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GEOLOGICAL INVESTIGATION OF TENNENT DAMSITE, GUDGENBY RIVER, A.C.T. 1966-1967

by

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SUMMARY

This Reocrd reports the geological investigations carried out to determine the feasibility of dam construction at the Tennent damsite, on the Gudgenby River, 18 miles south of Canberra. Several damsites near Canberra are being investigated, and one of the sites will be chosen for construction of a dam for the water-supply of Canberra and Queanbeyan.

The Tennent damsite is topographically suitable for dam construction. Geological investigations to date suggest that an earth and rockfill structure 220 feet high could be built at reasonable cost. However the dam foundations on the east bank may require extensive treatment, and there may be some difficulty in obtaining adequate construction materials cheaply.

The rock at the site is adamellite, a type of granite. Fresh exposures near the riverbed would provide good dam foundations, as the rock is homogeneous and strong, with few defects. The higher levels of the damsite are extensively weathered. A rockfill dam could probably be built without great difficulty.

The dam would be extended as a low embankment across a saddle on the west bank. A spillway would be located in the saddle; the proposed spillway site appears to be geologically suitable. The valve tower and diversion tunnel would be located on the east bank; a satisfactory site for these structures could be located by further investigation.

INTRODUCTION

The Gudgenby-Naas river system is one of several in and around the Australian Capital Territory being investigated for the National Capital Development Commission. The purpose of the investigations is to permit feasibility evaluations and order-of-cost comparisons of several damsites in order to select the next water-supply for Canberra and Queanbeyan. The Gudgenby-Naas river system is being investigated by the Commonwealth Department of Works, and the Bureau of Mineral Resources has provided the necessary geological services.

The most suitable location for a damsite is a gorge about 3 miles south of Tharwa. The general location is shown in Plate 1. This Record reports the geological investigations in the gorge, which were particularly concerned with determining the suitability of the site for an earth-and-rockfill dam approximately along the axis ALM shown on Plate 3. The site is known as Tennent damsite, after Mount Tennent which is nearby.

The Gudgenby River flows generally north, but at the damsite it turns sharply west and then back to north. A steep-sided gorge has been cut by the river. The rock is a type of granite which is exposed in the riverbed and on parts of the slopes. On the higher, gentler slopes the rock is deeply weathered. The dam proposed would be 220 feet high and would have low embankments extending along a ridge on the east bank, and across a saddle on the west bank. It is proposed that the spillway be in the saddle.

Access to the site is obtained by the Tharwa-Naas Road, which passes through the saddle. The river upstream of the gorge can be reached by a four-wheel-drive vehicle by a track which leaves the Naas Road about 600 feet south of the saddle. The east bank can be reached by a four-wheel-drive vehicle by a track which leaves Smith's Road (Plate 2) at the third grid from Tharwa.

Geological, and some geophysical work was carried out between December 1966 and February 1968 by D. E. Mackenzie, I. Raine, D.A. Buchhorn and I.D. Loiterton, of the Bureau of Mineral Resources. Mapping was done at a scale of 40 feet : 1 inch, using a plane table and telescopic alidade, and at a scale of 100 feet : 1 inch by inspection. The Department of the Interior provided a photogrammetric base map and survey control. The Commonwealth Department of Works carried out the main seismic survey and investigation of construction materials. The Snowy Mountains Hydro-Electric Authority diamond-drilled three holes in January and February, 1968.

A summary report on the site has been issued (Carter & Buchhorn, 1968).

REGIONAL GEOLOGY

GENERAL

The regional geology is shown on Plate 2.

The Tennent damsite is located on Tharwa Adamellite, which is part of the Siluro-Devonian Murrumbidgee Batholith. The eastern boundary of the batholith is a major north-trending fault, the Murrumbidgee Fault, which at its closest is half a mile east of the damsite. Silurian and Devonian sediments occur east of the fault. The Tharwa Adamellite has an indistinct primary foliation marked by xenoliths and an indistinct secondary gneissic (metamorphic) foliation. The Clear Range Granodiorite which occurs over most of the reservoir area differs from the Tharwa Adamellite in having a greater proportion of plagioclase feldspar relative to potassium feldspar, and a greater proportion of biotite. The Clear Range Granodiorite has a distinct primary foliation marked by numerous xenoliths, and lacks a secondary foliation. (Snelling, 1960; Mackenzie, 1966).

SEISMICITY

The area is one of low seismicity. Between 1958 and 1961 two earthquakes with epicentres in the area of Plate 2 were recorded. They were both close to the Murrumbidgee Fault, approximately 5 miles south-east and 12 miles south-south-east of the damsite and were of magnitude $2\frac{1}{4}$ and $2\frac{3}{4}$ (Richter scale) respectively (Cleary, 1968).

None-the-less the greatest intensity of earthquake recorded in the Canberra region was 8 (Modified Mercalli Scale), in 1930; the epicentre of this shock, of magnitude $5\frac{1}{2}$, was near Gunning.

Ground acceleration associated with an earthquake of intensity 8, in Californian experience, does not exceed 0.35 g; averages 0.17g and may be as low as 0.05g on strong rock.

PHYSIOGRAPHY

In the area of Plate 2 the land is hilly and ranges in elevation from 1900 feet above sea level at Tharwa to 4550 feet above sea level (Mount Tennent). Topographic features, such as the Murrumbidgee, Gudgenby and Naas Rivers, and the Clear Range, trend approximately north-south. The Murrumbidgee River is controlled by the Murrumbidgee Fault; the Gudgenby and Naas Rivers are possibly similarly controlled by a fault, of which the fault zone found at the damsite may be a part. The Clear Range may be a horst between a fault along the Gudgenby River and the Murrumbidgee Fault.

The Gudgenby River valley is wide and has gentle slopes, particularly on the left bank. The river is mature and has a gently meandering course through its own small deposits of alluvium. For a short distance of its course, through the gorge in which the damsite lies, the river changes to a youthful habit. Below the gorge the river reverts to its normal habit before joining the Murrumbidgee River two miles farther downstream.

DAMSITE GEOLOGY

PHYSIOGRAPHY

Upstream of the gorge the river flows north. Near the head of the gorge the river turns sharply west and continues straight for a distance of 800 feet (the "upstream reach") before turning slightly east of north (the "downstream reach"). The bend is the most suitable damsite for present purposes.

The east bank, upstream reach (Fig. 2) consists of high cliffs formed by undercutting by the river as it changes direction toward the west. The cliffs are vertical because of control by vertical joints. These are set 1 and 2 joints described under "structure". The west bank, upstream reach (Fig. 1) has a maximum slope of 45°.

The east bank, downstream reach, (Fig. 4) has a maximum slope of 30°. The west bank, downstream reach (Fig. 3) is steeper because of undercutting by the river as it turns west. The bank is not as steep as the east bank upstream because blocks of rock slide down easterly-dipping joints. (set 3 joints). These are probably sheeting joints formed parallel to a former ground surface, which must have been farther east, as similar sheeting joints occur in the riverbed. Joints which may be sheeting joints also occur on the east bank, upstream reach, (horizontal set 4 joints) and on the west bank, upstream reach (south-east-dipping set 5 joints). These joints are not related to the present land surface and probably result from a former land surface.

The riverbed is an extremely irregular surface and has numerous potholes, some quite large and above present river level (for example, that at co-ordinates E18,810/S85,745). The river seems to have cut itself a narrow bed below presumed former river levels.

Some of the minor watercourses entering the river near the gorge may be structurally controlled. A minor stream on the east bank downstream, at co-ordinates E18,960/S84,760, seems to have cut a course in blocky outcrop there. The watercourse running from the saddle on the west bank is straight and could be structurally controlled (see "Weathering").

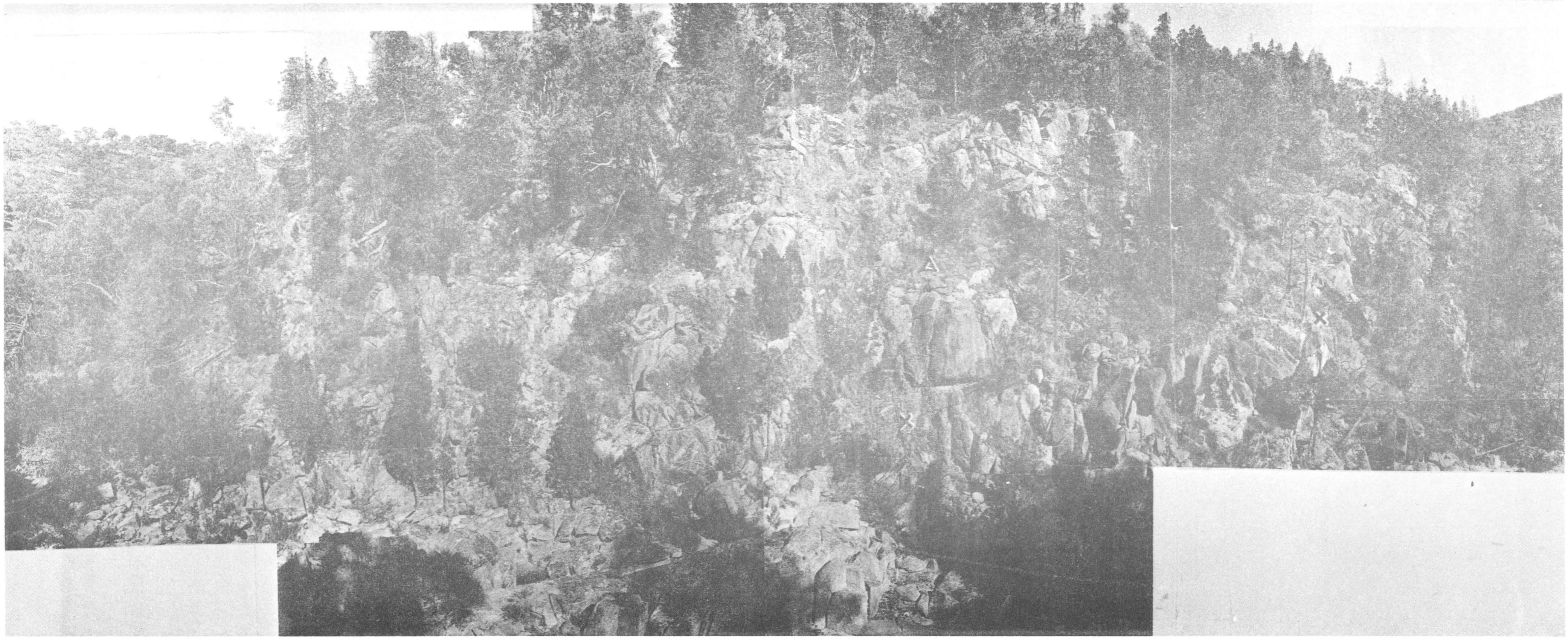
There is no obvious structural explanation for the topography of the gorge; apparently the river is deflected and entrenched because it has very few and very short tributaries at the gorge. The nearby country is drained by streams which flow away from the gorge and join the river either farther upstream or farther downstream.

PETROLOGY

The rock at the damsite may be broadly referred to as a granite, but a more exact name is adamellite. The plagioclase has been albitised, and the biotite has been chloritised.

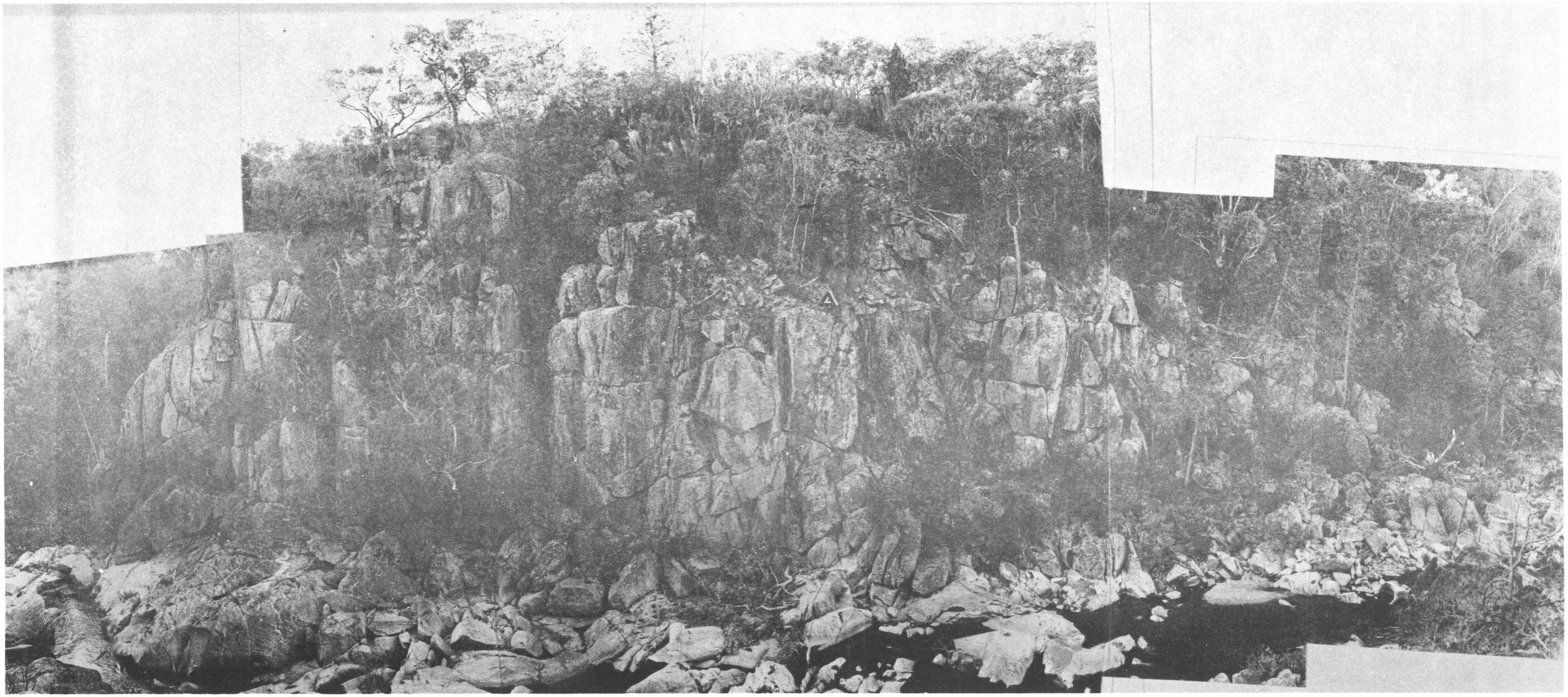
The rock is fairly uniform in appearance at the damsite. Coarse-grained and biotite-rich phases occur in the rock body but not at the damsite. A biotite-deficient phase ("pink granite") occurs at a number of locations on the east bank. Aplite, pegmatite, quartz and mylonite also occur. A few xenoliths of the common grey adamellite occur in the pink adamellite, and a few xenoliths of a dark grey biotite-rich rock occur in the grey adamellite.

Descriptions of representative rocks are given in Appendix 3.



