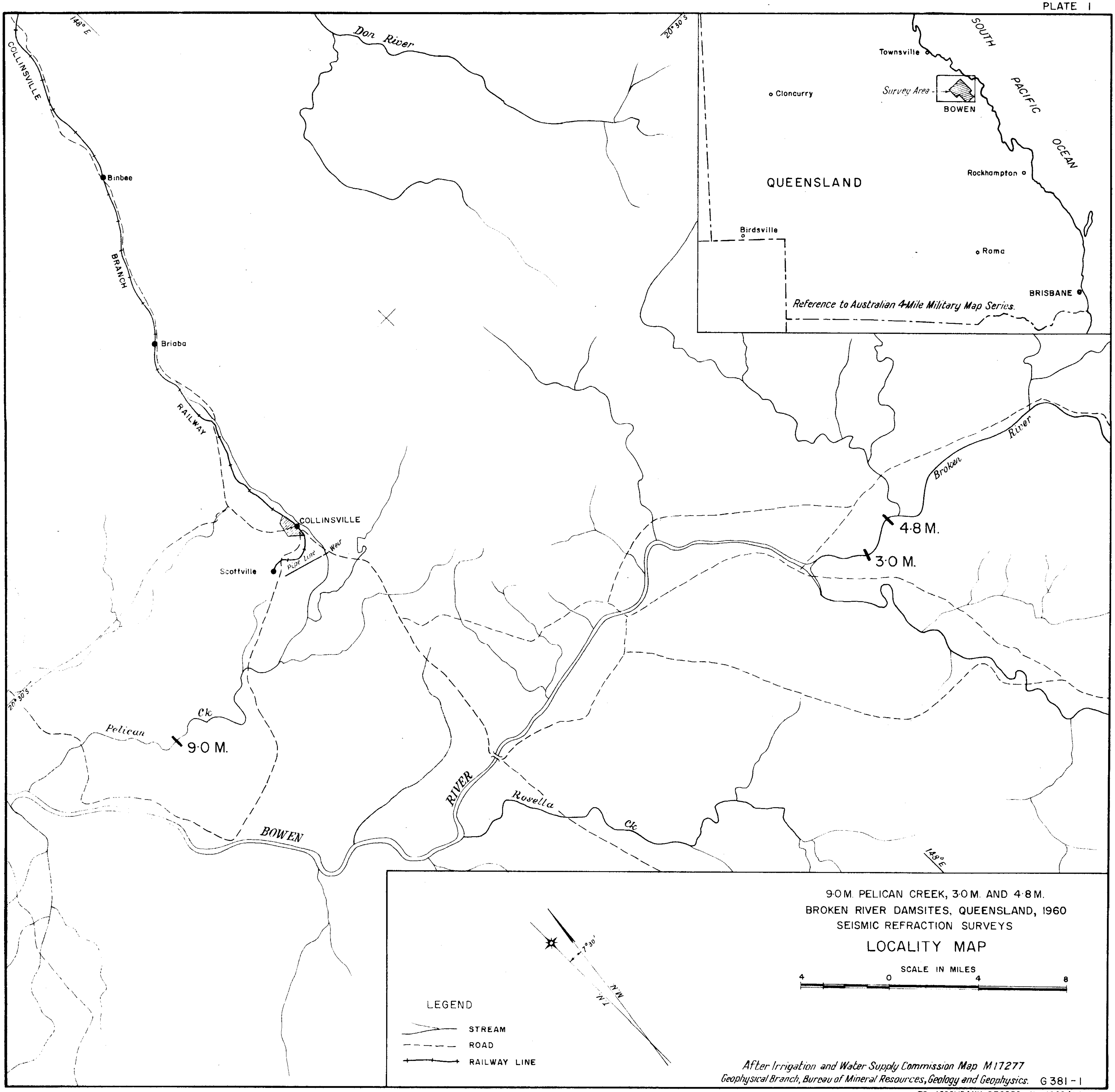
PLATE I



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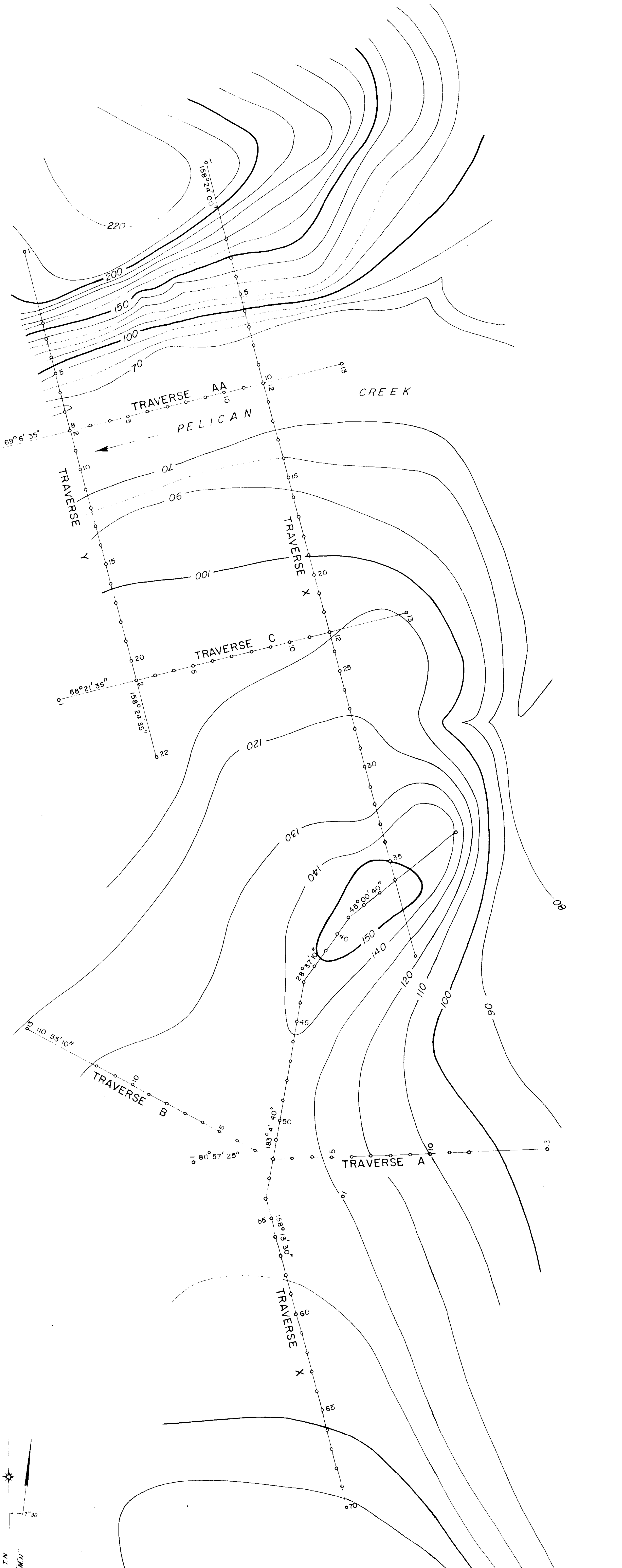

LEGEND

o—o—5—o—o	SEISMIC TRAVERSE WITH STATIONS
68° 21' 35"	MAGNETIC BEARING OF SEISMIC TRAVERSE
—100— / —90—	TOPOGRAPHICAL CONTOURS

AZIMUTH DATUM: Magnetic
ELEVATION „ R.L. 100·00 ft (assumed) Add 295·38 ft to equate to State Datum.

9·0 M. PELICAN CREEK DAM SITE

TOPOGRAPHICAL CONTOURS AND SEISMIC TRAVERSES

SCALE IN FEET
200 0 200 400 600

CONTOUR INTERVAL 10 FEET

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PLATE 3

PELICAN CREEK QLD DAM SITE

TRAVERSE X

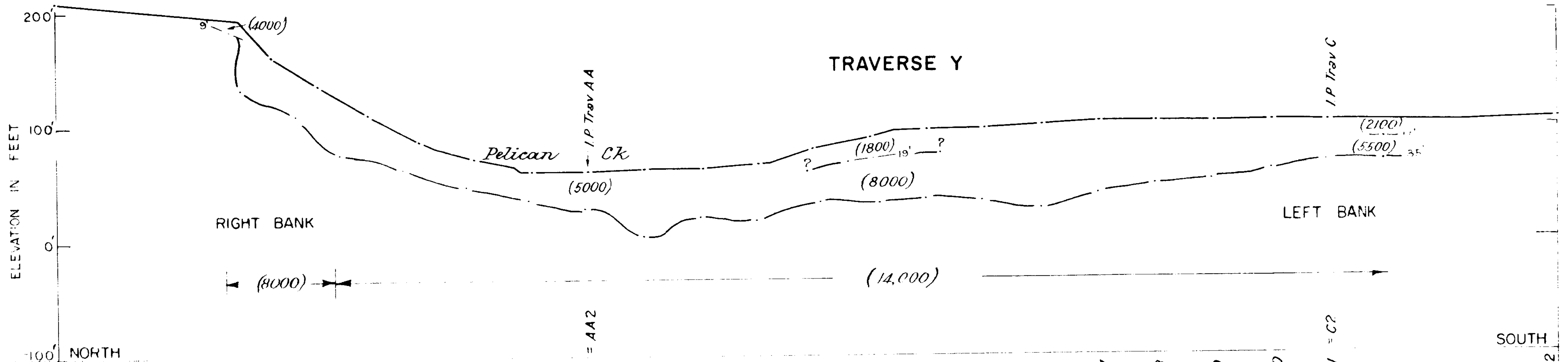
STATION NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
STATION ELEVATION	217	168	150	135	120	97	72	62	61	62	68	68	73	83	89	93	96	97
DEPTH TO BEDROCK		36	34	47	34	6	0	0	12	15	18	22	20	18	16	13	9	10

STATION NUMBER	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
STATION ELEVATION	100	104	104	107	110	113	117	118	119	121	122	123	123	129	135	144	152	154
DEPTH TO BEDROCK	11	10	20	18	25	21	32	28	33	41	42	49	54	68	83	(46)	(73)	87

STATION NUMBER	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
STATION ELEVATION	157	157	158	157	154	149	146	143	141	139	138	138	137	136	136	136	137	138
DEPTH TO BEDROCK	(87)	87	(78)	(68)	(60)	111	55	54	48	45	72	57	55	46	23	37	49	56

