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PRELIMINARY GEOLOGICAL REPORT ON YARRALUMLA WEIR SITE WITH RECOMMENDATIONS FOR TESTING

by

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SUMMARY

The bedrock at the Yarralumla Weir Site is porphyry which appears on the northern side of the river to be a hard and tough foundation material. On the southern side two zones within the porphyry characterized by relatively low seismic velocities probably correlate with a zone of shearing and a zone of fracturing. No information is available concerning the foundation conditions beneath the river channel; possibly a zone of weakness occurs parallel to shear fractures mapped on the southern bank. Preliminary testing of the weir site by three diamond drill holes, aggregating 320 feet of drilling, is recommended.

INTRODUCTION

Proposals for developing Canberra provide for the construction of a weir across the Molonglo River in order to create an artificial lake within the city boundary. Two possible sites are being considered, one, the Acton site, within the City Division of Acton and the other, the "Yarralumla" site, about ½ mile west of the City boundary (and of the Division of Yarralumla). A preliminary investigation including a few hundred feet of diamond drilling is to be made at each site in order to select the one that appears most practicable.

A seismic survey of the Yarralumla site was carried out during 1956 by the Geophysical Section of the Bureau of Mineral Resources (Hawkins and Stocklin, 1957). A geological investigation was started in January, 1958, when topographic mapping was done by plane table and alidade, and resumed in March, 1958, when the jointing, fracturing and weathering of outcropping rocks was mapped. The geological and the seismic data have been considered together in making recommendations for testing the site by diamond drilling. Access to the northern side of the weir site is along a Forestry Dept. road which branches off from Weetangera Road at the Government Woodyard, O'Connor. Access to the southern side is through Govt. House grounds.

TOPOGRAPHY

After a sharp northerly bend, shown in Plates 1 and 2, the river flows towards the south-west in a channel about 150 ft. wide flanked on the north-west by a high, steep slope and on the south-east by the spur enclosed in the northerly bend. The top water level of the proposed weir is at 1825 ft. on Canberra datum. This is shown by the broken-line contour of Plates 1 and 2. The shortest distance across the valley between the 1825 ft. contour on either side is 600 ft. and theoretically this should be the approximate length of the weir. The slope on the north-western side rises steeply to a considerable height above top water level and probably any excavating needed at this

end of the weir would not appreciably increase its length. (The additional length to unweathered bedrock at the 1825' contour is approximately 50 ft. See Plate 3) On the south-eastern side of the river at the point where the crest height of the spur is at top water level, the width of the spur is only 180 ft. The spur maintains this width for 200 ft. south-westwards, where the crest height is 9 ft. above top water level. It is very unlikely that this low, narrow spur probably capped by old stream gravels would retain water without giving rise to considerable leakage. To overcome the trouble two alternatives can be examined. Firstly, the retaining wall could be constructed across the valley to terminate at the spur, and thence a cut off wall could be constructed in an excavation along the crest of the spur to a point where width and crest height are adequate to ensure safe retention of water. It can be seen by reference to Plate 2 that the spur width at top water level near the southern end of the area shown is 400 feet and crest elevation is 10 ft. above top water level. Plate 1 shows that at 300 ft. farther south the crest elevation is 14 ft. above top water level and the width is 1200 ft.
Secondly, the weir could be sited downstream from the spur where the steep valley sides both rise well above the 1825' contour. Plate 1 shows that it would be necessary to move about 1200 ft. downstream. Such a site would necessitate a separate investigation and will not be considered here.

GEOLOGY AND GEOPHYSICS

Lithology and Weathering

Porphyry. The country rock in the area is the Mount Painter Porphyry, an intrusive sill of Upper Silurian age. Relatively fresh outcrops occur along the river channel and in places along steep slopes. Elsewhere it is covered by a veneer of soil and alluvium and is weathered to some depth below its surface.

In hand specimens the typical porphyry is dark greenish-grey in appearance, and contains phenocrysts of quartz and of felspar. The scattered quartz grains are clearly visible; the felspar is more obvious in partly-weathered rock. Some outcrops contain little, if any, quartz; in these, the rock seems to consist largely of weathered felspar, and appears more basic in composition than the typical porphyry. This more basic (?) porphyry, as far as is known, occurs in irregularly distributed masses; it appears to be more susceptible to weathering, particularly when sheared and fractured, than is the typical quartz-bearing porphyry. An example is the weathered mass in Plate 2 in the bend of the river near the northern end of the spur. A body of basic (?) porphyry that is deeply weathered but not apparently fractured or sheared outcrops about 100 ft. west of the present low-level weir. (It is cut by a narrow shear.)