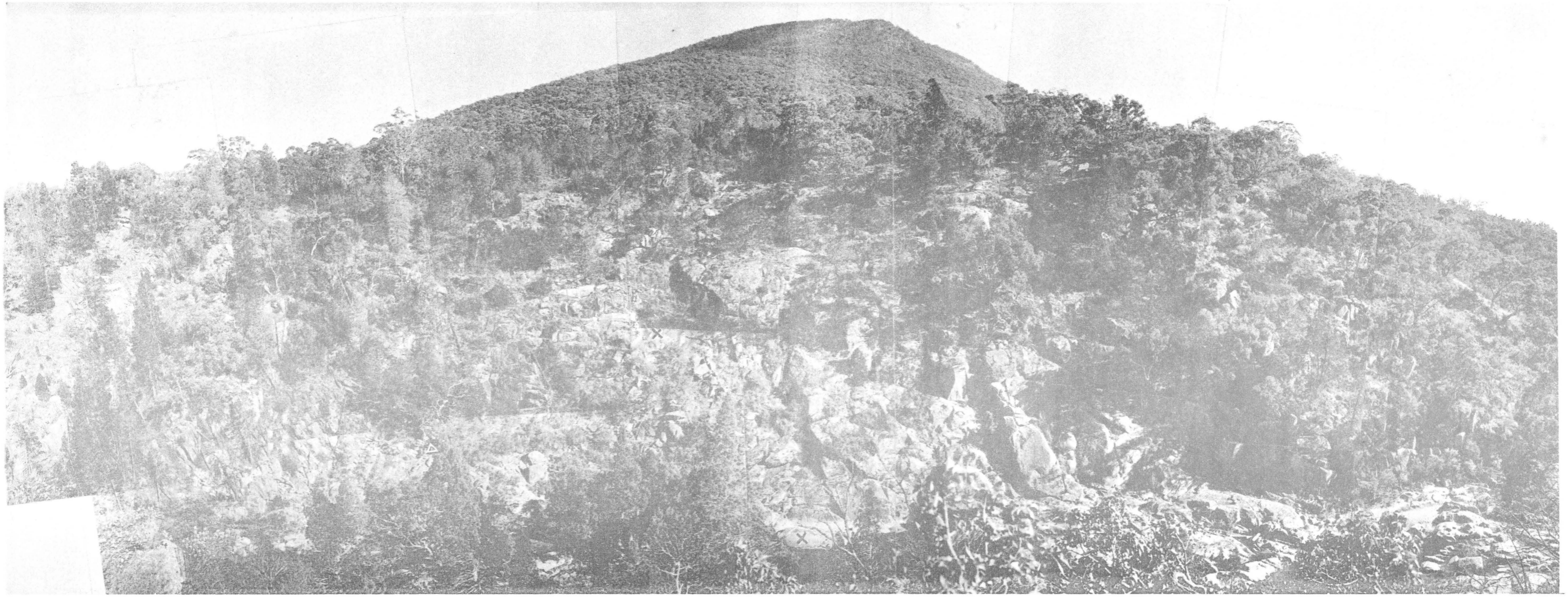
WEST BANK UPSTREAM

Fig. 1. From 19050/85720 (near station 791) looking West. Station 779 near centre; large dipping joint marked by crosses at each end.



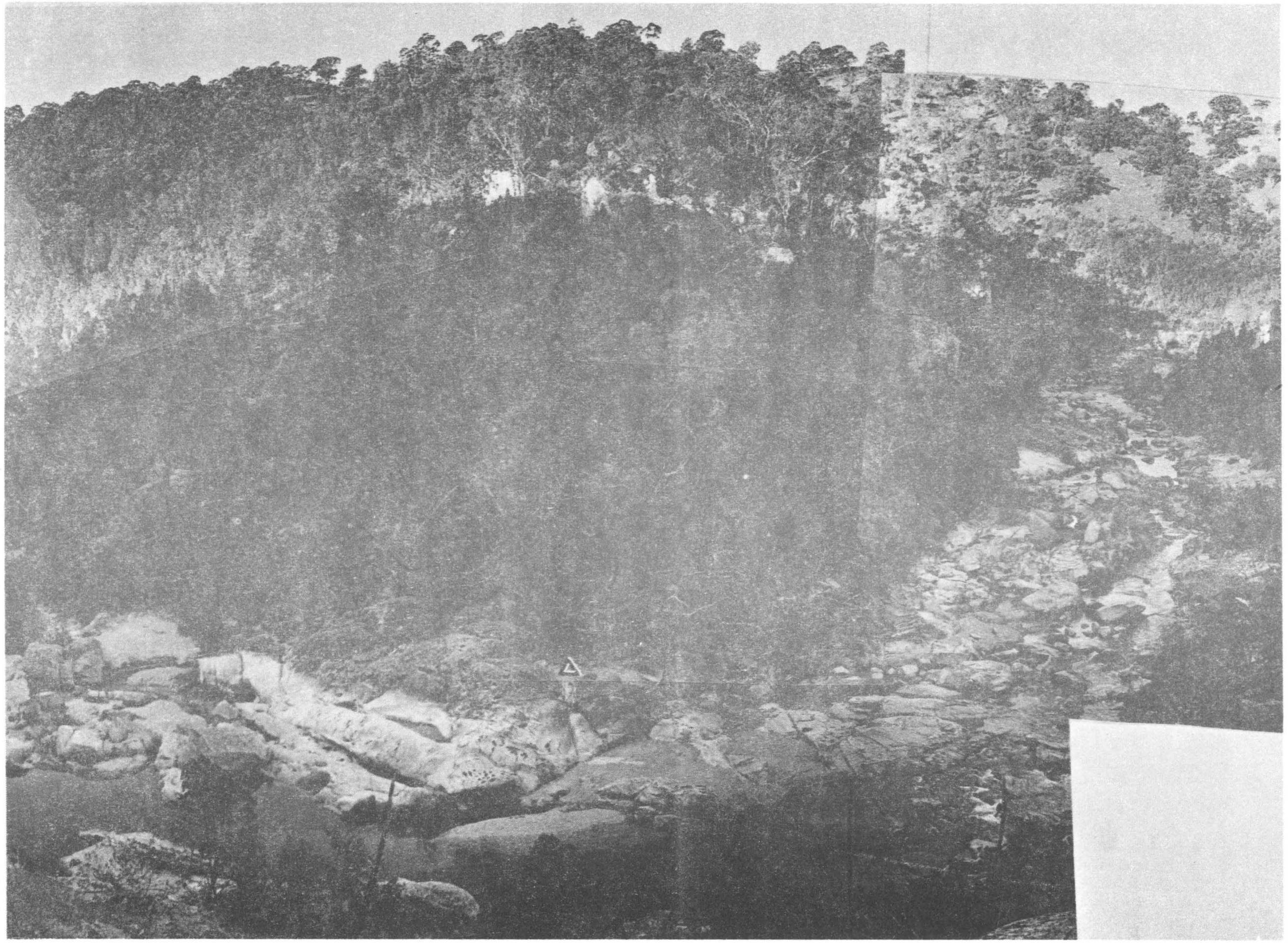
EAST BANK UPSTREAM

Fig. 2. From 18930/85870 (Station 779). Station 766 near centre. Cliffs are up to 60 feet high; steeply-dipping joints are predominant, but there are some horizontal and gently-dipping joints.



WEST BANK DOWNSTREAM

Fig. 3. From 18830/85500 looking West. Station. K at lower left. Mt. Tennent in the distance. The slope of this bank is controlled to a large extent by easterly-dipping joints which often appear as "dip slopes"; two of these are marked by crosses.



EAST BANK AND NARROW RIDGE

Fig. 4. From 18450/85610 looking East. Station R marked. River flows from right to left. Note rocky riverbed, high cliffs upstream, and lack of outcrop on East Bank Downstream.

STRUCTURE

Structural features include xenoliths, dykes and veins, foliation, faults and joints. These are planar or linear structures which reflect former stress conditions in the rock; the manner in which they are believed to have developed is described under the heading "Geological History".

Xenoliths

The sparse xenoliths present define the primary foliation. The only one measured was elongate in the direction 145° magnetic.*

Dykes and Veins

Aplite, pegmatite and quartz are intrusive igneous rocks which occur in dykes and veins. Mylonite "seams" are the product of crushing of rock in fault zones, and are discussed under "Faults".

Aplite dykes and veins are abundant and are up to 6 feet wide. They are generally vertical and most commonly trend between 130° and 180°; the modal trend is 155°, parallel to Set 2 joints and foliation (see below). The dykes are long and straight; one is at least 150 feet long (Plate 8). Aplite dykes and veins of other orientations are less numerous, smaller, and are folded. Aplite dykes and veins, mechanically, are as strong as the adamellite.

Pegmatite veins are infrequent, less than 6 inches wide, and are curved and branching. They are slightly weaker than the adamellite because they break easily along grain boundaries and mineral cleavages.

Quartz veins are sparse except at E19090/S84740 ** where they are numerous. They are less than 6 inches in width. They are slightly weaker than the adamellite.

One chlorite vein has been mapped (see Appendix 3).

Foliation

The foliation in the adamellite is caused by the rough alignments of the platy minerals: biotite and its alteration products, and of tabular quartz aggregates and granulated quartz and feldspar. Its modal strike is 155° and its dip is vertical, and it is parallel to Set 2 joints.

Because of the foliation the adamellite has a slight tendency to break into tabular fragments. The foliation exercises a strong control over the pattern of weathering (see "Weathering").

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* All bearings given in this report are magnetic directions

** Co-ordinates are those that appear on Plates 3,6,7,8 and 9. (Origin Mt. Stromlo).

Faults.

A fault zone cuts the east bank of the damsite, but because of the poor outcrop little is known about it; several faults were intersected in drillhole DG1. Further surface mapping may reveal more about the zone, but further drilling is probably necessary to determine fully its nature and extent.

For the purpose of illustration in Plates 3 and 4 the faulted zone has been assumed to have a constant width of 370 feet, a trend of 155° and to be vertical: the zone appears to consist of a number of impersistent faults of that orientation. East of the fault zone only one rock-type occurs: pink adamellite. West of the faulted zone only grey adamellite occurs, and within the zone both types occur. In most places noted pink adamellite lies to the east of grey adamellite but the boundary cannot be traced as a single line from one outcrop to the next.

On this evidence three structural explanations are possible:

(1) There is a single fault of direction 155°/90° * having grey adamellite to the west and pink adamellite to the east, it would probably be a dip-slip fault uplifted to the east. The non-linearity of the fault could be explained by a number of east-west-trending faults having both right-handed and left-handed strike-slip displacements of up to 370 feet. Apart from faults of very small displacement (see below) no east-west faults have been observed.

(2) There are a number of faults of direction roughly 155°/90° forming alternating, possibly lenticular, blocks of pink and grey adamellite within the fault zone. The faults could be of any type, i.e. the fault inducing stress and relative displacement of blocks is not determinable on the available evidence.

(3) There are a number of faults of direction 155°/90°. The surface distribution of the two types of adamellite could be explained by an irregular intrusive contact between the pink and the grey adamellites. The faults could be of any type.

The faults, where exposed, are marked by mylonite up to one foot thick, layered and oriented roughly parallel to the foliation. The mylonite is somewhat different in appearance from that exposed in the riverbed along east-west faults (see below). Both types are described in Appendix 3. The exposed faults are mechanically strong and impermeable but any not exposed may be weak like the faults in drillhole DG1.

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* That is, strike 155° magnetic, dip vertical

In drill-hole DG1 Appendix 6 mylonite occurs from depth 18feet to 18feet 4inches and 34 feet to 34 feet 4 inches within pink adamellite. From depth 90 feet 9 inches to 95 feet there is a major fault zone. The rock above the fault zone is pink adamellite, that below the fault zone is grey adamellite; the fault zone itself could consist of either or both types. The rock is highly weathered, clayey and discoloured. There are numerous curved thin films of clay within the fault which are thought to be slickensides. Assuming the fault zone to have an orientation 155°/90°, its true thickness would be 1 foot 6 inches.

The pink adamellite near the fault may have been fractured at the time of faulting, and recemented. Up to 12 recemented fractures per foot of core have been observed in the first 90 feet 9 inches of the hole. The faulting has not caused weathering in the pink adamellite. The grey adamellite is highly weathered from 95 feet to 116 feet 6 inches and from 121 feet 6 inches to 144 feet. This weathering could have been assisted by faults or could have occurred along joints.

The seismic velocity of the refractor in most of the fault zone is about 13,000 feet/second; the average for the site is 15,500 feet/second. The lower velocity in the fault zone may be related to faults, although a velocity of 13,000 feet/second was also obtained in the saddle where no faults are known. Further, a velocity of 13,000 feet/second is somewhat higher than would be expected in the rock in DG1. It is therefore concluded that though weaker than the rock in the east bank west of the fault zone, the rock in the fault zone is generally, stronger than that intersected in drillhole DG1. The core from 0-90 feet may be fairly typical, whereas that from, 90 - 224 feet 5 inches probably represents localised very poor rock conditions. The weak zone from 90 feet to 224 feet 5 inches is most likely to have been caused by faults of orientation 155°/90°, or by joints of orientation either 155°/90° or 060°/90°, (the commonest joint directions). If vertical, the weathered zone from 90 feet 9 inches to 144 feet would not be more than 18 feet thick, and would be vertical.

If faulting is the cause, several faults could occur in the east bank, within the faulted zone.

In the riverbed a few minor faults occur. Where they cut aplite dykes they have displacements of less than one foot and most are left-handed. They range in strike from 080° to 140° and dip nearly vertically. Contacts are generally clean or are marked by recemented mylonite up to 2 inches thick. They do not form weak zones.

Joints

Joints are naturally-occurring fractures along which there has been no relative movement of adjoining rock masses. At the damsite exposed joints are clean for the most part, but a few of the joints in the drill-core are filled with clay (of maximum thickness 0.5 inch) which is probably a product of weathering. Joints are believed to have formed after release of tectonic stress at depths of several thousand feet. (Price, 1959). Some joints ("sheeting joints") are formed by stress relief much closer to the surface. Their spacing increases with depth, unlike tectonic joints which are ideally uniform in spacing.

In their original state they are closed, and this is how they generally are in the riverbed; however some of those in the riverbed, and many of those in outcrops away from the riverbed, are open due to slight movement of adjoining blocks of rock.

In the following paragraphs a number of types of joints which have been recognised on physical characteristics are described; the joints are then classified into sets according to their orientation:

Type 1. Widely-spaced large parallel joints (see Appendix 1 for definitions of size and spacing). These are by far the commonest.

Type 2. Closely-spaced large parallel joints.

Type 3. Closely-spaced subparallel joints, small to moderate in size.

Type 4. Closely-spaced parallel joints, moderate size, within a horizontal zone, and having the orientation of set 3 joints, i.e. strike 152° magnetic and dip 37° east. The joints occur between two horizontal planes about 4 feet apart. An example is shown in Figure 8; the photograph shows how readily the joints are eroded by the river. These joints are exposed in the downstream portion of the gorge between R.L's 1930 and 1955 and have also been found in DG1 between the same elevations. In DG2 a set was found between R.L's 2076 and 2079. The areal extent of a particular zone is large. For example, the zone which has its lower surface at R.L. 1955, is mostly eroded but occurs at E18620/S85300, E18690/S85210 and E18750/S85220 and thus may have had an areal extent of greater than 2600 square feet.

Type 5. Closely-spaced joints of more than one orientation. Joints are small to moderate in size. This type of jointing occurs at two places, shown on Plate 3 as "blocky outcrops".

By putting all joint measurements on the stereogram, Plate 12, five sets of joints were recognised. They are listed in decreasing order of abundance:

Set 1 joints Strike 060° magnetic, dip vertical. The joints are almost perpendicular to the foliation.

Set 2 joints Strike 155° magnetic, dip vertical. The joints are almost parallel to the foliation.

Set 1 and Set 2 joints are by far the most common joints at the site. They consist mainly of type 1 joints but types 2, 3 and 5 may be represented. Both sets are visible in Figure 2.

Set 3 joints Strike 152°, dip 37° E. They consist of type 1 and type 4 joints, which are illustrated in Figures 9 and 8 respectively. The type 1 joints of this orientation are believed to be sheeting joints. They occur on the west bank downstream.

Set 4 joints Generally horizontal joints. They are type 1 and are believed to be sheeting joints. Many are irregular in shape, especially on the east bank upstream. (Fig. 2).