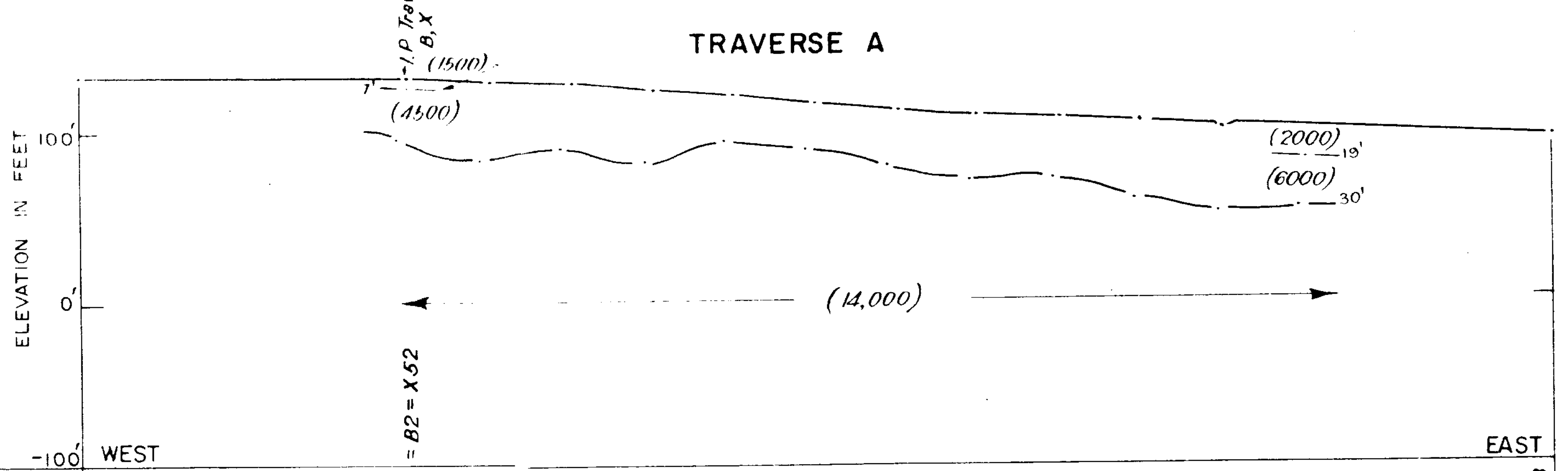
STATION NUMBER	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
STATION ELEVATION	139	138	139	140	142	143	144	145	146	148	149	151	152	154	157	161
DEPTH TO BEDROCK	58	59	56	53	51	53	56	46	53	44	60	48	51	59	56	45

TRAVERSE Y



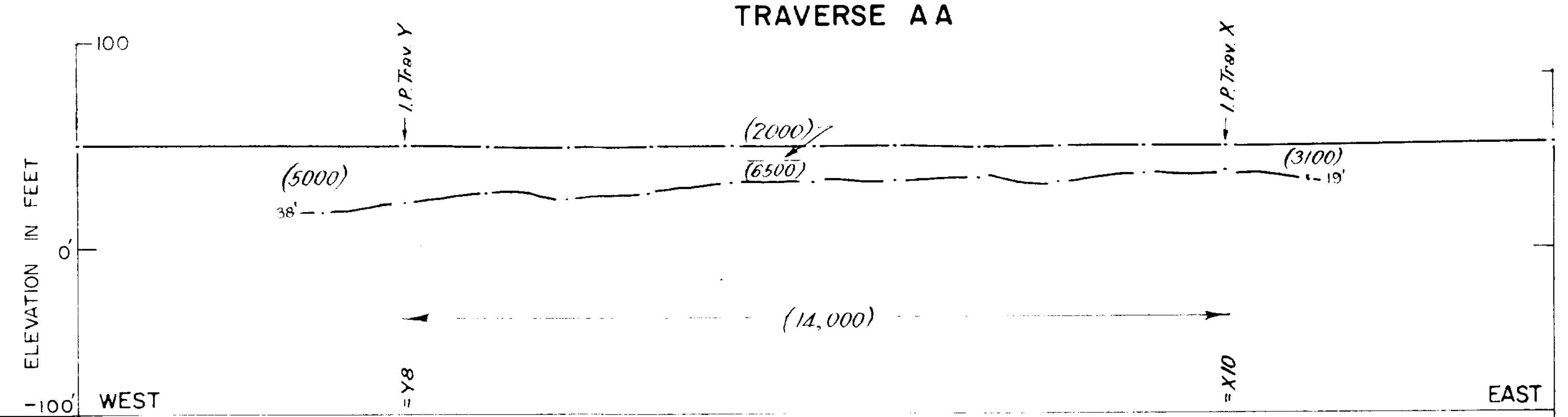
STATION NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
STATION ELEVATION	208	161	135	110	87	72	60	61	62	62	66	78	89	95	96	99	101	102	102	102	101	103
DEPTH TO BEDROCK		39	32	45	27	25	26	33	59	43	49	48	58	59	63	73	63	54	49	43	35	