In the road cutting shown in the north-western part of Plate 2 fresh porphyry is exposed in rounded masses a few feet across and in angular masses bounded by joint surfaces. It is surrounded by partly-weathered porphyry. The seismic investigation of the area revealed relatively low velocities from the surface down to about 20 to 40 feet, presumably the depth to unweathered porphyry, (see Plate 3 of this report). Hence it seems likely that the unweathered outcrops in the area are mainly residuals that are surrounded and underlain by weathered rock.

<u>High Level Gravels</u>. Numerous quartz pebbles ranging in size from about ½ inch to 3 inches are scattered on the slopes of the spur that is to form the southern abutment of the weir. The quartz pebbles have drifted downslope from old alluvial deposits that cap the spur. Their extent and thickness is not known. On the eastern side of the spur weathered porphyry occurs at about the 100 foot contour. In the pit near the south-eastern corner of Plate 2 gravel thickens from 2'6" in the eastern wall to at least 5'6" in the western wall. On the western side of the spur the surface is formed of sandy and loamy soil. At the 105' contour gravel has been dug out of a post hole. Porphyry does not appear at the surface above the 70 foot contour. The sections of Plate 3 indicate that the unweathered porphyry is 35 to 40 feet below the surface, or 30 to 35 feet below proposed top water level. These estimates may have a maximum error of ± 15 per cent.

Because of the porous gravel beds on the spur and the apparent depth to unweathered porphyry, it will be necessary to construct a cut-off wall for some distance along the spur in order to prevent excessive leakage. This has already been recommended under the heading "Topography".

<u>River Alluvium</u>. Sand and gravel form the river bed, and together with loam, make up a long narrow island within the channel. Some river alluvium may underlie the narrow relatively flat area between the northern bank and the steep slope that leads up to the pine plantation. The greatest thickness of alluvium to be excavated probably lies beneath the river channel. This was not tested during the seismic investigation.

<u>Soil</u>. The true soils in the area, excluding alluvium and weathered porphyry, are quite shallow, probably of the order of 1 foot in thickness. Weathered porphyry may, to some depth, have the mechanical characteristics of soils, and will have to be excavated probably down to the unweathered porphyry shown in Plate 3.

FRACTURING

On the northern side of the river fracturing seems to be practically restricted to simple jointing. The main joints are in two directions, 083° to 096° and 345° to 354° and their dips range from vertical to very steep. A minor steep or vertical jointing strikes about 040°. On the southern side the porphyry has been relatively strongly fractured and in part shattered. The earliest fractures mapped at the northern end of the spur have been filled with quartz. The adjoining rock, partly silicified and rendered more resistant to weathering, forms resistant outcrops broken by narrow bands and lenses of non-silicified, partly weathered porphyry.

All the outcropping porphyry on the northern and eastern sides of the spur has been shattered as a result of differential movement under compression, which probably resulted from thrusting from the north-west. The rock is intersected by numerous slickensided fractures that trend in two principal directions, approximately north and approximately east and dip at angles ranging from about 35° to 80° to east and north respectively. The fracture surfaces are not planar. They are marked by linear flexures whose axes are about parallel to the direction of slickensiding. On the northerly trending fractures in which the eastern side appears to have moved to the south, the slickensides have an apparent dip to the north, ranging from 20° to 40°; on the easterly fractures in which the northern side appears to have moved east, the dip is to the west and ranges from 20° to 30°. The fractures have broken the rock into blocks of varying dimensions, and numerous smaller fractures or cracks with random orientations have shattered these into smaller irregular masses. Displacements may have been quite small on the larger slickensided fractures, and there has been no displacement in the small-scale cracking.

The shattering, although obvious in the partly weathered and eroded outcrops, has not resulted in the zones of weakness that are characteristic of some linear faults. The fracturing took place under compression, which prevented any separation at right angles to the fracture surfaces; individual blocks are tightly interlocked and probably the rock mass has considerable strength.