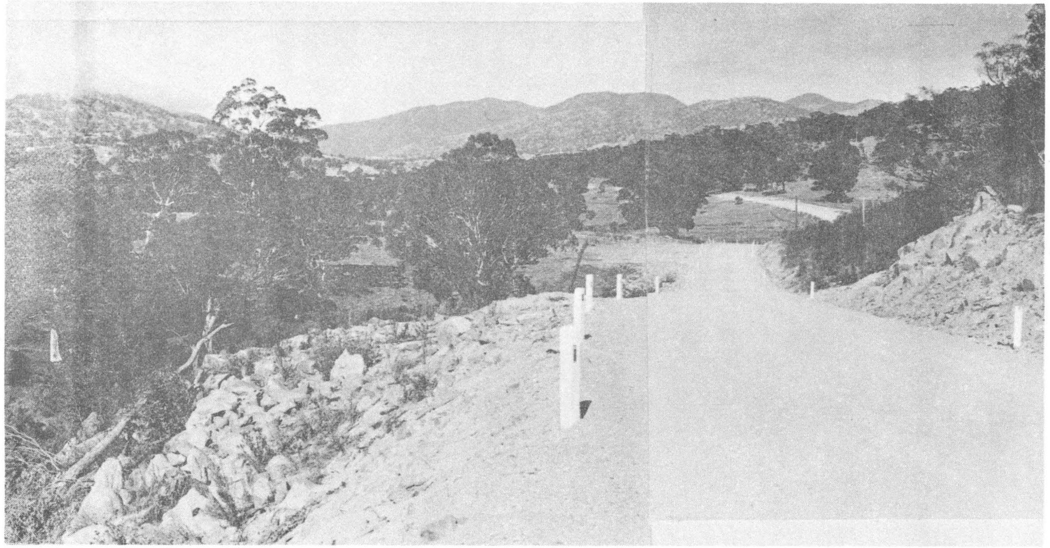
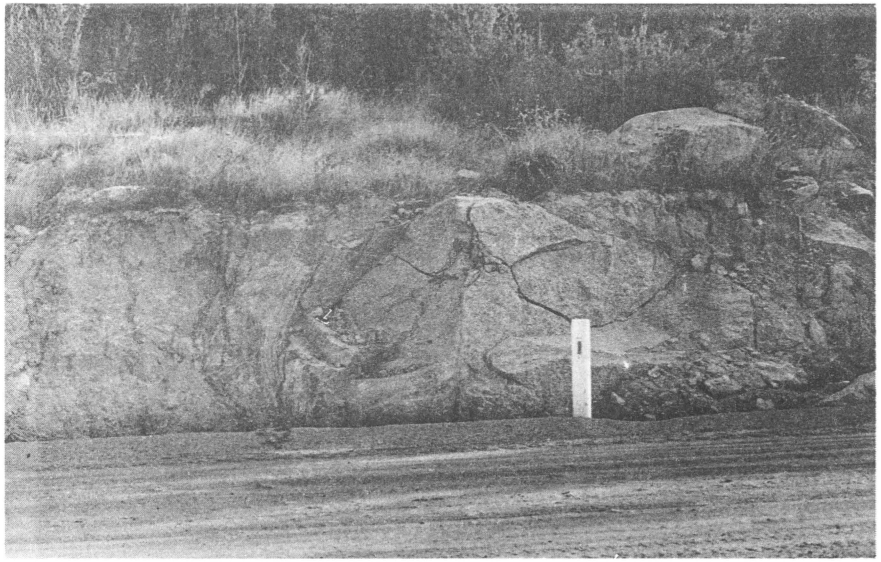
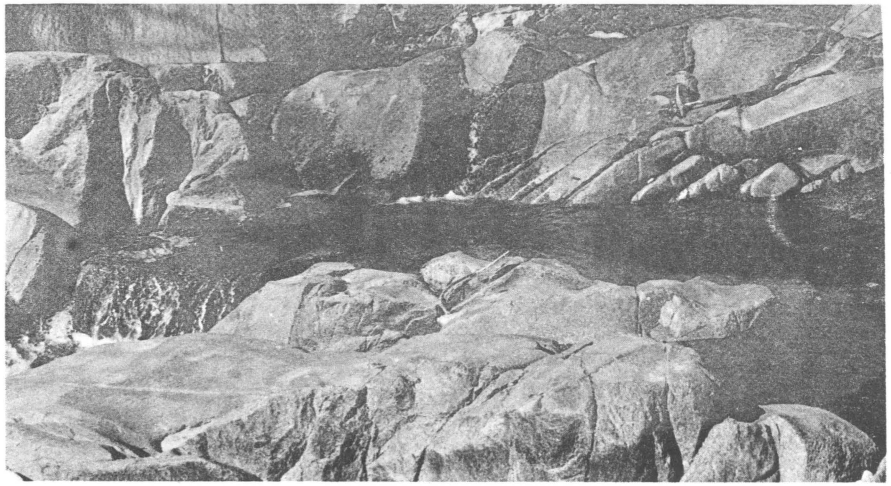


Fig. 5. From 18020/84670 looking South. Naas Road and reservoir area; a spillway running from the saddle down the small valley at the left is proposed.

Fig. 6. From 17860/84310. Road-cutting showing depth of weathering near a large outcrop. $2 note for scale.





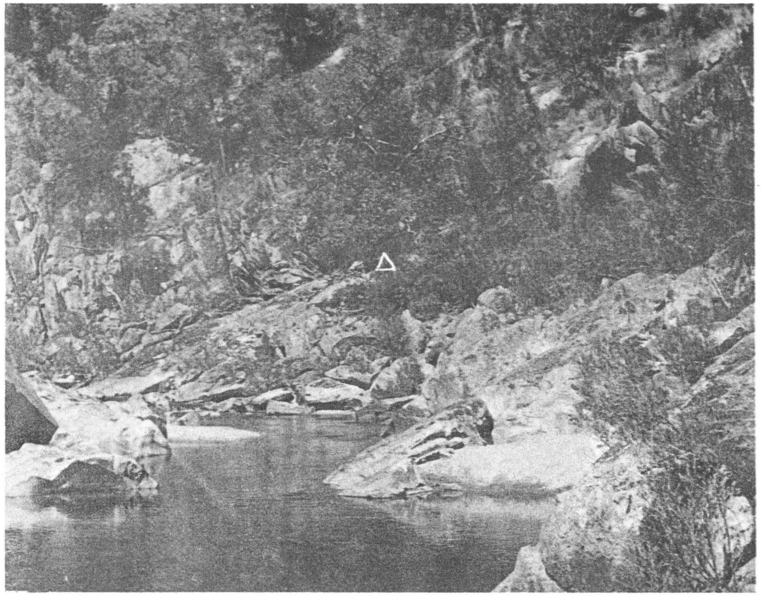


Fig. 7. (Above left) From 17750/84250. Road-cutting showing weathering. Note sharp boundary between completely-weathered and unweathered rock, and rounding of the rock-body by weathering. Hammer at left end of boulder gives scale.

Fig. 8. (Above right) From 18740/85200. Multiple joints, analogous to current-bedding: parallel closely-spaced dipping joints restricted to a horizontal zone a few feet thick. In the foreground a horizontal surface representing the lower extremities of these joints ("bottom-set beds"). Hammer gives scale.

Fig. 9. (Left) From near Station S, looking South (upstream). Station K marked. Riverbed and West bank, showing easterly-dipping joints (also shown in fig. 3).

Set 5 joints Strike approximately 046°, dip 26° south-east. Because of their small numbers and wide spread occurrence they do not appear as contours and are therefore plotted individually on Plate 5. They are believed to be sheeting joints. (see Fig. 1).

WEATHERING

Both mechanical and chemical weathering have affected the rocks at the site; five degrees of chemical weathering are defined in Appendix 1. The following discussion is confined to chemical weathering.

Chemical weathering is the action of water and air which causes chemical changes in a rock, resulting in the softening and discolouration of the rock. Biotite alters to clay minerals and iron oxide (which discolours the rock), feldspar alters to clay minerals, while quartz, epidote and chlorite remain unchanged. The clay minerals generally form or accumulate in joints but at the Tennent damsite this is not commonly seen at the surface.

The character and depth of weathering are dependent on (a) Permeability, (b) Water table, (c) Rate of erosion

(a) As fresh granite is almost impermeable weathering is confined to surfaces, particularly where moisture is retained; it is therefore most active along joints.

Faults, if permeable, may also assist weathering. Weathering proceeds most easily along grain-boundaries and mineral cleavage planes or along micro-fractures of the rock mass has been deformed.

Because of joint control, weathering at the damsite has the following characteristics:

(1) Weathering extends to moderate depths because the joints are large. In DG1 moderately weathered rock occurs at hole depth of 217 feet, or 160 feet depth perpendicular to the surface.

(2) Tors are developed. There are two perpendicular vertical joint sets and several low-angle joint sets, which divide the rock into large blocks which resist weathering and become rounded in shape while weathering occurs along joints. The rounded boulders which result are called tors. When the weathered material is removed by erosion rounded tors project above the general surface.

(3) As vertical joints are much more common than low-angle joints (see Plate 5) weathered zones may be expected to be more commonly vertical than low-angle. Figure 6 shows a vertical weathered zone. For the same reason tors are commonly pinnacle-like.

Because of a grain-boundary weathering, weathering at the Tennent damsite has these additional characteristics:

(1) Weathering proceeds more easily along the foliation. Thus many outcrops are elongate parallel to the foliation (Plate 3). The ease of weathering of biotite, which is parallel to the foliation, is another possible cause of this phenomenon.

(2) Weathering is initially difficult within the granite and thus tors may be fresh, but surrounded by highly weathered rock. The boundary is commonly sharp, as in the example in Figure 7.

At the damsite data obtained so far suggest that most weathering has occurred above the present water table. The rate and duration of erosion is the most important factor affecting the depth of weathering. In the riverbed, and in riverbanks being undercut by the river, the rock is fresh or slightly weathered, although physical weathering has occurred. On slopes, weathering is well-advanced. On high-level, flatter areas, weathering is deepest of all, because erosion is not active.

In the centre of the saddle west of DG2 weathering is apparently deeper than nearby. Possibly the small valley north of the saddle is joint or fault controlled, and the same control has assisted weathering in the saddle; or alternatively erosion has been restricted in the saddle, allowing weathering to proceed deeply.

GEOLOGICAL HISTORY

The following is a brief geological history:

1. Intrusion of "grey adamellite" magma, into sedimentary country rock orientation of xenoliths to form a primary foliation.

2. Solidification, formation of cooling joints, and filling of the latter by the remaining liquids, forming dykes and veins of aplite, pegmatite and quartz.

3. Intrusion of "pink adamellite" magma, which encloses xenoliths of the grey adamellite rock.

4. Regional deformation, subjecting the rock to stress and heat, and resulting in metamorphism with the development of secondary foliation, and folding of some dykes. Faulting, formation of mylonite, chloritisation and albitisation, may belong to this stage.

5. Uplift; development of joints due to release of stresses.

6. Chemical and physical weathering with concurrent erosion.

ENGINEERING GEOLOGY

DAM FOUNDATIONS

General Fresh adamellite at the damsite is, as a substance, very strong and impermeable. However weathering considerably weakens the rock ultimately to the extent that it becomes in the engineering sense a soil. As the adamellite is extensively, and in places profoundly weathered the suitability of the site for dam construction depends mainly on the weathering.

In addition, joints have an effect on the strength and stability of the rock. On present evidence faults do not have an important effect on foundation conditions, except in so far as they allow weathering to occur at depth. Foliation, dykes of veins, and xenoliths have negligible effect on foundation conditions.

Weathering is discussed in "Damsite Geology, Weathering", joints and faults are discussed in "Damsite Geology, Structure".

Seismic activity is discussed in "Regional Geology, Seismicity". Some allowance should be made for seismic activity in the design of the dam embankment.

Surface Data See Plates 3,6,7,8, and 9.

1. On the higher parts of the east bank, i.e. approximately east of the benchmark, outcrops are sparse, small and weathered. Weathered rock is expected to occur below the soil cover.

In a 370 -foot-wide zone which cuts across the ridge (Plate 3) there are a number of faults which could partly cause the lack of outcrop. East of the faulted zone outcrops are equally sparse. The faults, where exposed, are strong and impermeable (having been silicified) but faults which are not exposed could be weak or permeable. Results from drillhole DG1 suggest that faults may have weathered zones adjacent to them (see Damsite Geology).

2. On the lower parts of the east bank bold outcrops account for about 10% of the surface area and are generally unweathered. The exposed rock, despite its strength, may have to be removed to provide sound, smooth dam foundations because weathered rock is expected around and even, in places, beneath it.

On the upstream part of the east bank high cliffs of open-jointed unweathered rock occur. These would lie in the rock-fill zone of the proposed dam. Pinnacles of rock would have to be removed but most of the rock could be left if proved stable.

3. The riverbed consists of unweathered rock except for a thin cover of sand and boulders. The surface is quite irregular; open joints occur under some prominent rock masses, which would need to be removed in the core zone. Some closely-jointed areas occur but are unlikely to affect foundation conditions greatly.

4. On the west bank unweathered rock crops out over 50% of the area. Weathered rock probably occurs between outcrops under a cover of soil scree and boulders on the higher parts of the bank. Large set 3 joints occur on this bank and are [illegible] roughly parallel to the slope of the bank. Some are exposed as joint faces. There is a possibility of slip or of leakage along these joints, unless treated. The joints also form the surface which would result from the removal of prominent rock masses.

5. On the knoll between the west bank and the saddle moderate outcrop, forming 10-20% of the surface, occurs. The outcrops are unweathered and sound but some are prominent and generally they are unsuitable for foundation.

6. In the saddle outcrops are sparse.

Drillhole data See Appendices 6 (drill logs), 4 (auger holes) and 5 (water pressure tests).

Three diamond drill holes were drilled. DG1 ,drilled on the right bank intersected moderately weathered rock, probably suitable for the foundation of a rock-fill dam, at a depth of 7 feet (hole length - perpendicular depth 5 feet). A fault zone occurs from 90 feet 9 inches to 95 feet. Highly weathered rock occurs from 50 to 62 feet, from 90 feet 9 inches to 116 feet 6 inches, from 121 feet 6 inches to 144 feet, and from 207 feet 6 inches to 208 feet 6 inches. If this rock condition is typical of the east bank dam construction would be extremely costly. In the discussion in "Damsite Geology, Weathering" it is concluded that the weathered zones are probably not typical and the weathering extending from 90 feet 9 inches to 144 feet probably has a true width of about 18 feet. The other weathered zones are narrower. It is assumed that these weathered zones are vertical; low angle weathered zones are less likely. If they do occur, however,they will require careful investigation at the design stage to determine what treatment is necessary.

DG2, drilled in the saddle, intersected moderately weathered rock at 5 feet (perpendicular depth 4 feet) and slightly weathered rock at 30 feet (perpendicular depth 26 feet). Highly weathered rock occurred from 60 feet 6 inches to 70 feet - probably a vertical zone of width 5 feet. An auger hole drilled within a few feet of DG2 intersected rock interpreted as moderately weathered from 0 to 17 feet, and highly weathered below that. It probably followed a vertical weathered zone, different from that intersected by DG2. Auger holes on the saddle (five in number) reached refusal at depths ranging from 7 to 48 feet, illustrating the extreme heterogeneity of weathering.

DG3, in the riverbed, recovered fresh rock throughout.

Waterpressure tests in the three diamond drillholes provided data from which joint permeabilities were calculated. The maximum permeability calculated was 100 feet/year and the average 15 feet/year (Appendix 5). These figures would indicate negligible grout consumption but the first 20 feet of each hole (about 17 feet perpendicular depth) was not tested and low grout consumptions will probably occur close to the surface. Further, the section from 95 feet 9 inchest to 148 feet in DG1 was not tested. Grout consumptions might be higher than present data indicate in some locations, e.g. on the left bank.

Seismic data. Seismic results obtained by the Commonwealth Department of Works (Drawing No. CD68/179B) show depths to the main refractor between 0 near the river to a maximum depth of 74 feet just south of the line ALM on traverse CD (see Plate 3). The velocity of the refractor averages 15,500 feet/second. It is generally about 17,000 feet/second but on the higher part of the right bank, and in the saddle, velocities were about 13,000 feet/second. Seismic results by the Bureau in the saddle (Plate 4) showed a main refractor of velocity 11,000 feet/second as well as zones of lower velocities above the refractor. The lower velocities could be due either to topographic or fault control of weathering.

There does not appear to be any anisotropy in velocities either in the main refractor or above it.

By comparison of velocities with drillholes and with other localities, seismic velocities are interpreted below in terms of weathering. It should be kept in mind that a seismic velocity is the average of several degrees of weathering rock through which the seismic wave passes; velocities may also be reduced by the presence of mechanical discontinuities.

15,000 - 20,000 feet/second	Fresh rock
8,000 - 15,000	Slightly weathered
5,000 - 8,000	Moderately weathered
3,000 - 5,000	Highly weathered
1,000 - 3,000	Completely weathered rock, soil.

Excavation

Because of the heterogeneity of weathering it is very difficult to predict the depth of excavation required to found an earth-and-rockfill dam. The orientation of weathered zones is important but this may not be known in some cases until excavation actually begins.

Most of the excavation is likely to be in material with a velocity of less than 4000 feet/second . Material with a seismic velocity of less than 4000 feet/second should be rippable. It may have unweathered tors, some of which will be large, and some blasting may therefore be required. Material of greater seismic velocity will generally require explosives. Any excavation on the steep part of the west bank and riverbed will certainly require explosives.