TRAVERSE A



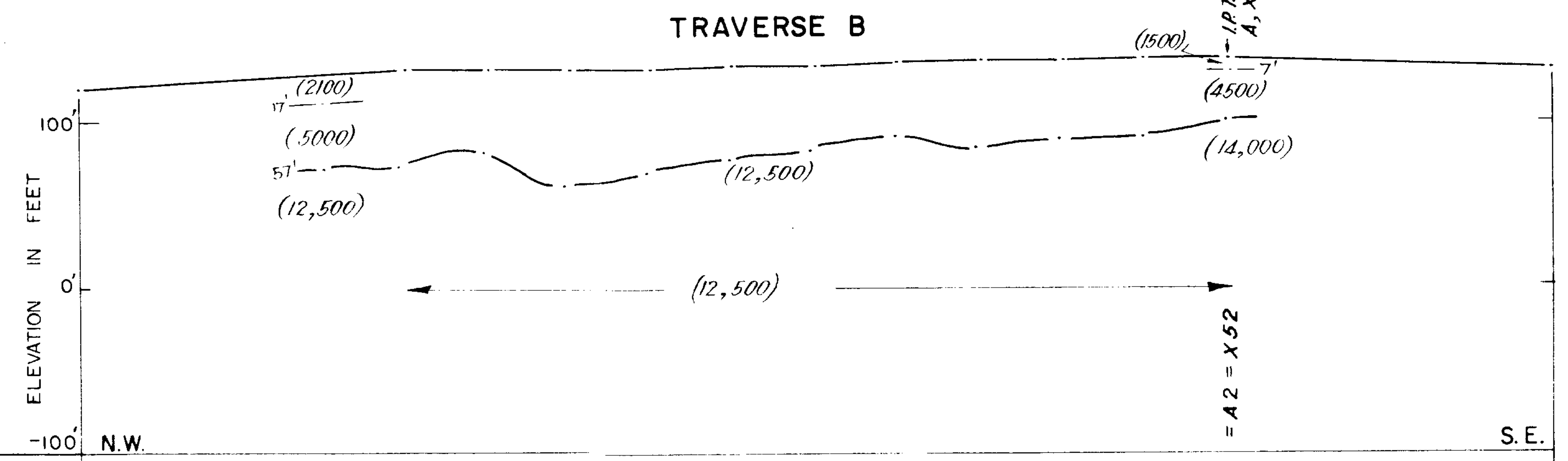
STATION NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13
STATION ELEVATION	137	136	134	133	127	125	120	115	112	110	107	102	96
DEPTH TO BEDROCK		37	49	39	44	28	28	35	40	37	47	49	

TRAVERSE AA



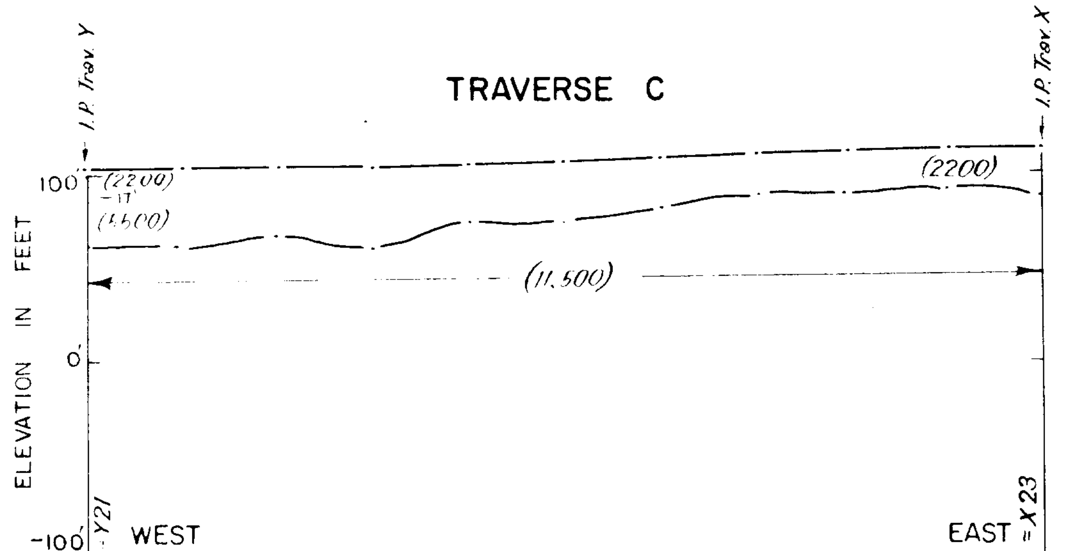
STATION NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13
STATION ELEVATION	60	61	60	61	61	61	61	62	62	63	62	62	64
DEPTH TO BEDROCK		33	26	29	27	21	20	19	17	21	16	15	

TRAVERSE B



STATION NUMBER	13	12	11	10	9	8	7	6	5	4	3	2	1
STATION ELEVATION	120	131	132	132	132	134	134	135	136	137	137	136	130
DEPTH TO BEDROCK		58	49	70	63	56	49	44	53	47	47	37	

TRAVERSE C



STATION NUMBER	2	3	4	5	6	7	8	9	10	11	12
STATION ELEVATION	101	101	102	100	102	103	105	107	109	110	110
DEPTH TO BEDROCK	39	40	35	42	28	29	25	19	20	19	25

LEGEND

(11,000)	FORMATION WITH SEISMIC VELOCITY 11,000 FT/SEC.
—37'	DEPTH TO FORMATION WITH DIFFERENT SEISMIC VELOCITY
I.P. Trav. C	INTERSECTION POINT.
	BEDROCK BOUNDARY

9·0 M. PELICAN CREEK DAM SITE

CROSS — SECTIONS

HORIZONTAL AND VERTICAL SCALES

FEET 100 0 50 100 200 300 400 FEET

ELEVATION DATUM: R.L. 100·00 (ASSUMED) ADD 295·38' TO EQUATE STATE DATUM.