Immediately east of the resistant rock that forms the northern end of the spur is a zone of slight shearing 100 ft. wide. The porphyry here is noticeably more weathered in the outcrop than it is in the adjacent areas. In addition, this porphyry appears to be slightly more basic. The relatively low velocity sections encountered in traverses A and C of the seismic survey lie almost exactly on the projection of the sheared zone along its strike; suggesting that the low velocities are a result of the shearing and possibly of partial weathering. The velocity along traverse B where intersected by the shear zone, though lower than the usual velocities in massive porphyry, is appreciably higher than in the other two traverses. This does not invalidate the supposition that the shear zone continues south-westwards beyond the traverse lines. Where crossed by traverse B, the shearing could be restricted to movement in a relatively narrow zone.

Near the south-eastern end of the outcrop the porphyry is cut by easterly-trending fractures of which some are vertical and others dip steeply both to north and to south. No noticeable weathering is associated with this fracturing. The fracturing extends over a width of about 70 feet. Its extension westerly along its strike coincides with the section in traverse B where the seismic velocity decreases from 18,000 to 13,500 and in traverse A with the low velocity of 11,000 f.p.s. Probably the reduction in velocity is due to fracturing.

Some minor very narrow shears that trend approximately westerly were mapped on the eastern side of the spur. In them the porphyry has weathered fairly deeply resulting in steep or vertical breaks in the outcrops.

It is considered that for the purpose of preliminary testing a vertical diamond drill hole should be put down at the locality where the bedrock is apparently weakest, viz., in the section of Traverse C where the seismic velocity is 10,500 f.p.s. The drill hole should penetrate 15 ft. below the top of the unweathered porphyry, that is, assuming that the geophysical estimate of its depth is correct, to about 45 ft. below the surface. Purposes of the hole will be to determine the nature and thickness of the alluvial capping, to core both weathered and fresh porphyry, to carry out water pressure testing in foundation rock, and to check the accuracy of the estimated depth to unweathered bedrock.

THE RIVER CHANNEL

A stream channel commonly follows zones of weakness in the bedrock and warrants special investigation if it is to be used as a foundation for any structure. At the Yarralumla weir site no information is available concerning bedrock conditions beneath the channel. On the northern side of the river a few small outcrops of massive porphyry show only simple jointing and give no reason to suspect zones of weakness due to shearing or fracturing. On the southern side, the large outcrop at the northern end of the spur is crossed by strong, persistent fractures, some of them definite shear fractures, which trend approximately parallel to the south-westerly channel of the river. Similar fractures occur in the porphyry outcrop within the channel. It is possible that one or more zones of shearing or faulting occur within the channel parallel to these fractures. To check up on this it is recommended that a drill hole inclined at 50° be put down beneath the channel from either bank of the river. The lengths of the holes will be 140 ft. and 135 ft., giving a total of 275 ft. Coring should be commenced at minimum depth and water pressure testing carried out.

SUMMARY OF PRELIMINARY TESTING

Three diamond drill holes are recommended as specified in the following table.