Localised excavation with jackhammers and hand tools will be required; this is further discussed under "Foundation Treatment".

Plate 4 shows a possible excavation profile. It is based on the very limited data obtained so far and should only be regarded as a guide for present estimating and planning purposes. Much further investigation work is still required to determine the foundation profile. Localised deeper excavation, especially on the east bank, will doubtless be required below the profile presented.

The profile was deduced from the following premises:

(1) Surface data (Plate 3) indicate that little excavation is required in the riverbed (except for shaping),and the excavation required on the left bank is in order to remove the possibility of slip along Set 3 joints and to provide a smooth profile.

(2) DG1 revealed moderately weathered rock below depth 7 feet (perpendicular depth 5 feet). Although more advanced weathering occurs at greater depths it is assumed that this is localised.

DG2 revealed moderately weathered rock below depth 5 feet (perpendicular depth 4 feet). Although more advanced weathering occurs at greater depths it is assumed that this is localised.

DG3 revealed fresh rock at the surface.

(3) Excavation profile not deduced by (1) or (2) above is deduced from seismic data. The profile separates rock of velocity 3500 feet/second or less, above the profile,from rock of velocity 5000 feet/second or greater below the profile. Depths range from 1 foot at several locations to 24 feet at M. The seismic data have been projected from the seismic traverses to the line ALM by distances as great as 170 feet.

Foundation Treatment

In the rock-fill zone the foundation should be stronger than the rockfill, should have very little settlement under design load and should resist erosion. Large low angle clay seams and weathered zones along which slip might occur should be absent. A foundation mostly of moderately weathered rock should be sufficient.

In the core zone and filter zone the foundation should have acceptably lower permeability (or be capable of economic treatment to achieve acceptable limits of permeability); settle very little, and uniformly, under load; and resist erosion. It should also be so shaped that the core zone material will not separate from the foundation: sharp corners and holes, and steep faces should be absent.

Excavation and filling of localised zones of deep weathering and excavation of rock underlain by low angle weathered zones may be required in the rock-fill zone of the dam and will almost certainly be required in the core zone. A weathered zone, probably 18 feet wide and vertical, was intersected by DG1; it is possibly much wider at the surface. Seismic results suggest that such large weathered zones are uncommon but further investigation is needed before detailed designs are prepared. It is likely that many narro, steeply-dipping, weathered zones occur on all parts of the site, and especially the higher parts of the east bank. Little other treatment is expected to be necessary in the rock-fill zone but the following additional treatments are probably required in the core-zone:

The surface will need to be shaped to a smooth profile not steeper than 60° in any place, gaps and open joints filled with concrete and closely-jointed zones gunited.

Rock-bolting may be necessary across joints parallel to the surface, such as those occurring on the west bank.

Any clay seams and clay-filled faults, and narrow weathered zones, will need to be excavated to a depth of 1½ - 2 times the width and backfilled with concrete or, in the case of smaller defects, capped by concrete or gunite.

Blanket and curtain grouting. Joint permeabilities indicate that grout consumptions would probably be low, and the grout curtain need not be taken deep. However information to date is very limited and in view of the erratic weathering, jointing and faulting of the rock, careful investigations will be required to determine a suitable depth for the grout curtain.

SPILLWAY

Topographically the preferred location for a spillway is in the centre of the saddle to the west of the river, on the knoll between the saddle and the gorge, or at some location between. In the first case discharge would occur along a small valley a distance of 1400 feet to the river. In the second case discharge would occur along a ridge a distance of 1100 feet to the river.

Drillhole DG2, near the centre of the saddle, intersected slightly weathered rock at 30 feet (perpendicular depth 26 feet, RL 2114) and this may be a suitable level for a spillway foundation. The location would probably be suitable although very little is known about chute conditions north of the saddle. In general, however, depth of weathering decreases toward river level. If the spillway were located some distance further east more excavation, which would be difficult, would be required. The excavated material would provide low-grade fill that could be used in low embankments. If the spillway were located even a short distance west of the centre of the saddle considerably deeper excavations may be necessary, in view of the seismic results obtained (see Plate 4).

Rock conditions in the saddle are discussed in more detail in "Dam Foundations".

It would be prudent to make allowance for seismic activity, particularly if the spillway design provides for a gated structure or high free-standing training walls.

DIVERSION AND OUTLET WORKS.

The east bank provides the location for the shortest diversion tunnel. However the eastern part of this bank is deeply weathered in at least one place (in DG1) and is cut by numerous faults. The western part of the ridge appears more suitable: outcrops are much more abundant, and in the upstream reach of the river high cliffs of unweathered open-jointed rock occur: further, seismic velocity below 60 feet depth is 17,000 feet/second. Once the loose rock is removed it should be possible to place an entrance portal in a vertical, sound cliff face about 60 feet high. Assuming an entrance portal in this location (i.e. in the vicinity of station 766) a possible alignment is along bearing 350° (grid north) to the grid-line S85200, turning to bearing approximately 300° and having an exit portal near E18100/S85100. Total length is 650 feet. Rock cover is at least 50 feet except for the last 90 feet of the tunnel. This alignment avoids the faulted and weathered zone, and cuts across major joint directions. Where the rock is fresh no lining and a minimum of rock bolting will be necessary but weathered zones are likely especially near the portals, which will necessitate concrete lining. Spalling is not expected to occur. The tunnel should not be very wet. Quarried material should be usable as rockfill.

A valve tower located near the entrance portal could probably be built on sound rock, as cliff exposures and surface outcrops are reasonably good. Some allowance should be made for seismic activity in design of the tower.

In the upstream reach, where a cofferdam would presumably be constructed, the riverbed is fresh and strong but extremely irregular in shape. The walls of the gorge nearby have approximately 50% unweathered outcrop; rock conditions between outcrops are unknown. Some treatment of the foundations of the cofferdam may be required to make them watertight.

CONSTRUCTION MATERIALS

No systematic study of possible construction material sources has been done by the Bureau. Some deposits have been investigated with hand and mechanical auger by the Commonwealth Department of Works. Some difficulty may be experienced in obtaining core-zone and filter-zone materials. Other materials are apparently available in sufficient quantities reasonably close to the damsite.

Material excavated from the damsite, spillway and tunnel, is likely to be variable in properties and at this stage waste from these sources should be regarded as suitable only for fill in low embankments.

Coarse aggregate for concrete

1. River gravel is associated in small quantities with sand deposits on the Murrumbidgee, Gudgenby and Naas Rivers.

2. Tuff or porphyry on the eastern side of the Murrumbidgee Fault (see Plate 2) could possibly be quarried and crushed.

3. Porphyry is already being quarried and crushed at Mugga Quarry, about 18 miles from the damsite.

4. Tharwa Adamellite could be quarried and crushed within a mile of the damsite. Pyrite is present only in small quantities. Chlorite is present and may have some effect on its suitability as an aggregate. The rock will probably crush into a suitable shape despite a tendency, only slight, to break along the foliation. This is probably the most suitable source of concrete aggregate. Normal acceptance tests will be needed.

Fine aggregate for concrete

Sand is present along the beds of the Murrumbidgee, Gudgenby and Naas Rivers. Large deposits occur on the Murrumbidgee River at Angle Crossing, three miles from the damsite, at Tharwa, three miles from the damsite and at Point Hut, about 9 miles from the damsite. These three deposits are all on the Murrumbidgee River, the last two are being dredged commercially and the product is used in Canberra for concrete.Sand also occurs along the Gudgenby River; one deposit is at its junction with the Naas River, 4 miles south of the damsite.

Sand dredging may supply some coarse aggregate or filter-zone material as a by-product.

Rockfill

A rockfill dam as proposed would require approximately 1,200,000 cubic yards of rockfill.

Tharwa Adamellite would be suitable. In most places it is covered by weathered material, which however may be usable in the dam. A possible quarry locality is the area in the right-hand corner of Plate 3. Otherwide a large number of sites are possible; in general the areas to the north and west of the damsite appear to be more suitable, in terms of outcrop and topography, than elsewhere.

As joints are widely-spaced the rock should be obtainable in blocks up to the size required for rip-rap. Crushing of some of the rock could provide filter-zone material or coarse aggregate.

Filter-zone material The rockfill dam proposed would require approximately 100,000 cubic yards.

1. Gravels are found in small quantities on the Murrumbidgee, Gudgenby, and Naas Rivers.

2. Crushed rock may be obtained from one of the coarse aggregate or rockfill sources. This material could, if necessary, be blended with sand, which is readily available.

Crushed rock is more likely to provide a satisfactory source of filter material than screened gravels.

Core-zone material A rockfill dam, as proposed, would require 300,000 cubic yards of material.

1. Weathered granite (Tharwa Adamellite) is abundant near the damsite but is generally unsuitable as a core material as it lacks fines. Some suitable material has been found by the Commonwealth Department of Works, however; two deposits totalling 280,000 cubic yards have been tested at about 2 miles distance.

2. Near the damsite a deposit of alluvium (south-west corner of Plate 3) apparently has 50,000 cubic yards of suitable material.

3. Weathered Silurian sediments, tuffs and porphyries, to the east of the Murrumbidgee Fault (Plate 2) may be suitable, but the surface layer of weathered rock is generally thin.

4. Silt deposits occur in the flats of the Murrumbidgee, Gudgenby and Naas Rivers, and of Woolshed (Spring Station) Creek (McKenzie, 1966). McKenzie describes a large deposit on the Murrumbidgee River at Tharwa, and other deposits on Woolshed Creek, west of the Naas Road. The material has not been studied but it is unlikely that it will prove suitable as the silt generally lacks cohesion.

(1) and (2) may be the best sources of core material but larger quantities are required.

CATCHMENT AREA

The catchment area is shown on Plate 1. It is 256 square miles in area and is mostly underlain by granites; there are also some Ordovician sediments. Most of the area is timbered; there is some grazing land, but no townships.

Stream water, even at periods of low flow, has a low content of dissolved salts (30 to 130 parts per million, depending on flow).

RESERVOIR AREA

The reservoir area is shown on Plate 2. The rock is granite (Tharwa Adamellite and Clear Range Granodiorite).

The storage capacity is approximately 21,000 million gallons at RL 2150.

The reservoir area has been investigated in reconnaissance. Shortest leakage path is about 2 miles except near the damsite and no significant leakage is expected from the reservoir.

Reservoir bank should be stable.

CONCLUSIONS

It is feasible to build an earth-and-rockfill dam of height about 220 feet at the site. Investigations to date are inadequate to indicate fully the extent of stripping needed for the dam foundations and the spilling chute. An assessment has been made, only for preliminary estimating and planning purposes, of the likely excavation requirements along the proposed dam axis. Faulting and deep weathering in parts of a zone less than 400 feet made in the east bank may require extensive treatment to provide sound foundations. It is considered that in all other respects the site is suitable for a fill dam and associated works - spillway, diversion and outlet works.

Not all construction materials required are known to be obtainable at reasonable cost, but further investigations should reveal adequate resources.

The reservoir area is satisfactory.

RECOMMENDATIONS

Should further investigation be required for more detailed feasibility, costing, or design purposes the following investigations are recommended.

1. Detailed geological mapping high on the east bank may help clarify the nature of faulting in that area. A limited amount of geological mapping will be required elsewhere at a later stage.

2. Diamond drilling is recommended to determine:

(a) The extent and depth of unsound rock in the dam foundation area. The higher east bank should be drilled at the first opportunity; other sites for drilling should be revealed by investigations (1) or (3)

(b) Suitable locations, and the conditions therein, of diversion and outlet works.

(c) Spillway conditions

(d) Suitable quarry site.

3. Extensive stripping and trenching of dam foundations and spillway is required.

4. Further investigation of construction materials is required. Additional general investigation of the area is recommended, followed by detailed investigation of specific sites of all construction materials.

REFERENCES

CARTER, E.K., & BUCHHORN, D.A., 1968 - "Geology of Tennent damsite, Gudgenby River, A.C.T." Bur. Miner. Resour. Aust. (Unpubl. rep.).

CLEARY, J.R., 1968 - "The seismicity of the Gunning and surrounding areas, 1958-1961." Jour. Geol. Soc. Aust. vol. 14. Pt. 1.

COMMONWEALTH DEPARTMENT OF WORKS, 1967 - "Major water storage sites; auger drilling investigations." C.D.W. Report (Unpubl.).

JEPHCOTT, S., 1966 - "Geology south of Tharwa, A.C.T.". Aust. Nat. Univ. Report (Unpubl.).

MACKENZIE, D.E., 1966 - "Geology of the Tharwa area". Aust. Nat. Univ. Report (Unpubl.).

PRICE, N.J., 1959 - "Mechanics of jointing in rocks". Geol. Mag. vol. 96

SNELLING, N.J., 1960 - "The geology and petrology of the Murrumbidgee Batholith." Q. Jour. Geol. Soc. London vol. 116

APPENDIX 1

DEFINITIONS OF TERMS

TABLES

Degrees of Weathering.

Fresh	Rock shows no discolouration, loss of strength, or any other effect of weathering.
Slightly weathered	Rock is slightly discoloured, but not noticeably lower in strength than the fresh rock.
Moderately weathered	Rock is discoloured and noticeably weakened, but a 2-inch diameter drill core cannot usually be broken by hand across the rock fabric.
Highly weathered	Rock is usually discoloured and weakened to such an extent that 2-inch diameter cores can be broken up readily by hand, across the rock fabric. Wet strength usually much lower than dry strength.
Completely weathered	Rock is discoloured and entirely changed to a soil, but the original fabric of the rock is mostly preserved. The properties of the soil depend on the composition and structure of the parent rock.

Particle Sizes.

Name	Size range, millimeters.
Clay	< 1/256
Silt	1/256 - 1/16
Sand	1/16 - 2
Granule	2 - 4
Pebble	4 - 64
Cobble	64 - 256
Boulder	> 256

Boulder sizes used in this report:

small boulders; size in the order of 2 x 1 x 1 feet.
boulders; size in the order of 5 x 5 x 3 feet.
large boulders; size in the order of 15x10 x 5 feet.

Joints

These terms are also applicable to other planar structures, such as veins.

Joint sizes.

Small joints = size $<$1 x 1 feet
Moderate-sized joints = size 1 x 1 to 6 x 6 feet
Large joints = size $>$ 6 x 6 feet

Joint spacings.

Closely-spaced joints = spacing $<$ 1 foot.
Moderately-spaced joints = spacing 1 - 6 feet
Widely-spaced joints = spacing $>$ 6 feet

Joint angles.

Low-angle joints: joints at angle $< 60^{\circ}$ to the horizontal, or in drillcore, at angle $< 60^{\circ}$ to the plane perpendicular to the core axis.

High-angle joints: joints at angle $\geqslant 60^{\circ}$ to the horizontal, or in drill core, at angle $\geqslant 60^{\circ}$ to the plane perpendicular to the core axis.

APPENDIX 2.

REPRESENTATION OF STRUCTURES ON PLATES 3,5,6,7,8,9

On the plans joints are represented by a line with a dip symbol. If the dip is unknown no dip symbol is given. Many unmeasured high-angle joints are shown as vertical joints. Only a proportion of high-angle joints are represented, but most low-angle joints exposed in the area mapped are represented. Joints are usually generalised so that curves, breaks or overlaps are shown as a continuous straight line. Closely-spaced joints (types 2,3,4,5) are shown by two joint symbols close together.

On the stereogram (Plate 5) the same joints are represented. The contours represent areal point densities (the points being the projections of the poles to the joint planes.)

Any sets of closely-spaced joints are weighted by plotting three points for each measurement.

Some of the joints which are not evident in the contours but are regarded as important are plotted as individual points. These are set 5 joints. All the other structures measured are plotted as individual points.

APPENDIX 3

SAMPLE DESCRIPTIONS

The samples described are from the immediate vicinity of the Tennent damsite. Some other samples collected are not described here, but their locations are marked on the plates.

All samples belong to the Tharwa Adamellite which is Siluro-Devonian in age.

Sample no DG1/74 was described by C.E. May, the rest by D.A. Buchhorn.