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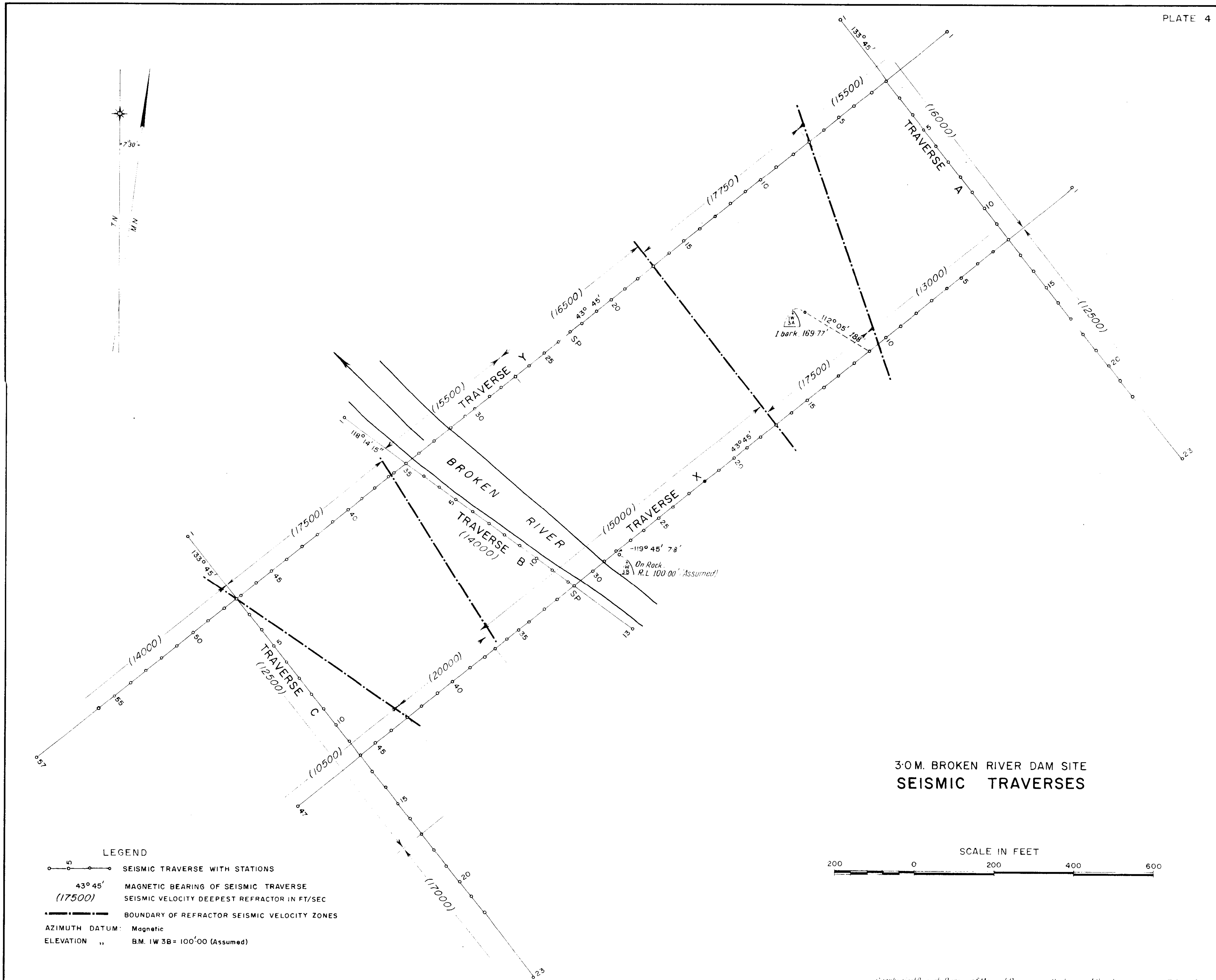
TO ACCOMPANY RECORD No 1962/46

PLATE 4



3·0 M. BROKEN RIVER DAM SITE

SEISMIC TRAVERSES

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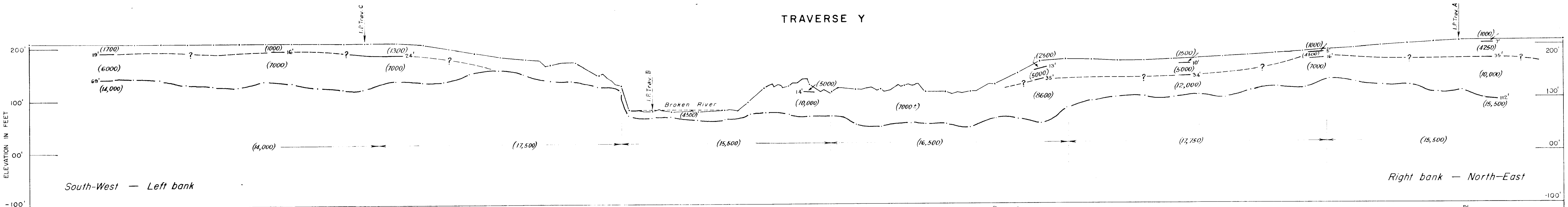
TO ACCOMPANY RECORD No. 1962/46