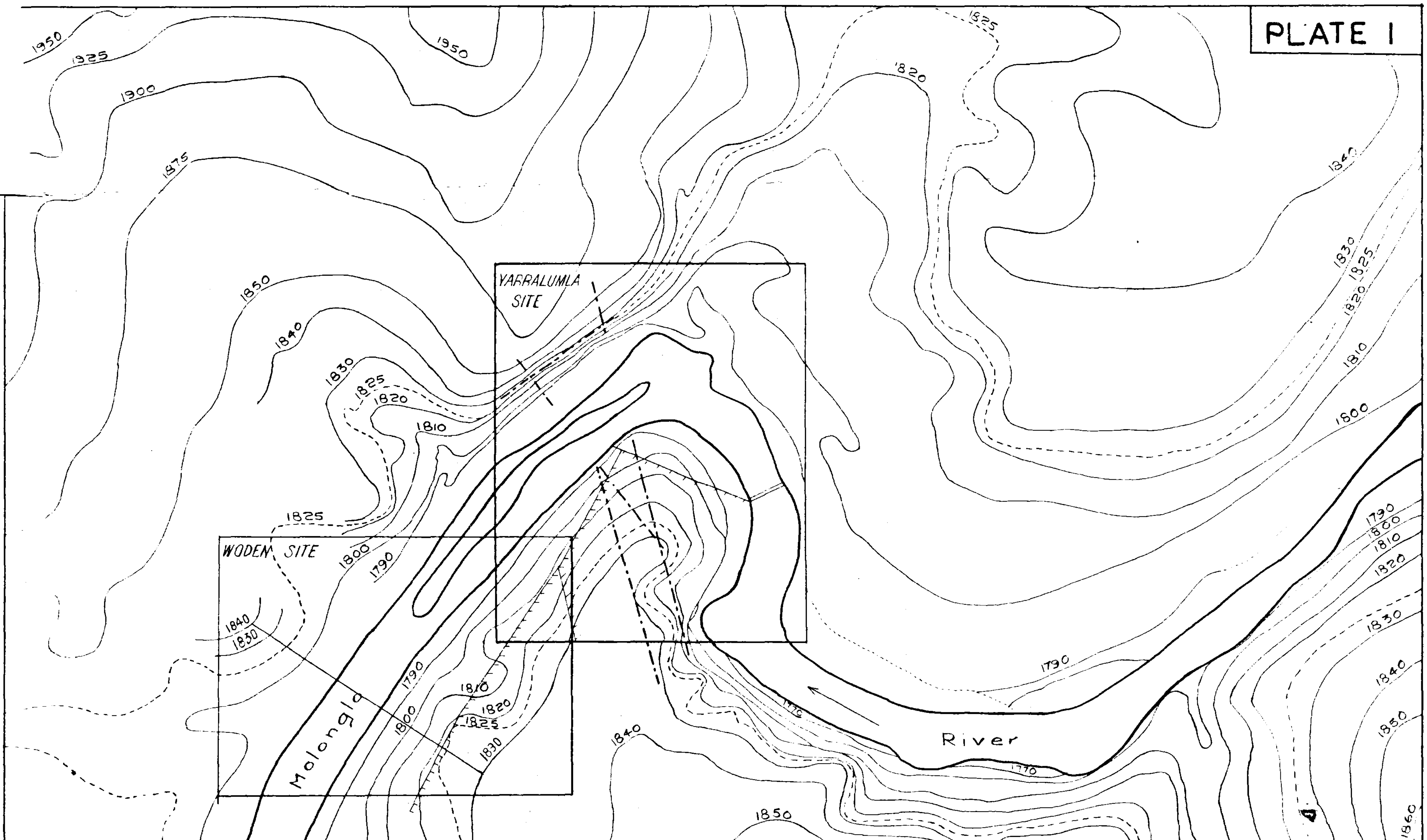
Hole No. Position and bearing are shown on Plate 2.	Attitude of hole.	Length of hole Ft.	Required.
No. 1	Vertical	45'	Nature of alluvial capping and thickness. Core of weathered bedrock and of fresh bedrock. Water pressure testing of possible foundations.
No. 2	Depressed 50°	135'	Continuous coring and water pressure testing.
No. 3		140'	