FIELD NO: 435 FIELD NAME: Adamellite REG. NO: 67360014

LOCALITY: Riverbed COORDINATES: E18590/S85480

FIELD OCCURRENCE: Dominant rock-type

HANDSPECIMEN DESCRIPTION: Light grey on fracture and waterwashed surface; coarse-grained and foliated; feldspar, quartz and biotite (latter probably altered by weathering) distinguishable; hard but slightly weathered; fracture controlled to a small extent by foliation.

THIN SECTION DESCRIPTION: Quartz and feldspar are about equal in proportions and make up the bulk of the rock.

Quartz occurs in broad bands of large crystals, also as very small grains bordering the large ones (granulated and recrystallised); shows undulose extinction.

Potash and feldspar occurs as large crystals, some showing microcline twinning, some showing perthitic albite; some granulated.

Plagioclase feldspar (albite) occurs and is zoned and twinned in some crystals; optic sign indicates that many grains which look like potash feldspar are, in fact, albite. Probably albite predominates over potash feldspar; albite is probably formed by diagenetic alteration of plagioclase.

Bounding some crystals are vein-like areas of chlorite, sericite, and epidote crystals, probably formed by diagenesis of biotite concurrent with albitisation. There is no biotite as such but some small crystals of muscovite, probably primary, occur.

Feldspars are clouded and sericitised.

FORMAL NAME & GENESIS: Metamorphically foliated adamellite. Regional metamorphism with strong dynamic component and moderate heat component.

FIELD NO: DG1/74 FIELD NAME: "Pink" Adamellite REG. NO: 68360035

LOCALITY: Drill hole DC 1. Sample depth 74 feet. COORDINATES: E19272/S85375

FIELD OCCURRENCE: Predominant rock high up on east bank.

HAND SPECIMEN DESCRIPTION: Fine grained, sheared, porphyritic, pink rock, containing phenocrysts of quartz in a fine-grained groundmass. Many quartz veins and sheared iron-stained bands transect the rock.

THIN SECTION DESCRIPTION: Phenocrysts of plagioclase (An10-An20) and microcline occur with large grains of polycrystalline and sheared quartz. Most grains show the effect of shearing and metamorphism; they are generally elongate, with ragged boundaries, and some grains have a vague strain shadow. Plagioclase grains are altered to sericite (now recrystallised to muscovite) and epidote, and are peppered with tiny grains of an opaque mineral. The microcline grains also contain iron oxide but are generally less altered than the plagioclase. Strain lamellae, recrystallization, and boundary solution present in the quartz grains all reflect the stress to which the rock has been subjected.

The groundmass (60%) is composed of small, inequant grains of quartz, plagioclase, microcline, and opaque minerals, with interstitial grains of muscovite paralleling the foliation. Clots of epidote and chlorite generally have a random orientation. Epidote occurs as an alteration product throughout the rock.

Percentage of each mineral present in the rock: Quartz 50%, plagioclase 20-25%, microcline 10-15%, muscovite 5%, epidote 5-8%, chlorite 2-3%, and opaque minerals 1-2%.

FORMAL NAME and GENESIS: Sheared quartz adamellite. An acid intrusive rock which has undergone dynamic metamorphism. The pink colouring of the rock is probably due to the exsolved iron oxide of the plagioclase and microcline grains.

FIELD NO: 11 FIELD NAME; Adamellite

LOCALITY: Saddle near Naas Road COORDINATES: E18040/S85310

FIELD OCCURRENCE: Predominant rock-type. This specimen is from a loose boulder, believed to be approximately in situ.

HANDSPECIMEN DESCRIPTION: Typical adamellite, like sample 435. Specimen has a vein of green material, probably quartz and a little epidote, surrounded by an apparent contact zone of light-coloured adamellite. Numerous small specks of pyrite occur, especially in the vein.

FORMAL NAME & GENESIS: Adamellite (see 435) The vein is an igneous intrusion which has introduced the pyrite into the country rock.

FIELD NO: 453 FIELD NAME: Aplite REG. NO: 67360012

LOCALITY: Riverbed COORDINATES E18650/S85340

FIELD OCCURRENCE: Dyke.

HANDSPECIMEN DESCRIPTION: Yellowish colour on waterwashed surface. Lighter-coloured on fresh fracture but discoloured by weathering. Medium-grained, foliation indistinct.

THIN SECTION DESCRIPTION: Rock consists of quartz (fractured, shows undulose extinction) potash feldspar (cleavages opened; clouded by alteration) and plagioclase. The minerals are in medium-sized grains separated by granules of the same crystals in bands which constitute the foliation. Muscovite is present in sparse continuous bands or moderate-sized crystals and as fine crystals in lenses. The muscovite appears to be primary; the fine crystals are granulated larger crystals. Chlorite pseudomorphs biotite.

FORMAL NAME & GENESIS: Adamellite aplite. An intrusion, affected by metamorphism.

FIELD NO: 452 FIELD NAME: Pegmatite REG NO: 67360011

LOCALITY: Riverbed COORDINATES E18640/S85370

FIELD OCCURRENCE: Vein

HANDSPECIMEN DESCRIPTION: Large crystals of quartz and feldspar occur. The rock fractures very easily along cleavages in feldspar and fractures in quartz. Grey and white in colour.

THIN SECTION DESCRIPTION: There are very large crystals, bordered by granulated areas of the same minerals. Quartz shows undulose extinction and deformation lamellae. Feldspar is perthitic potash feldspar.

FORMAL NAME & GENESIS: Granite pegmatite; intrusion of liquid rich in volatiles which has since undergone regional metamorphism.

FIELD NO: 409 FIELD NAME: Chlorite

LOCALITY: Riverbed COORDINATES: E18580/S85600

FIELD OCCURRENCE: Usually occurs as small isolated patches, in small quartz veins. In this case occurs as a vein, one inch thick and 12 feet long as exposed.

HANDSPECIMEN DESCRIPTION. Green chlorite with quartz.

FORMAL NAME & GENESIS: Fine chlorite aggregate produced by alteration (retrograde metamorphism or diagenesis?) of some other material, **perhaps** biotite.

FIELD NO: R4 FIELD NAME: Mylonite REG. NO: 67360018

LOCALITY: Riverbed COORDINATES: E18630/S85530

FIELD OCCURRENCE: Thin irregular veins through adamellite, marking fault of small displacement.

HANDSPECIMEN DESCRIPTION: Grey, fine-grained, shows streaks of different shades parallel to length of vein. Does not split along the layering.

THIN SECTION DESCRIPTION: Patches of quartz and quartz-aggregates, generally lenticular in shape, occur in a very fine matrix consisting mainly of epidote. Quartz and occasional chlorite occur in fairly large crystals. Pyrite cubes are present.

FORMAL NAME & GENESIS: Mylonite formed by crushing of rock (probably by faulting); subsequently recrystallized.

FIELD NO: 5 FIELD NAME: Layered mylonite or "sheared rock".

LOCALITY: East bank, downstream reach. COORDINATES: E19510/S84760

FIELD OCCURRENCE: Thin seam.

HANDSPECIMEN DESCRIPTION: Fine-grained, with a phyllitic foliation along which the rock breaks very easily. Greenish-grey, lustrous and soft.

FORMAL NAME & GENESIS: Mylonite produced by deformation of adamellite, and probably affected also by weathering. Like the exposure at E19410/S85950, it probably marks a minor fault.

APPENDIX 4

INTERPRETATION OF AUGER HOLE LOGS

Holes were drilled to refusal by a Gemco mechanical auger. An attempt is made to interpret the logs (Commonwealth Dept of Works, 1967), in terms of degrees of weathering, on the following basis=

Fresh and slightly weathered rock - auger does not penetrate.
Moderately weathered rock - auger penetrates under weight of motor and trailer.
Highly and completely weathered rock - auger penetrates under weight of motor.

Traverse, chainage and offset (in feet)	Depth (in feet)	Interpretation
CD30 (25 right)	0 - 3½	completely weathered
	3½- 7	highly and moderately weathered
	7(end of hole)	slightly weathered
CD30 (21 right)	0 - 3½	completely weathered
	3½-16	highly and moderately weathered
	16 (end of hole)	slightly weathered
CD200	0- 17	moderately weathered
	17 -47	highly weathered
	47 -48	moderately weathered
	48 (end of hole)	slightly weathered
CD350 (50 left)	0 -15	highly weathered
	15 -30	moderately weathered
	30 (end of hole)	slightly weathered
AB360	0 - 3	completely weathered
	3 -19	moderately weathered
	19 (end of hole)	slightly weathered.

APPENDIX 5

CALCULATION OF JOINT PERMEABILITIES

Test sections were about 20 feet in length (as indicated in the drill logs). Tests were of 5 minutes duration and were repeated once or twice; repetitions rarely showed any variation in flow. Gauge pressures of up to 200 psi were reached and leakage rates of up to 0.68 gallons per minute per foot of test section (gpm/ft were obtained. Water was supplied direct from a Mindrill 1200 reciprocating pump, and mechanical packers of length 20 inches (two rubbers) were used.

The following procedure was used to calculate joint permeabilities; the symbols are defined at the end of the appendix.

1. The test section, time of test, gauge pressure (d) and water meter readings were taken from SMA form No. 12/2 completed by the driller).

2. The linear leakage rate equivalent to 20 feet of NX hole, t, was calculated by the formulae :

$$t = K \frac{h}{i}$$

The value of K was read off a graph which is a plot of the relation

$$K = \frac{1 + 0.825 \log 10 \frac{i}{Ro}}{1 + 0.825 \log 10 \frac{20}{1.49}}$$

3. The linear leakage rate t was plotted against gauge pressure recorded on the drill logs.

4. The average water column pressure for the test section was calculated by one of the following three formulae :

1. $l > b$ $\quad P = 0.44 \text{ Sin } \Theta \left(\frac{a}{2} + \frac{b}{2} + m \right)$
2. $b > l > a$ $\quad P = 0.44 \text{ Sin } \Theta \left(\frac{2lb - a^2 - l^2}{2\ (b-a)} + m \right)$
3. $a > l$ $\quad P = 0.44 \text{ Sin } \Theta \ (l + m)$

Formula 3 can be used when the depth to standing water (l) is negative, i.e. when the hole is making water and the water would rise above the collar if a pipe were screwed into the collar. This occurred with DG3 but the (negative) value of l was not measured. For this hole a value of l=o was used for calculation purposes.

5. The friction loss in the supply line (q) was calculated. A length of supply line a + m was assumed, but as the pressure gauge was not in any case directly over the hole, a somewhat longer supply line was usual. No records were made of the true length of the supply line.

Friction loss per 100 feet was obtained from an empirical graph prepared by E.J. Best for N-rods with streamflow couplings.

Friction loss $q=\frac{n}{100}$ (friction loss per 100 feet).

6. The friction loss in the packer (r) was read from an empirical graph prepared for 4-rubber mechanical packers by E.J. Best.

7. Effective test pressure

$$s = d + p - q - r$$

8. Joint permeability *

$$u = \frac{t}{S} 31200$$

For each test section several values of joint permeability were obtained. The mean of these values was usually taken as the joint permeability for that section, except that divergent values were eliminated.

The following symbols were used:

Symbol	Meaning	Unit of measurement
a	Slope depth from collar of hole to top of test section	feet
b	slope depth from collar of hole to bottom of test section	feet
d	gauge pressure, in pounds per square inch	p s i
h	leakage rate, in imperial gallons per minute	g p m
i	length of test section = b-a	feet
k	conversion factor equivalent to 20 feet of NX hole	no units
l	slope depth from collar of hole to water table	feet
m	slope height of gauge above collar of hole	feet
n	length of supply line	feet
p	water-column pressure, average for test section	p s i
q	friction loss in supply line	p s i
r	friction loss in packer	p s i
s	effective test pressure	p s i
t	linear leakage rate for equivalent 20 foot test section, NX hole	gpm/foot
Ro	radius of drillhole	inches
θ	inclination of drillhole from horizontal	degrees
U	joint permeability	feet/year

---

* This permeability, though expressed in feet/year, is not comparable with intergranular permeability expressed in the same terms; nor, owing to the heterogeneity of openings, are the figures necessarily truly indicative of the general permeability of the rock mass about the test section. The figures obtained provide a useful guide only, particularly for comparative purposes.

JOINT PERMEABILITIES

The maximum joint permeability calculated was 100 feet/year. The average value was 15 feet/year.

The lefthand column gives the test section (feet) and the righthand column the joint permeability (feet/year).

DG1

Standing water level 212'5 on 29-3-68 and below end of hole on 12-6-68

1 = 212' 5 m= 0

Section of hole tested	Permeability (U) in feet/year
23' 1" - 43' 1"	0
40' 8" - 60' 8"	10
58' 9" - 78' 9"	0
75' 9" - 95' 9"	0
95' 9" - 148' 1"	not tested
148' 1" - 168' 1"	70
168' 6" - 188' 6"	10
189' 2" - 209' 2"	100
209' - 224' 5"	20

DG2

Standing water level 31'6 on 13-3-68 and 25' on 12-6-68

1 = 31'6 m = 0

Section of hole tested	Permeability (U) in feet/year
20' 5" - 40' 5"	0
40' 4" - 60' 4"	10
59' 5" - 79' 5"	0
79' 2" -100' 2"	10
100' 4" -110' 4"	0

DG3

Standing water level above collar of hole on 25-1-68

1 = 0 m = 0

Section of hole tested	Permeability (U) in feet/year
18' 4" - 38' 4"	0
30' 3" - 50 '3"	0

APPENDIX 6.

GEOLOGICAL LOGS OF DIAMOND DRILL HOLES.

BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

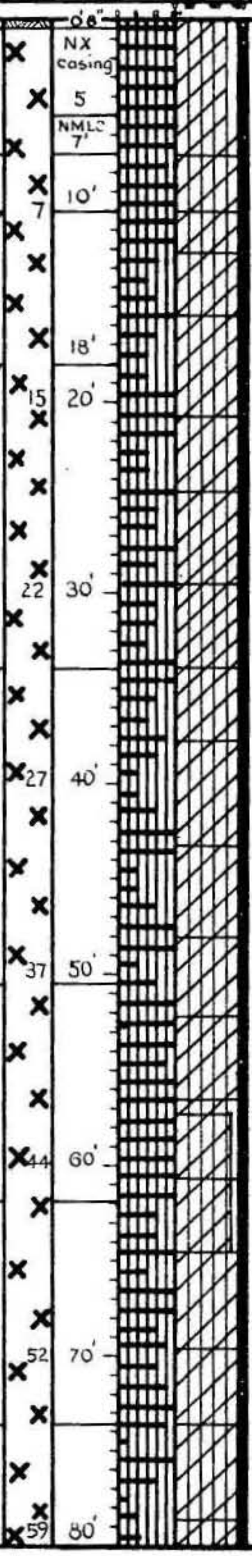
PROJECT TENNENT DAMSITE, GUDGENBY RIVER A.C.T.
LOCATION RIGHT BANK, ON PROPOSED DAM AXIS - 76 FT. ON BEARING 345° MAG FROM S.L.CH. 580 OF SEISMIC TRAVERSE EF
ANGLE FROM HORIZONTAL 70° DIRECTION 265° MAG
COORDINATES E 19272 / S 85375 R.L. 2152

HOLE NO **DG1**

SHEET 1 OF 3

ROCK TYPE & STATE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC
SOIL	
HIGHLY WEATHERED PINK ADAMELLITE	Pink
MODERATELY WEATHERED PINK ADAMELLITE	Pink Highly weathered 6" Fine grained layered zone (mylonite). 4" thick with quartz vein ¼" thick Fine grained layered zone (mylonite) 4" thick - small quartz veinlets up to ⅛" across filling fractures
HIGHLY WEATHERED PINK ADAMELLITE	Pink
MODERATE TO HIGHLY WEATHERED PINK ADAMELLITE	Pink
SLIGHT TO MODERATELY WEATHERED PINK ADAMELLITE	Pink

GRAPHIC LOG & DEPTH | DEPTH & SIZE OF CORE | FRACTURE LOG | LIFT & % CORE RECOVERY | CASING



10" core loss

Sample 74'-75'

STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES

Large proportion of fractures are true joints except in small closely fractured zones where fractures are due to weathering. Joints are at all angles. Many are clay filled - white clay ~ 0.02 inches thick. A few seams occur and are high angle ~ 0.10 inches thick. Solid lengths of core contain recemented joints numbering as many as 12 per foot in places.