QLD. 1960

TRAVERSE Y

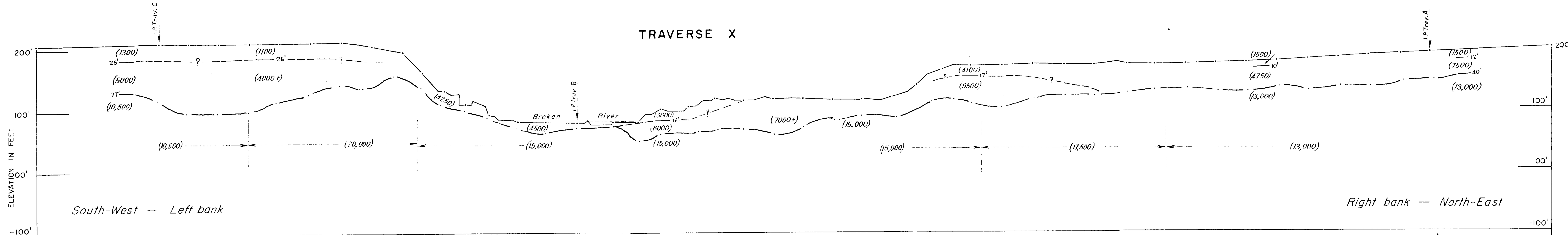


STATION NUMBER	57	56	55	54	53	52	51	50	49	48	C2 47	46	45	44	43	42	41	40	39
STATION ELEVATION	207	207	207	207	207	207	207	207	207	208	209 209	209	205	197	189	182	177	166	168
DEPTH TO BEDROCK		68	72	80	83	85	74	79	87	91	90	75	71	66	41	27	30	34	37

STATION NUMBER	38	37 36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19
STATION ELEVATION	145	125 81	79	77	77	79	96	121	124	128	115	118	119	125	114	112	114	129	149
DEPTH TO BEDROCK	25	12 12	13	10	17	18	24	49	56	63	48	68	75	73	63	62	71	66	89

STATION NUMBER	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2 =A2	1
STATION ELEVATION	171	173	172	169	170	171	173	176	179	184	186	189	191	195	199	203	206	205
DEPTH TO BEDROCK	120	94	80	70	69	74	70	78	68	65	70	57	65	77	78	99	95	

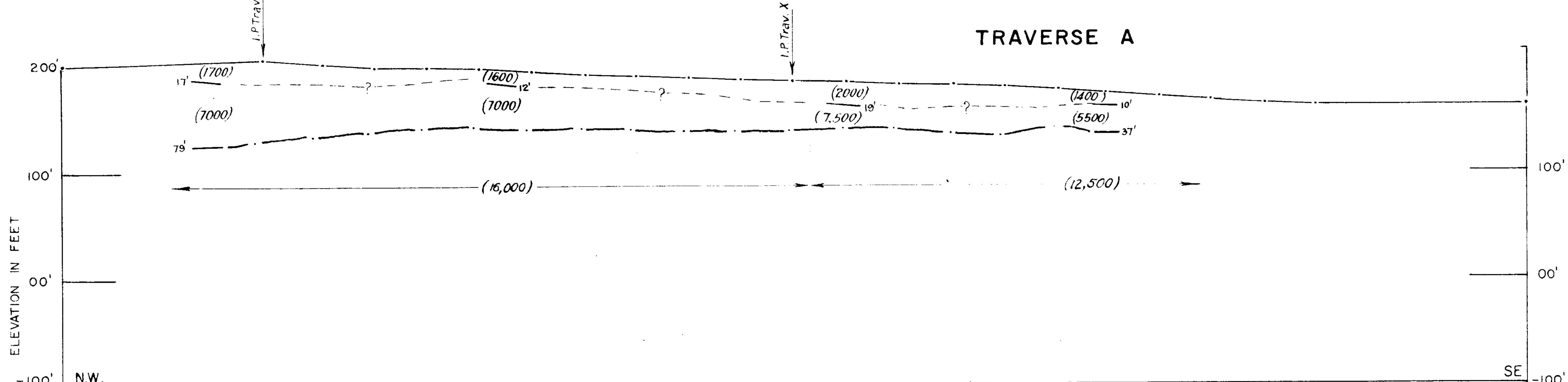
TRAVERSE X



STATION NUMBER	47	46 =C12	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30
STATION ELEVATION	208	208	208	209	209	209	210	210	203	104	160	130	109	92	80	80	80	80
DEPTH TO BEDROCK		92	112	112	112	95	83	68	70	38	23	23	10	4	10	17	8	6