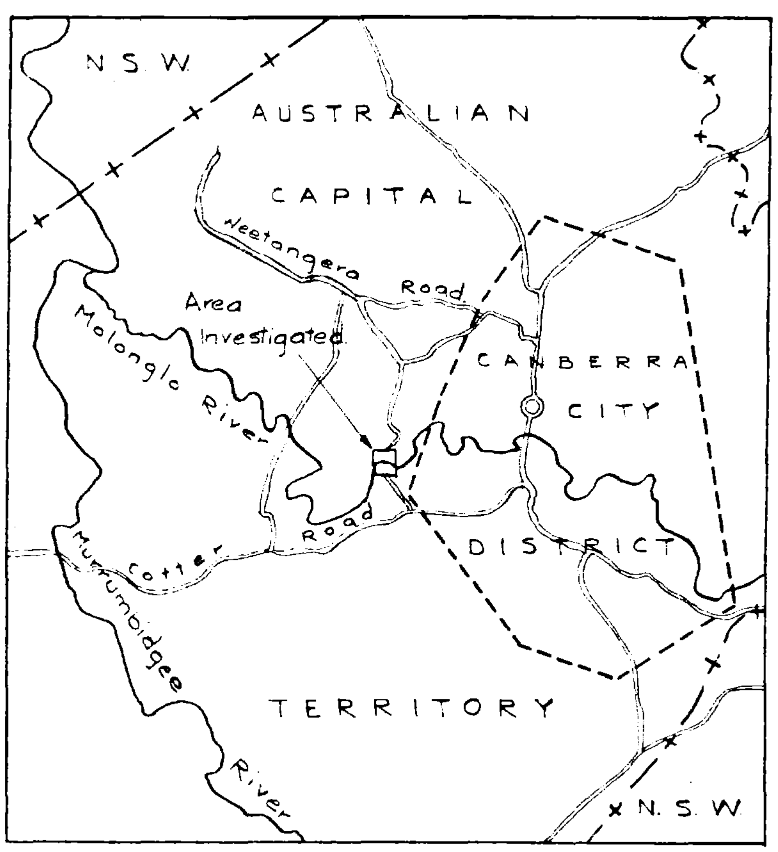
The investigation programme recommended at this stage has been kept to a minimum; the Dept. of Works has requested this to enable essential information to be gathered from both possible sites with the money at present available for the investigation. If investigation of the Yarralumla site is subsequently required, the northern abutment, and the southern abutment near top water level will probably need diamond drilling and the depth of gravel and degree of weathering of bedrock in the narrow spur above reservoir level in the southern abutment will need detailed investigation.

REFERENCE

HAWKINS, L.V. and STOCKLIN, A., 1957 - Seismic survey of the Yarralumla Weir Site, Canberra, A.C.T. Bur. Min. Resour. Aust., Rec. 1957/35.

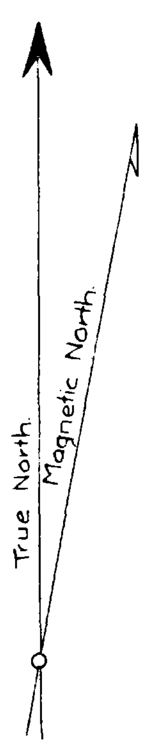
PLATE I





LOCALITY MAP

Scale: 0 2 4 6 Miles.



YARRALUMLA AND WODEN WEIR SITES
CANBERRA A.C.T.
CONTOUR MAP.

(Adapted from field sheets, Survey Section, Dept. of the Interior.)

Scale: 0 200 400 800 Feet.

1800 Contour based on Canberra City datum

Contour at proposed top water level.

Seismic survey traverse.