Majority of fractures are joints. There

WATER LEVEL | WATER PRESSURE TEST Loss in gallons per minute per foot

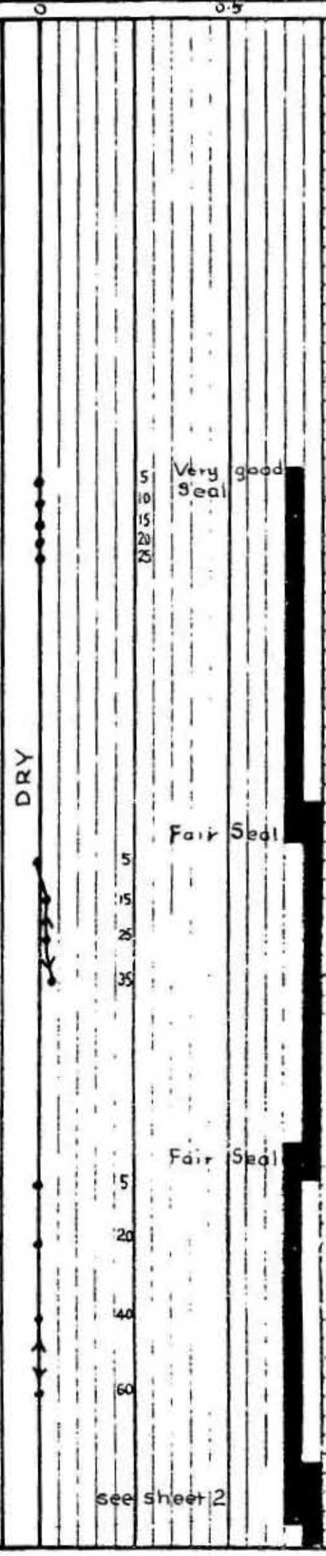


PHOTO REF. | CORE BARREL

NO PHOTO
M/702/12
M/702/14
M/702/16
M/702/17
M/716/2
M/702/18
M/702/19
M/702/20
M/702/21
M/702/22
M/702/23
M/716/5
M/702/24
M/702/25
M/702/26
M/702/27
M/702/28
M/716/6
M/702/29
M/702/30
M/702/31
M/716/8

DRILL TYPE BOYLES BBS2
FEED HYDRAULIC
CORE BARREL TYPE N.M.L.C.
SPLIT INNER TUBE
DRILLER M.R. PARCELL
COMMENCED 28·1·68
COMPLETED 10·2·68
LOGGED BY I.D. LOITERTON
VERTICAL SCALE 1 INCH : 10 FEET

NOTES

FRACTURE LOG - Number of fractures per foot of core. Zones of core loss are blocked in.
BEDDING AND JOINT PLANES - Angles are measured relative to a plane normal to the core axis

Foliation direction 155/90 assumed for calculation of joint directions. Most core loss is due to washing of the lighter fractions from highly weathered rock or rock ground up by the drill.
Degrees of weathering defined in text.

▨ Soil ✕✕ Pink Adamellite ✚ Grey Adamellite / Aplite vein
▨ Aplite (fine grained) ▨ Aplite (coarser grained)

continued on sheet 2.

WATER PRESSURE TESTS
PACKER TYPE MECHANICAL
SUPPLY LINE N-ROD, STREAM FLOW COUPLINGS
VERTICAL SCALE 50 PSI/IN
Figures given are gauge pressures
Test sections are indicated graphically by blocked in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE B.M.R. FILM NO. & FRAME NO.
COLOUR

I55/A16/482-1 M(Pf)99

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT TENNENT DAMSITE, GUDGENBY RIVER A.C.T.
LOCATION RIGHT BANK, 0°, PROPOSED DAM AXIS - 78 FT. ON BEARING 345° MAG FROM SL.H 580 OF SEISMIC TRAVERSE EF
ANGLE FROM HORIZONTAL 70°
DIRECTION 265° MAG
COORDINATES E 19272 / S 85375
R.L. 2152

HOLE NO **DG1**

SHEET 2 OF 3

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC	GRAPHIC LOG & depth	DEPTH & SIZE OF CORE
SLIGHT TO MODERATELY WEATHERED PINK ADAMELLITE	Pink		
HIGHLY WEATHERED PINK ADAMELLITE		66	90'9"
	High clay content Yellow brown colour - boundry not distinct		93'0"
HIGHLY WEATHERED ADAMELLITE			95'0"
HIGHLY WEATHERED ADAMELLITE	Brown	74	100'0"
	Moderately weathered 9"		
			108'0"
	Moderately weathered 6"	81	110'0"
	Moderately weathered 2'6"		112'6"
	2" aplite vein - low angle		
SLIGHTLY TO MODERATELY WEATHERED ADAMELLITE	4" aplite vein - low angle		116'6"
	- Pinkish - Grey	89	120'0"
MODERATELY WEATHERED ADAMELLITE	Grey		121'6"
	High white clay content		125'0"
HIGHLY WEATHERED ADAMELLITE	Reddish Brown		129'6"
HIGHLY TO COMPLETELY WEATHERED ADAMELLITE	Highly weathered adamellite with high content of green clay 129'6" to 130'3"	96	130'
		103	140'
MODERATELY TO HIGHLY WEATHERED ADAMELLITE			142'6"
	Pink		144'
SLIGHTLY TO MODERATELY WEATHERED ADAMELLITE	Brownish Pink	110	150'
		118	160'

STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES

87' reaming bit would not penetrate
88' - high angle joint - ¼" seam white clay

Very thin high angle clay seams
10" core loss at 95'9".

Rock washed - leaving sand

118'-120' - low angle joints sp. 6"
Measurements at 18'6":
170/25E
135/50W
130/85NE
140/15NE
160/35E
120' - 122' - Joint parallel to core - filled with clay ~0·02" thick
125', 10 ft. of caving
127'3 reaming bit jammed, had to be jarred.

-142'6" about 3 ft. of caving.
145', about 6 ft of caving.

... are some closely fractured zones not related to jointing. Joints are mostly clay filled ~0·02" Joints are all angles but most commonly low angle. Recemented fractures - as many as 12 per foot.

Mainly low angle joints - some high angle. Most fractures are joints except in places where core losses have occured - here the fractures are drilling fractures.

WATER LEVEL: DRY

WATER PRESSURE TESTS
0 0·5
5
25
55
75
Not tested - impossible to Seal packers
Not Tested because of caving
30
70
110
130

PHOTOGRAPHS NO
M/702/31
M/702/33
M/702/34
M/702/35
M/702/36
M/702/37
M/716/8
M/716/10
M/716/12
M/716/14

DRILL TYPE BOYLES BBS2
FEED HYDRAULIC
BARREL TYPE N M L C
SPLIT INNER TUBE
DRILLER M.R. PARCELL
COMMENCED 28-1-68
COMPLETED 10-2-68
LOGGED BY I.D. LOITERTON
VERTICAL SCALE 1 INCH : 10 FEET

NOTES

FRACTURE LOG Number of fractures per foot of core. Zones of core loss are blocked in
BEDDING AND JOINT PLANES - Angles are measured relative to a plane normal to the core axis

see sheet 1.
Water Returns

0	- 119'6"	100%
119'6"	- 122'6"	90%
122'6"	- 160'6"	100%
160'6"	- 191'6"	75%
191'6"	- 224'5"	60%

WATER PRESSURE TESTS
PACKER TYPE MECHANICAL
SUPPLY LINE N-ROD, STREAM FLOW COUPLINGS
VERTICAL SCALE 50 PSI/IN
Figures given are gauge pressures
Test sections are indicated graphically by blocked in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE B.M.R. FILM NO. & FRAME NO.
COLOUR —

I55/A16/482-2 M(Pf)99

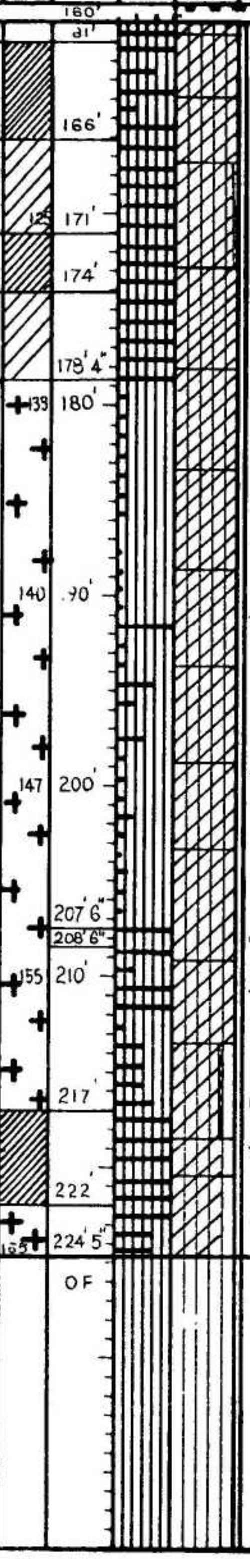
BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

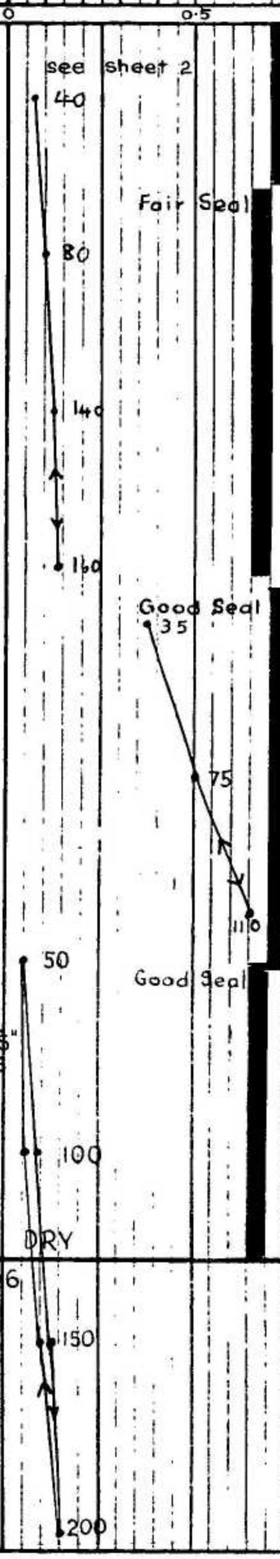
GEOLOGICAL LOG OF DRILL HOLE

PROJECT TENNENT DAMSITE, GUDGENBY RIVER A.C.T.
LOCATION RIGHT BANK, ON PROPOSED DAM AXIS, 76 FT. ON BEARING 345 MAG FROM SLCH. 580 OF SEISMIC TRAVERSE EF
ANGLE FROM HORIZONTAL 70° DIRECTION 265° MAG
COORDINATES E 19272 / S 85375 RL 2152

HOLE NO. **DG1**
SHEET 3 OF 3

ROCK TYPE & WEATHERING	DESCRIPTION: LITHOLOGY, COLOUR, STRENGTH, HARDNESS	DEPTH & SIZE OF CORE	STRUCTURES: JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES		WATER LEVEL
		160'			
SLIGHTLY TO MODERATELY WEATHERED ADAMELLITE		161'		See sheet 2	
	Pink-fine grained	166'			
APLITE FRESH TO MODERATELY WEATHERED	Pink-medium grained	171'	Sample 168' 1" - 168' 4"		
APLITE-FRESH TO SLIGHTLY WEATHERED	Pink-fine grained	174'		Most fractures are joints Joints mainly low angle -some are high angle. Clay seams appear only on the high angle joints. Weathering occurs along all joints Some re-cemented joints occur but are mainly in the aplite.	
	Pink-coarse grained	178' 4"			
SLIGHTLY WEATHERED ADAMELLITE	2½" wide shear zone containing clay	180'			DRY
	Mostly pink some sections blue grey - depending on the extent of iron staining	190'	½" clay seam at 183' 6" 1/10" clay seam at 190' 6" 2x¼" clay seams at 194' 6" ¼" clay seam at 197' 6"		
		200'			
		207' 6"			
HIGHLY WEATHERED ADAMELLITE	high clay content - pinkish brown	208' 6" 210'	closely-spaced low angle joints 208' 9" to 222' 5"	Joints mainly low angle. All fractures are joints except where noted. Numerous partly developed fractures in the aplite from 217-222 -probable cause of the core loss	
MODERATLEY WEATHERED ADAMELLITE	Pinkish grey	217'	16" core loss from 217' 0" to 218' 4" 60% core loss from 218' 4" to 220' 0" due to drilling fractures		212' 5" 29-3
APLITE-FRESH	White fine grained Gradational boundry	222'			WET
FRESH ADAMELLITE	Blue grey RL 1941	224' 5"	224' 5", 3' 6" of caving		HOLE DRY ON 12-6
	END OF HOLE				





PHOTOGRAPHS REF. NO.
M/716/14
M/716/17
NO
M/716/18

DRILL TYPE BOYLES BB.S2
HYDRAULIC
CORE BARREL TYPE N.M.L.C
SPLIT INNER TUBE
DRILLER M.R. PARCELL
COMMENCED 28·1·68
COMPLETED 10·2·68
LOGGED BY I.D. LOITERTON
VERTICAL SCALE 1 INCH : 10 FEET

NOTES

FRACTURE LOG - Number of fractures per foot of core. Zones of core loss are blacked in.
BEDDING AND JOINT PLANES - Angles are measured relative to a plane normal to the core axis

WATER PRESSURE TESTS
PACKER TYPE MECHANICAL
SUPPLY LINE N-ROD, STREAM FLOW
VERTICAL SCALE 50 PSI/IN COUPLINGS
Figures given are gauge pressures
Test sections are indicated graphically by blocked in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE B.M.R. FILM NO. & FRAME NO.
COLOUR

I55/A16/482-3 M(Pf)99

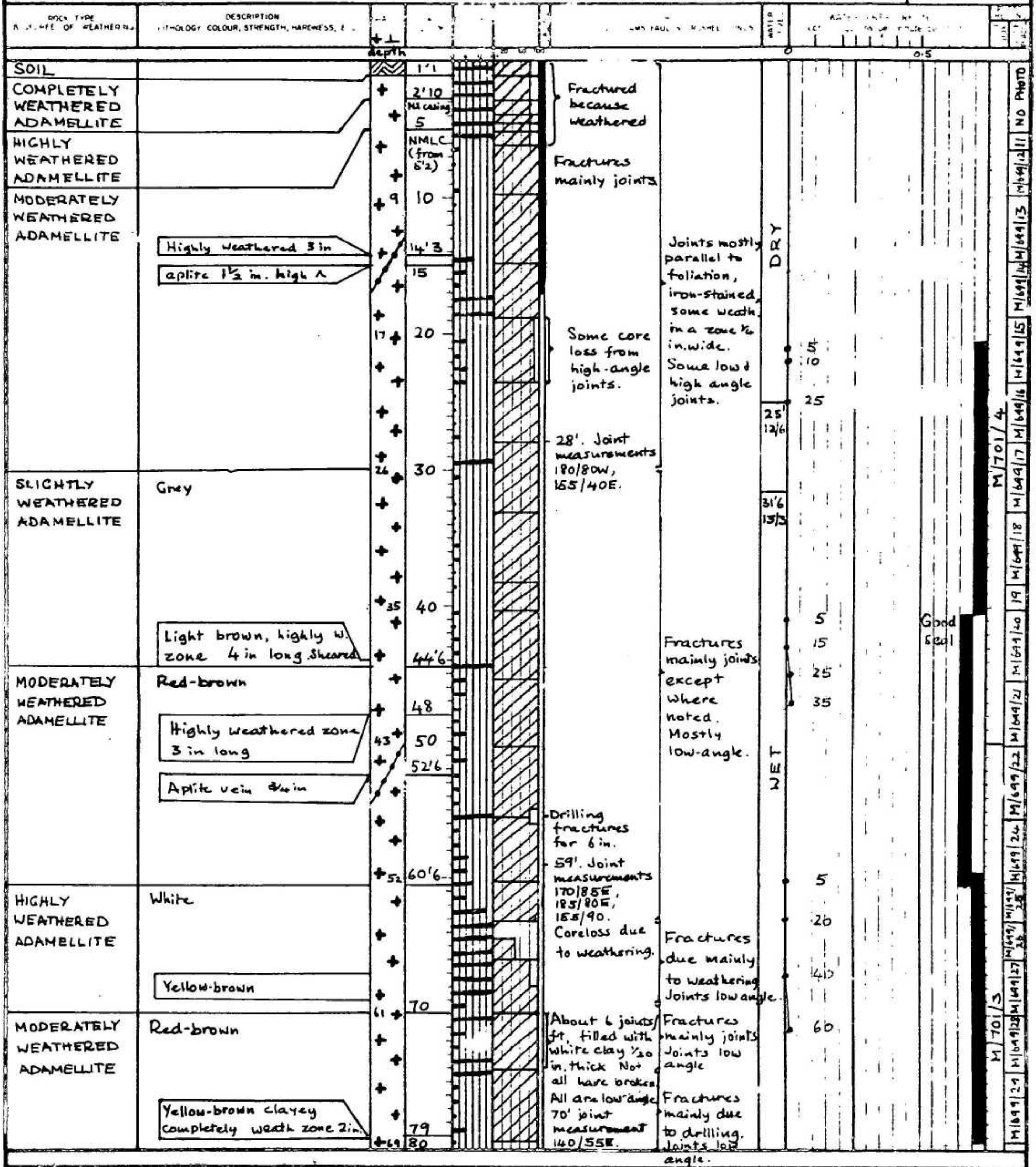
BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT TENNENT DAMSITE, GUDGENBY RIVER, ACT.
LOCATION SADDLE ON WEST SIDE OF RIVER, NEAR I.P OF SEISMIC TRAVERSES AB & CD.
ANGLE FROM HORIZONTAL 60°
DIRECTION 260° mag.
COORDINATES E17927 S85405 Stromlo Grid
R.L. 2140

HOLE NO. DG2

SHEET 1 OF 2



SOIL

COMPLETELY WEATHERED ADAMELLITE — Fractured because weathered

HIGHLY WEATHERED ADAMELLITE — Fractures mainly joints

MODERATELY WEATHERED ADAMELLITE

Highly weathered 3 in

aplite 1½ in. high ∠

Joints mostly parallel to foliation, iron-stained, some weath. in a zone ½ in. wide. Some low & high angle joints.