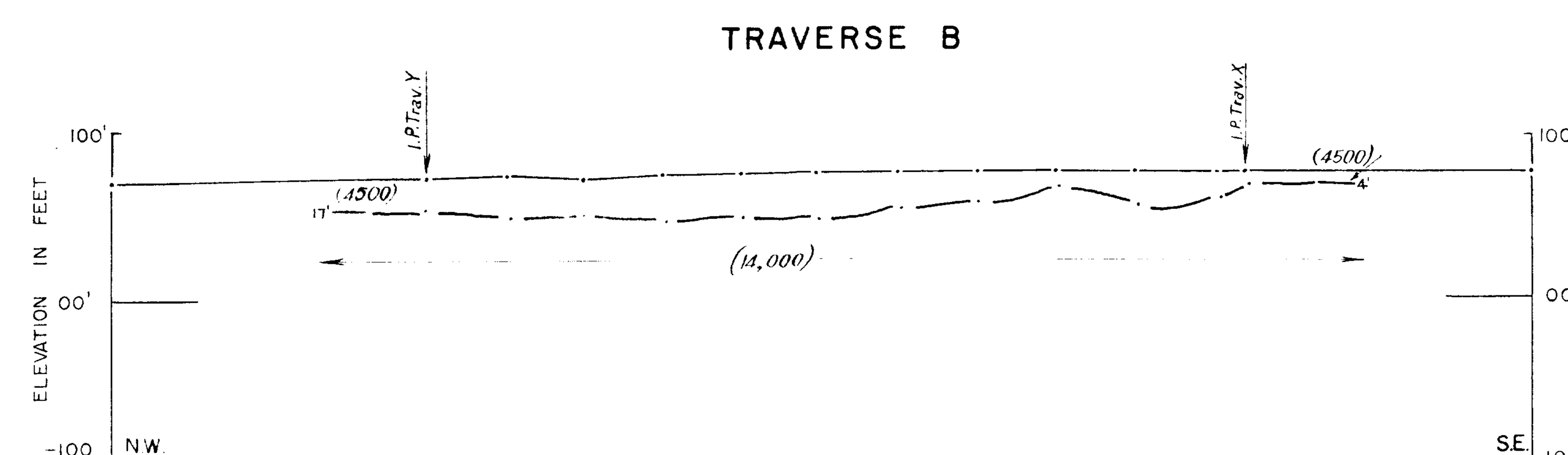
STATION NUMBER	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2 =A7	1
STATION ELEVATION	81	100	105	116	114	117	117	114	116	119	141	164	169	170	169	170	170	171	170	170	171	173	175	178	181	183	185	186	197
DEPTH TO BEDROCK	32	40	43	51	46	58	45	33	24	35	36	52	62	70	57	50	51	46	41	40	44	47	42	51	47	52	46	46	

TRAVERSE A



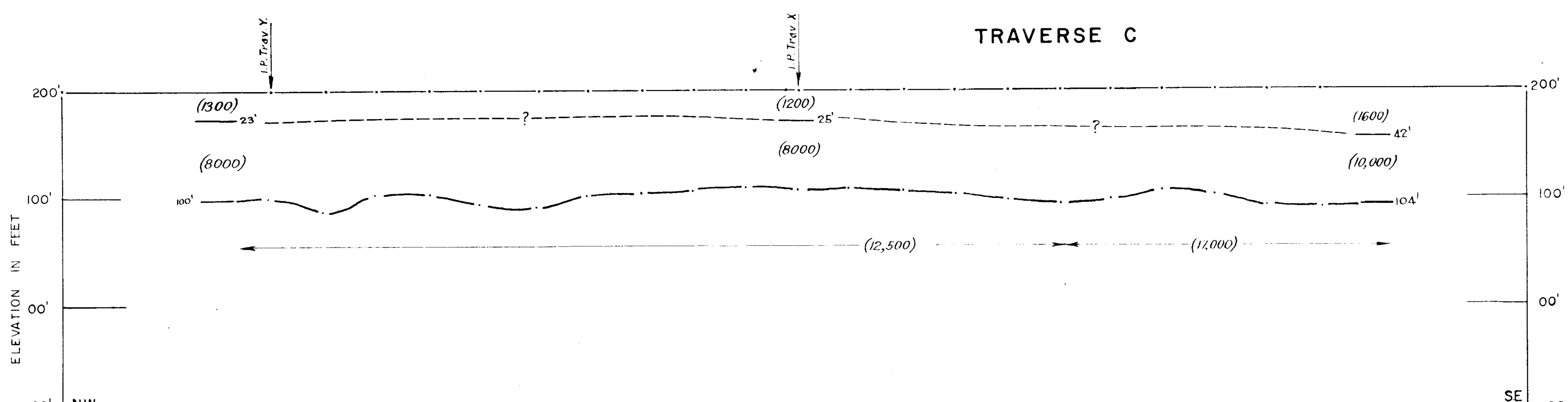
STATION NUMBER	1	2	3	4	5	6	7	8	9	10	11	12 =X2	13	14	15	16	17	18	19	20	21	22	23
STATION ELEVATION	206	206	203	204	199	198	195	192	190	189	188	186	185	184	184	182	180	177	174	171	167	166	167
DEPTH TO BEDROCK		77	67	59	56	53	53	49	49	48	48	46	43	40	44	44	35	37					

TRAVERSE B



STATION NUMBER	1	2 =Y19	3	4	5	6	7	8	9	10	11	12 X31	13
STATION ELEVATION	76	79	80	78	80	80	81	81	81	81	81	80 80	79
DEPTH TO BEDROCK		17	22	19	25	24	26	19	17	6	9	13 5	