Inset shows area covered in Plate 2

ACT.31-1

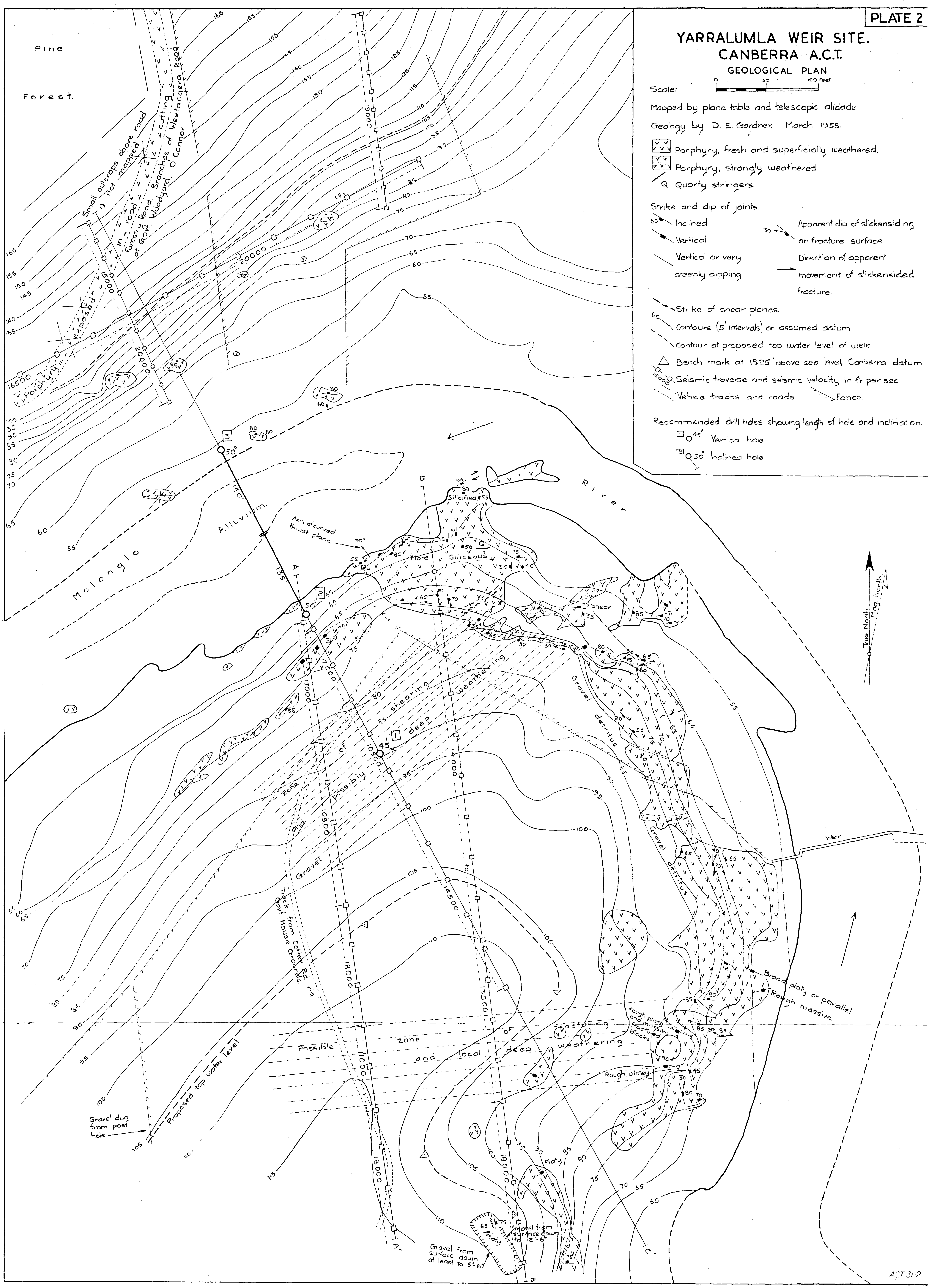


PLATE 2
YARRALUMLA WEIR SITE.
CANBERRA A.C.T.
GEOLOGICAL PLAN
Scale: 0 50 100 feet
Mapped by plane table and telescopic alidade
Geology by D. E. Gardner. March 1958.
Porphyry, fresh and superficially weathered.
Porphyry, strongly weathered.
Q Quartz stringers
Strike and dip of joints.
Inclined
Vertical
Vertical or very steeply dipping
Apparent dip of slickensiding on fracture surface.
Direction of apparent movement of slickensided fracture.
Strike of shear planes.
Contours (5' intervals) on assumed datum
Contour at proposed top water level of weir
Bench mark at 1825' above sea level, Canberra datum.
Seismic traverse and seismic velocity in ft. per sec.
Vehicle tracks and roads
Fence.
Recommended drill holes showing length of hole and inclination.
Vertical hole.
Inclined hole.
Pine Forest.
Small outcrops above road not mapped
in road cutting
Forestry Road Branches of Weetangera Road at Govt. Woodyard, O'Connor
Porphyry exposed
Molonglo River
Alluvium
Axis of curved thrust plane.
More Siliceous
Silicified
Shear
Zone of shearing and possibly deep weathering
Gravel detritus
Gravel
Weir
Track from Cotter Rd. via Govt. House Grounds
Broad platy or parallel
Rough massive.
Rough platy and massive fractured blocks
Possible zone of fracturing and local deep weathering
Rough platey
Platy
Proposed top water level
Gravel dug from post hole
Gravel from surface down to 2'-6"
Gravel from surface down at least to 5'-6"
True North
Mag. North
ACT 31-2