Some core loss from high-angle joints.

28'. Joint measurements 180/80W, 155/40E.

SLIGHTLY WEATHERED ADAMELLITE — Grey

Light brown, highly w. zone 4 in long Sheared

MODERATELY WEATHERED ADAMELLITE — Red-brown

Fractures mainly joints except where noted. Mostly low-angle.

Highly weathered zone 3 in long

Aplite vein ¾ in

Drilling fractures for 6 in.

59'. Joint measurements 170/85E, 185/80E, 155/90.

HIGHLY WEATHERED ADAMELLITE — White

Coreloss due to weathering.

Fractures due mainly to weathering. Joints low angle.

Yellow-brown

MODERATELY WEATHERED ADAMELLITE — Red-brown

About 6 joints/ft, filled with white clay 1/20 in. thick. Not all have broken. All are low angle. 70' joint measurement 140/55E.

Fractures mainly joints. Joints low angle. Fractures mainly due to drilling. Joints low angle.

Yellow-brown clayey completely weath. zone 2 in.

DRILL TYPE MINDRILL F55
FEED HYDRAULIC
CORE BARREL TYPE NMLC
SPLIT INNER TUBE
DRILLER P. GRECH
COMMENCED 13-1-68
COMPLETED 17-1-68
LOGGED BY D.A. BUCHHORN
VERTICAL SCALE 10 ft/in.

NOTES

FRACTURE LOG – Number of fractures per foot of core ... of core loss are ... used ...
BEDDING AND JOINT PLANES – Angles are measured relative to a plane normal to the core axis

Foliation fairly constant in direction throughout hole at angle of 60°. It is assumed to have strike 155°, dip 90°, for calculation of true dips.

Degrees of weathering are defined in text.

//\\\ SOIL + + + GREY ADAMELLITE ⁄ VEIN

Full water return 5'2 – 14'4, no water return to approx. 45', full water return to 110'4.

WATER PRESSURE TESTS
PACKER TYPE MECHANICAL
SUPPLY N-rod, streamflow couplings.
VERTICAL SCALE 50 psi/in.

PHOTOGRAPH REFERENCE ... BUREAU OF MINERAL RESOURCES FILM NO. & FRAME NO.

M(Pt)93

I55/A 6/482-4

BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

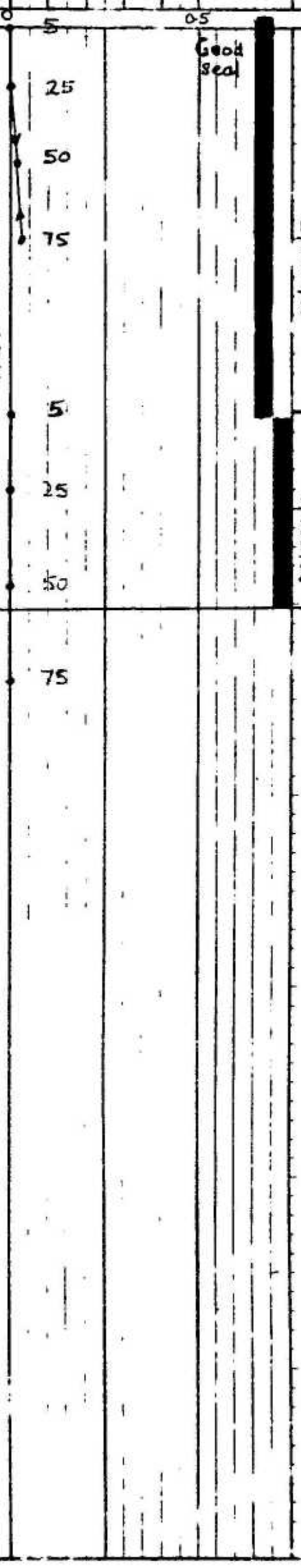
PROJECT TENNENT DAMSITE, GUDGENBY RIVER, ACT.
LOCATION SADDLE ON WEST SIDE OF RIVER,
NEAR I.P. OF SEISMIC TRAVERSES AB + CD
ANGLE FROM HORIZONTAL 60° DIRECTION 260° mag.
COORDINATES E 17927 S 85405 Stromlo grid. RL 2140

HOLE No. **DG2**

SHEET 2 OF 2

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION COLOUR, STRENGTH, HARDNESS	GRAPHIC LOG / % core	DEPTH	FRACTURES	
		69	80		
MODERATELY WEATHERED ADAMELLITE	Red-brown		81'6 82'5	Joints red-stained, weathered.	About half the fractures are due to breakage, the rest are joints. Joints are low or moderate angles, only one is high angle.
SLIGHTLY WEATHERED ADAMELLITE	Light brown, grey.	78	90 93		
FRESH ADAMELLITE	Blue-grey Irregular mass of pale green mylonite, approx 3x1 in. on one side of core only.	86	100	Some joints are slightly weathered and yellow-stained, others are quite clean. One high-angle joint has muscovite crystals	
	R.L. 2045	95	110'4		

WATER LEVEL: WET



SAMPLE NO.: M/699/30, M/699/31, M/699/32, M/699/33, M/699/34, M/699/35, M/701/3, M/701/1

END OF HOLE

DRILL TYPE MINDRILL F55
FEED HYDRAULIC
CORE BARREL TYPE NMLC
SPLIT INNER TUBE
DRILLER P. GRECH
COMMENCED 13-1-68
COMPLETED 17-1-68
LOGGED BY D.A. BUCHHORN
VERTICAL SCALE 10 ft/inch.

NOTES
FRACTURE LOG - Number of fractures per foot of core. Zones of core [illegible] are blocked in.
BEDDING AND JOINT PLANES - Angles are measured relative to [illegible] normal to the core axis.

See sheet 1.

WATER PRESSURE TESTS
PACKER TYPE MECHANICAL
PIPE N-rod, streamflow couplings.
HORIZONTAL SCALE 50 psi/in.
[illegible] pressures [illegible] graph [illegible] blocked [illegible]

PHOTOGRAPH REFERENCE SYSTEM
BUREAU OF MINERAL RESOURCES
FILM NO. + FRAME NO.

I 55/A16/482-5 M(Pf)99

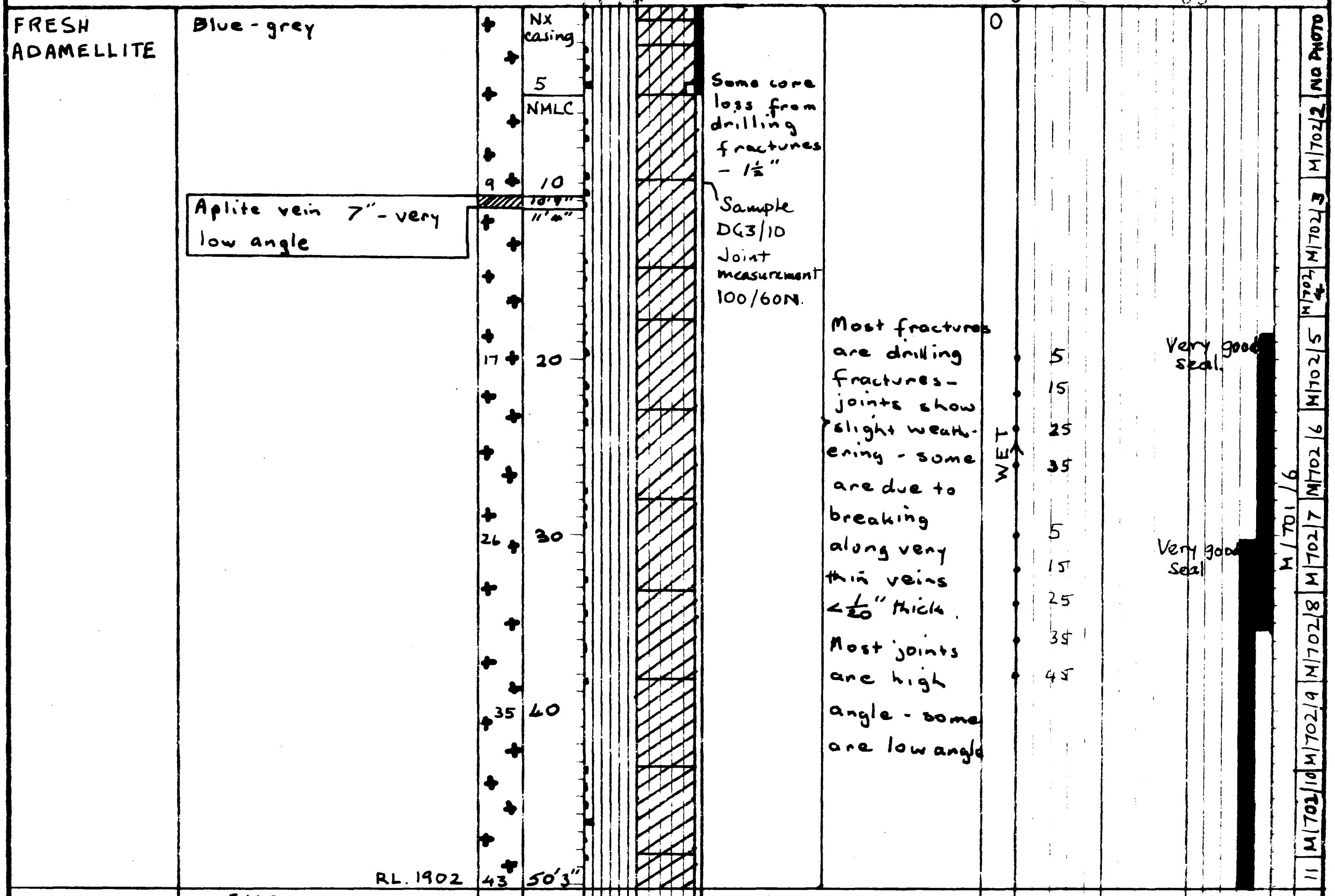
BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT TENNENT DAMSITE, GUDGENBY RIVER A.C.T.
LOCATION RIVERBED ON PROPOSED DAM AXIS
ANGLE FROM HORIZONTAL 60°
DIRECTION 255° mag.
COORDINATES E 18640 / S 85425 STROMLO GRID
RL 1945

HOLE NO **DG 3**
SHEET 1 OF 1

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC.	GRAPHIC LOG	DEPTH & SIZE OF CORE	FRACTURE LOG	LIFT & % CORE RECOVERY	CASING	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST LOSS IN GALLONS PER MINUTE PER FOOT	PHOTO REF.



FRESH ADAMELLITE

Blue-grey

Aplite vein 7" - very low angle

RL. 1902

Some core loss from drilling fractures - 1½"

Sample DG3/10

Joint measurement 100/60N.

Most fractures are drilling fractures - joints show slight weathering - some are due to breaking along very thin veins <1/20" thick. Most joints are high angle - some are low angle

Very good seal.

Very good seal

END OF HOLE

DRILL TYPE BOYLES BBS2
FEED HYDRAULIC
CORE BARREL TYPE NMLC
SPLIT INNER TUBE
DRILLER M. R. PARCELL
COMMENCED 15-1-68
COMPLETED 23-1-68
LOGGED BY I.D. LOITERTON
VERTICAL SCALE 10 FT/IN.

NOTES

FRACTURE LOG - Number of fractures per foot of core. Zones of core loss are blocked in.
BEDDING AND JOINT PLANES - Angles are measured relative to a plane normal to the core axis.

Degrees of weathering defined in text.
Full water return obtained in this hole.

✚ ✚ adamellite (grey)

▨ vein

WATER PRESSURE TESTS
PACKER TYPE MECHANICAL
COUPLINGS N-ROD, STREAMFLOW COUPLINGS
HORIZONTAL SCALE 50 PSI/IN.
Figures given are gauge pressures. Test sections are indicated graphically by blocked in strips.

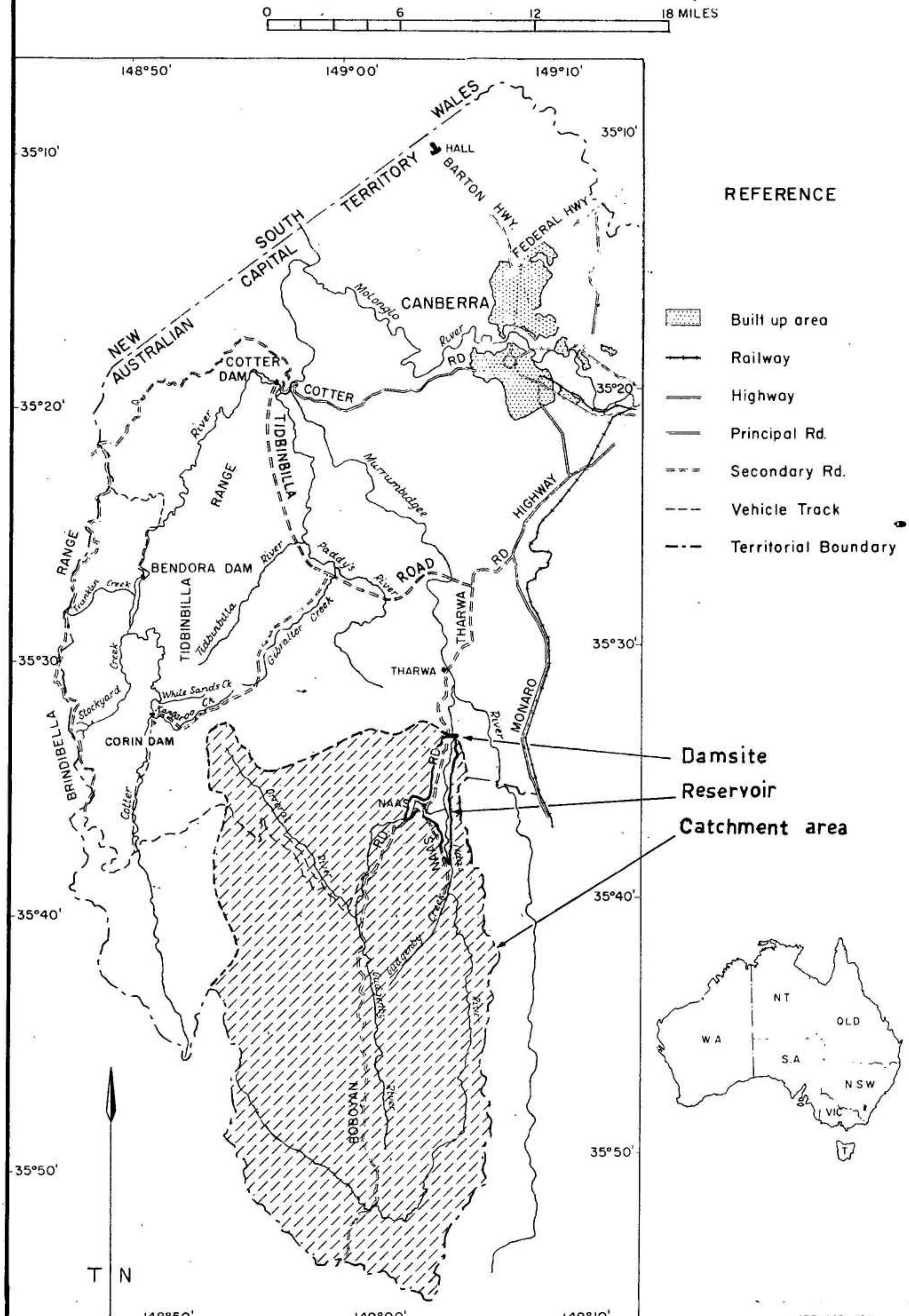
PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE BMR FILM NO. & FRAME NO.
COLOUR —

I55/A16/482-6 M(Pf)99

PLATE 1

TENNENT DAMSITE, GUDGENBY RIVER.