TRAVERSE C



STATION NUMBER	1	2	3	4	5	6	7	8	9	10	11	12 =X46	13	14	15	16	17	18	19	20	21	22	23
STATION ELEVATION	208	209	208	208	208	208	208	208	208	208	208	208	208	208	208	208	208	208	208	208	208	209	208
DEPTH TO BEDROCK		98	111	95	95	104	107	96	94	91	88	92	88	92	94	100	104	99	92	95	104	107	

LEGEND

(14,000) FORMATION WITH SEISMIC VELOCITY 14,000 ft /sec

——— 20' DEPTH TO FORMATION WITH DIFFERENT SEISMIC VELOCITY

I.P. Trav. X INTERSECTION POINT

—·—·— UNWEATHERED BEDROCK BOUNDARY

— — ? — INTERPOLATED OR EXTRAPOLATED BOUNDARY OF FORMATION WITH DIFFERENT SEISMIC VELOCITY

3.0 M. BROKEN RIVER DAM SITE

CROSS — SECTIONS

HORIZONTAL AND VERTICAL SCALES IN FEET

100 50 0 100 200 300 400

ELEVATION DATUM: B.M. † I.W.3B = R.L.100.00' (ASSUMED)

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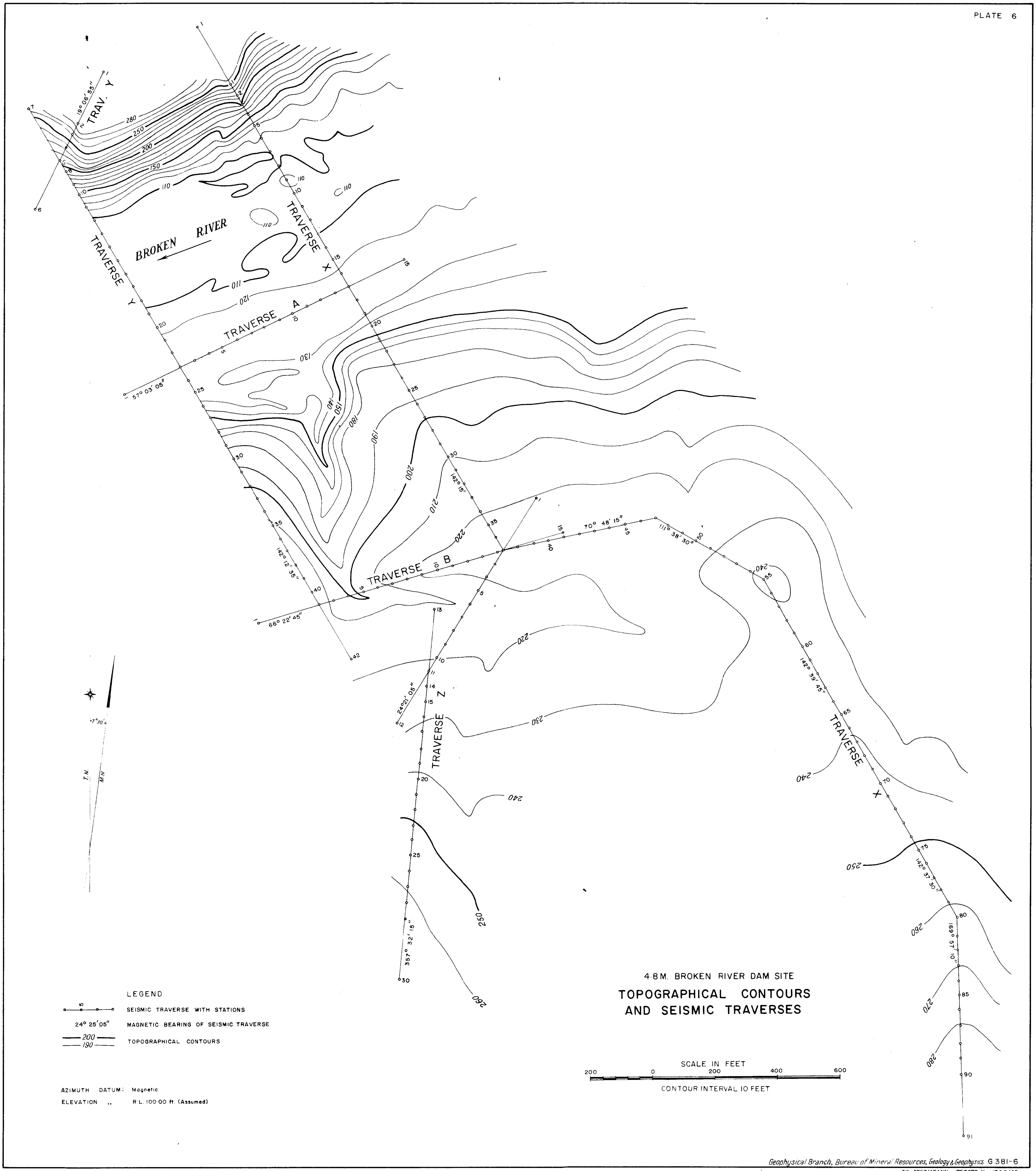
TO ACCOMPANY RECORD No. 1962/46

Broken Riv., Qld., Dam Site

PLATE 6



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TO ACCOMPANY RECORD No 1962/46

BROKEN RIV D-SITE, QLD. 1960.

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TO ACCOMPANY RECORD No. 1962/46

BROKEN RIVER QLD DAM SITE