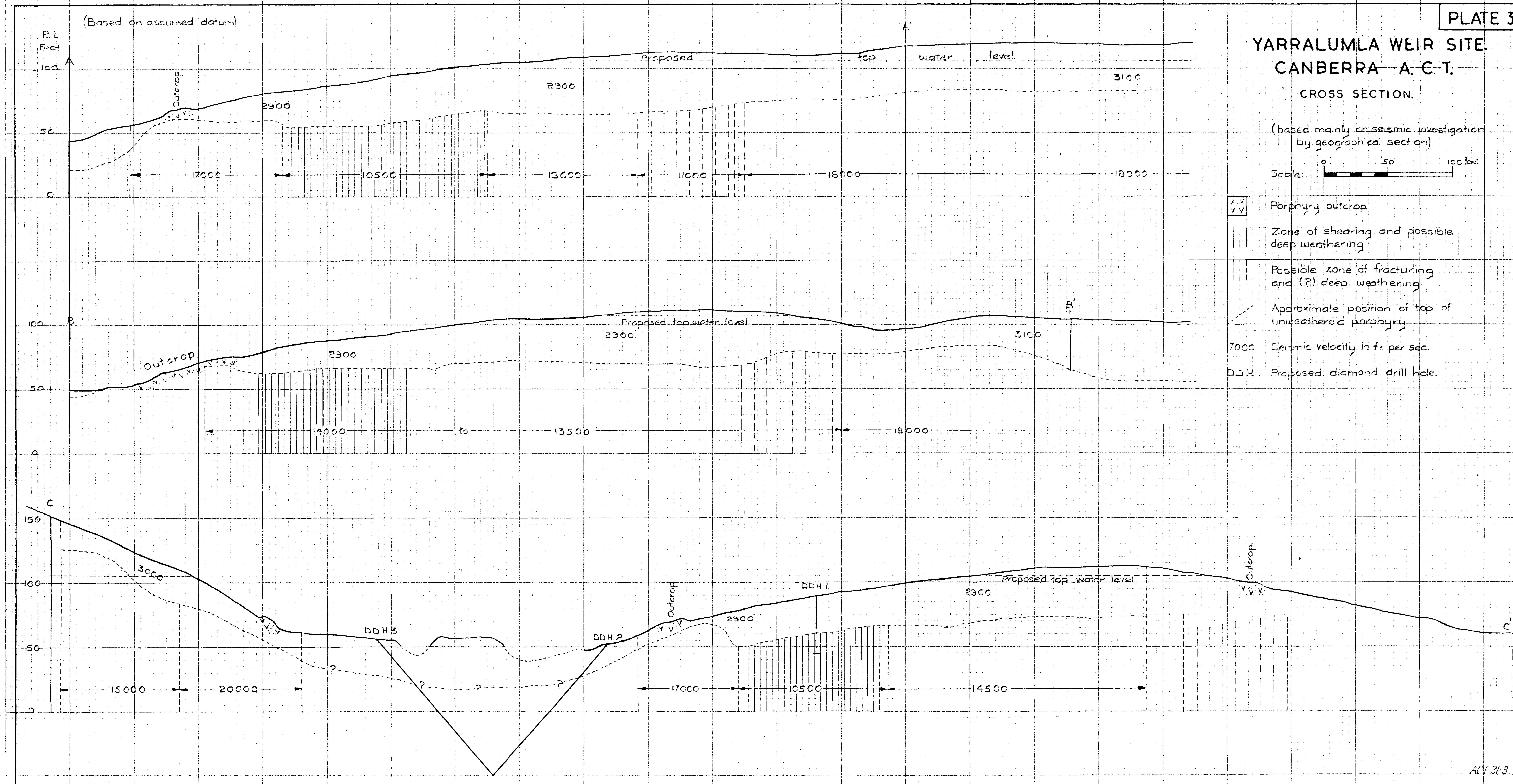


PLATE 3
YARRALUMLA WEIR SITE.
CANBERRA A. C. T.
CROSS SECTION.
(based mainly on seismic investigation by geographical section)
Scale: 0 50 100 feet
Porphyry outcrop
Zone of shearing and possible deep weathering
Possible zone of fracturing and (?) deep weathering
Approximate position of top of unweathered porphyry
17000 Seismic velocity in ft. per sec.
DDH. Proposed diamond drill hole.
(Based on assumed datum)
R.L. Feet
A
A'
Proposed top water level
Outcrop
2900
3100
17000
10500
18000
11000
B
B'
14000
to
13500
C
C'
3000
DDH.1
DDH.2
DDH.3
15000
20000
14500
ACT 31-5