LOCALITY MAP

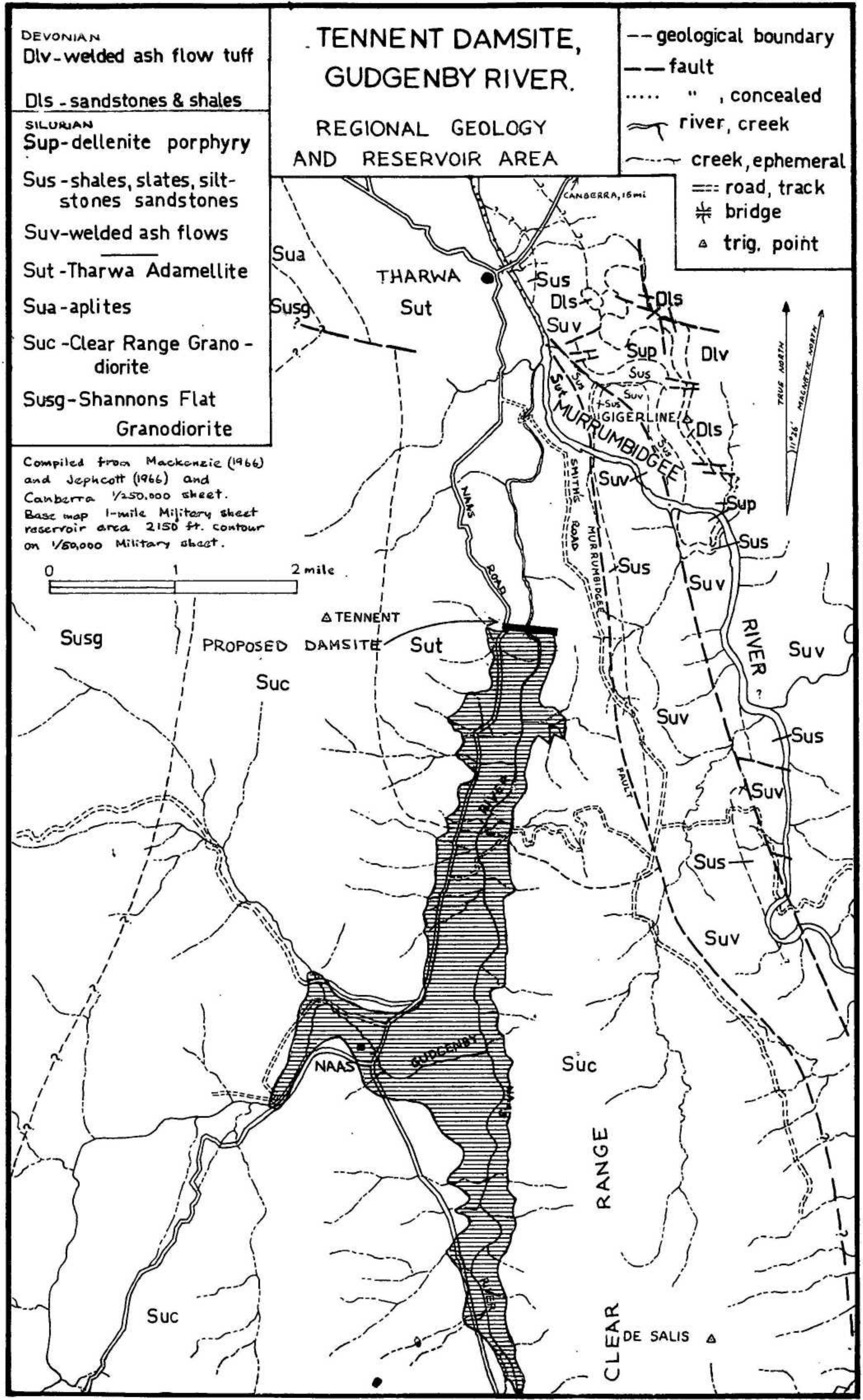


155 A16 162

Bureau of Mineral Resources, Geology and Geophysics March, 1964.

To accompany Record 1968/88

PLATE 2

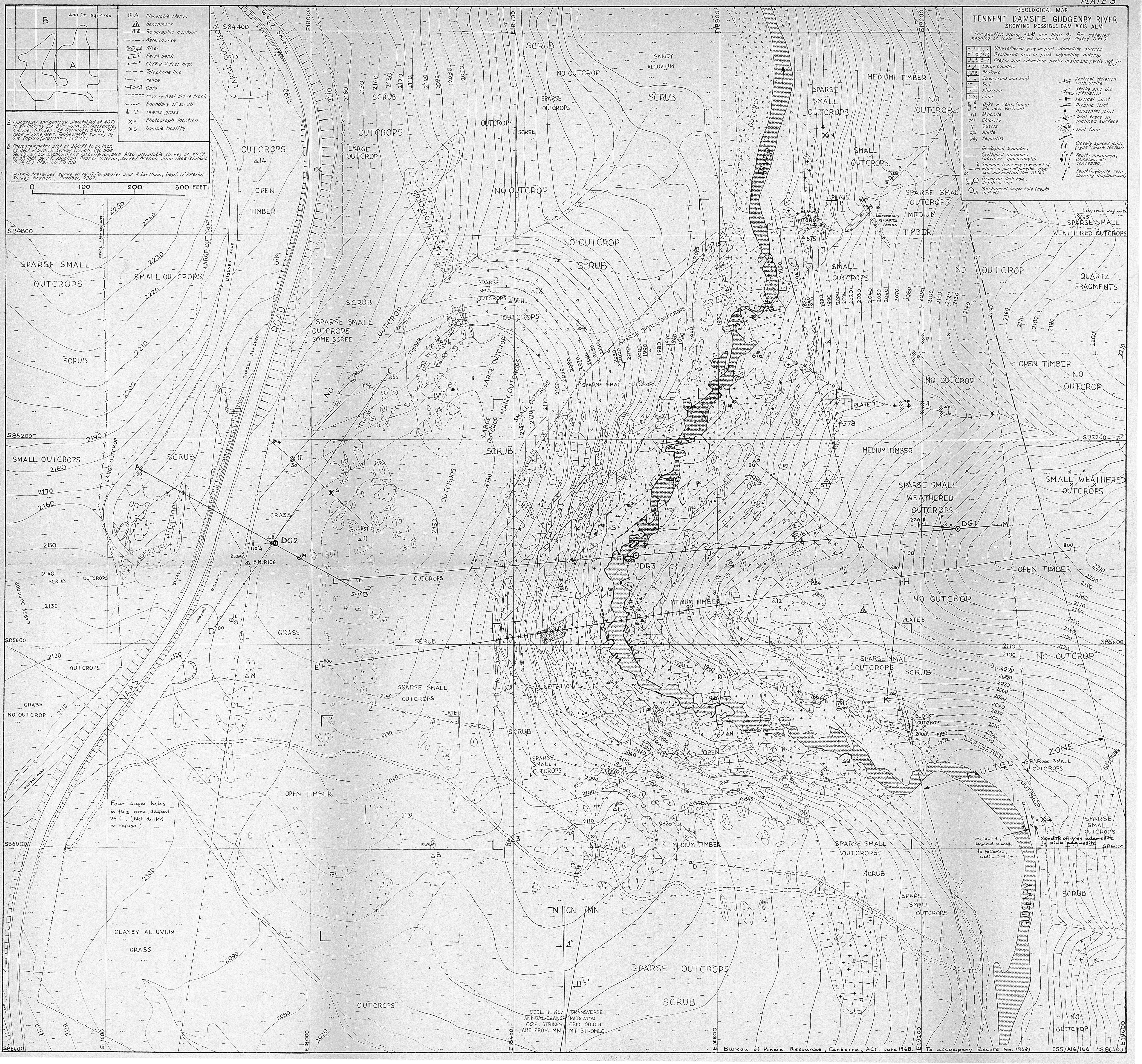


Bureau of Mineral Resources, Canberra. To accompany Record No. 1968/88 F55/A16/163

PLATE 3

GEOLOGICAL MAP
TENNENT DAMSITE GUDGENBY RIVER
SHOWING POSSIBLE DAM AXIS ALM

For section along ALM see Plate 4. For detailed mapping at scale 40 feet to an inch see Plates 6 to 9



A. Topography and geology planetabled at 40 ft to an inch by D.A. Buchhorn, D.E. Mackenzie, I. Raine, D.W. Lea, P.A. Delhunty, BMR, Dec. 1966 – June 1967. Tacheometer survey by G.W. English (stations 1-7, 9-12)

B. Photogrammetric plot at 200 ft. to an inch by Dept. of Interior Survey Branch, Dec 1966. Geology by D.A. Buchhorn and I.D. Loiterton, BMR. Also planetable survey at 40 ft. to an inch by J.R. Vaughan Dept of Interior, Survey Branch June 1965 (stations 13, 14, 15) Drawing RD 108

Seismic traverses surveyed by G. Carpenter and R. Leetham, Dept. of Interior Survey Branch, October, 1967.

Bureau of Mineral Resources, Canberra, ACT. June 1968. To accompany Record No. 1968/ I55/A16/166

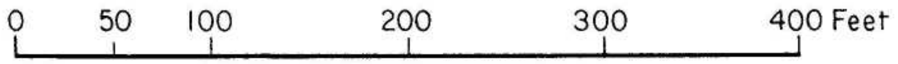
PLATE 4

TENNENT DAMSITE
GUDGENBY RIVER

SECTIONS

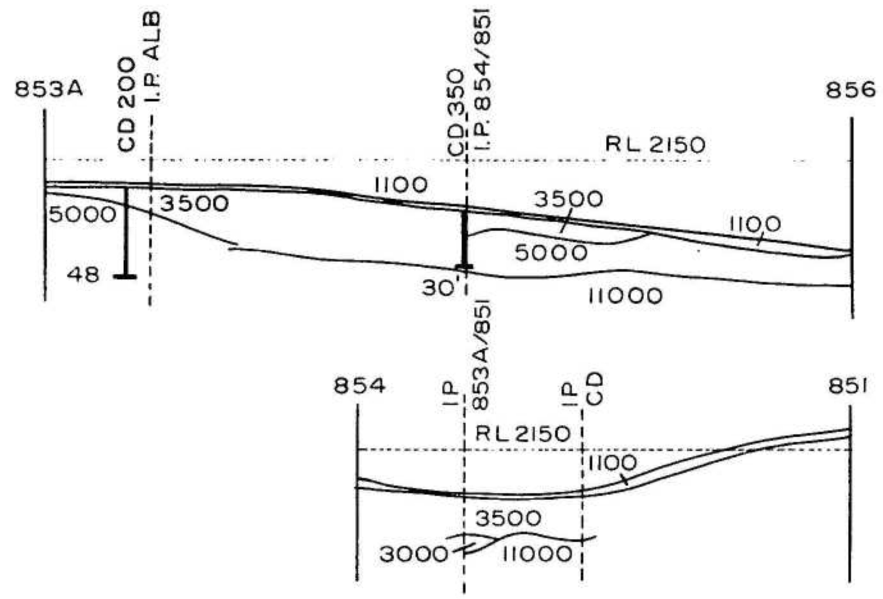
For plan see Plate 3

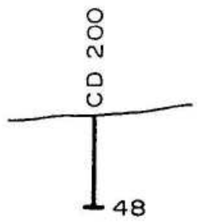
Vertical & horizontal scale
100 ft. to an inch



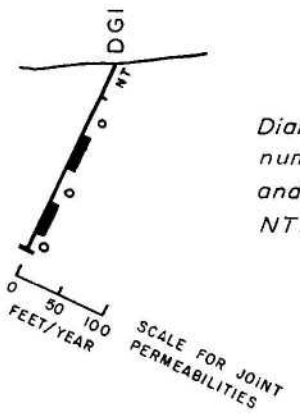
SEISMIC RESULTS OBTAINED BY B.M.R.

VELOCITIES IN FEET / SECOND





Auger hole, number and depth to refusal in feet

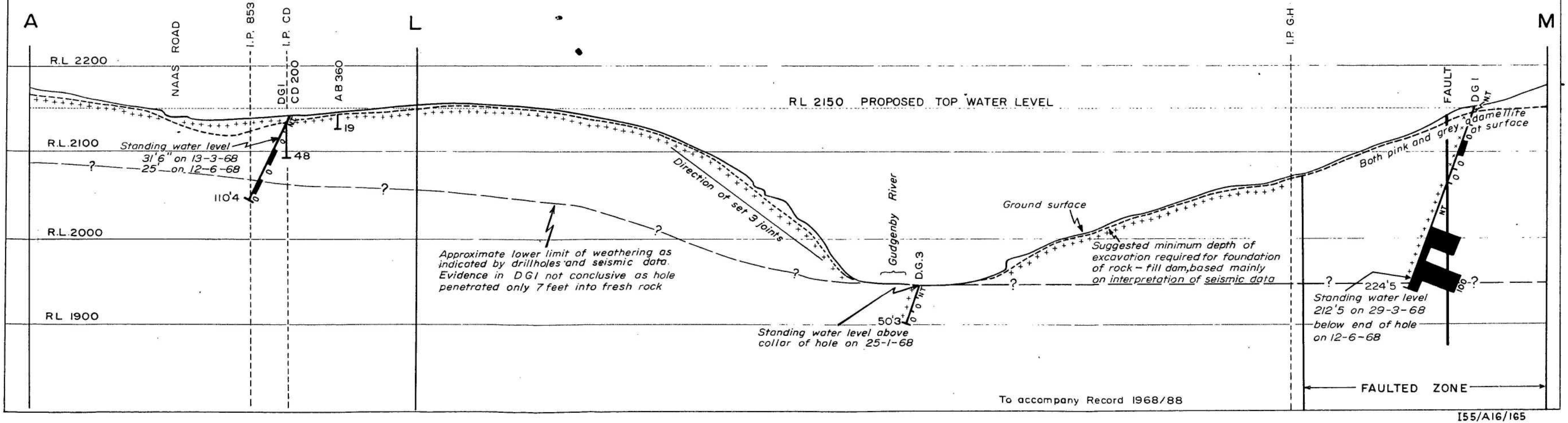


Diamond drill hole,
number depth,
and joint permeability (blacked in)
NT section not tested

\+ + + + Grey adamellite

× × × Pink adamellite

SECTION ALM, POSSIBLE DAM AXIS, LOOKING NORTH (DOWNSTREAM)



Standing water level
31'6" on 13-3-68
25' on 12-6-68

Approximate lower limit of weathering as indicated by drillholes and seismic data. Evidence in DGI not conclusive as hole penetrated only 7 feet into fresh rock

Standing water level above collar of hole on 25-1-68

Suggested minimum depth of excavation required for foundation of rock – fill dam, based mainly on interpretation of seismic data

Standing water level
212'5 on 29-3-68
below end of hole
on 12-6-68

To accompany Record 1968/88

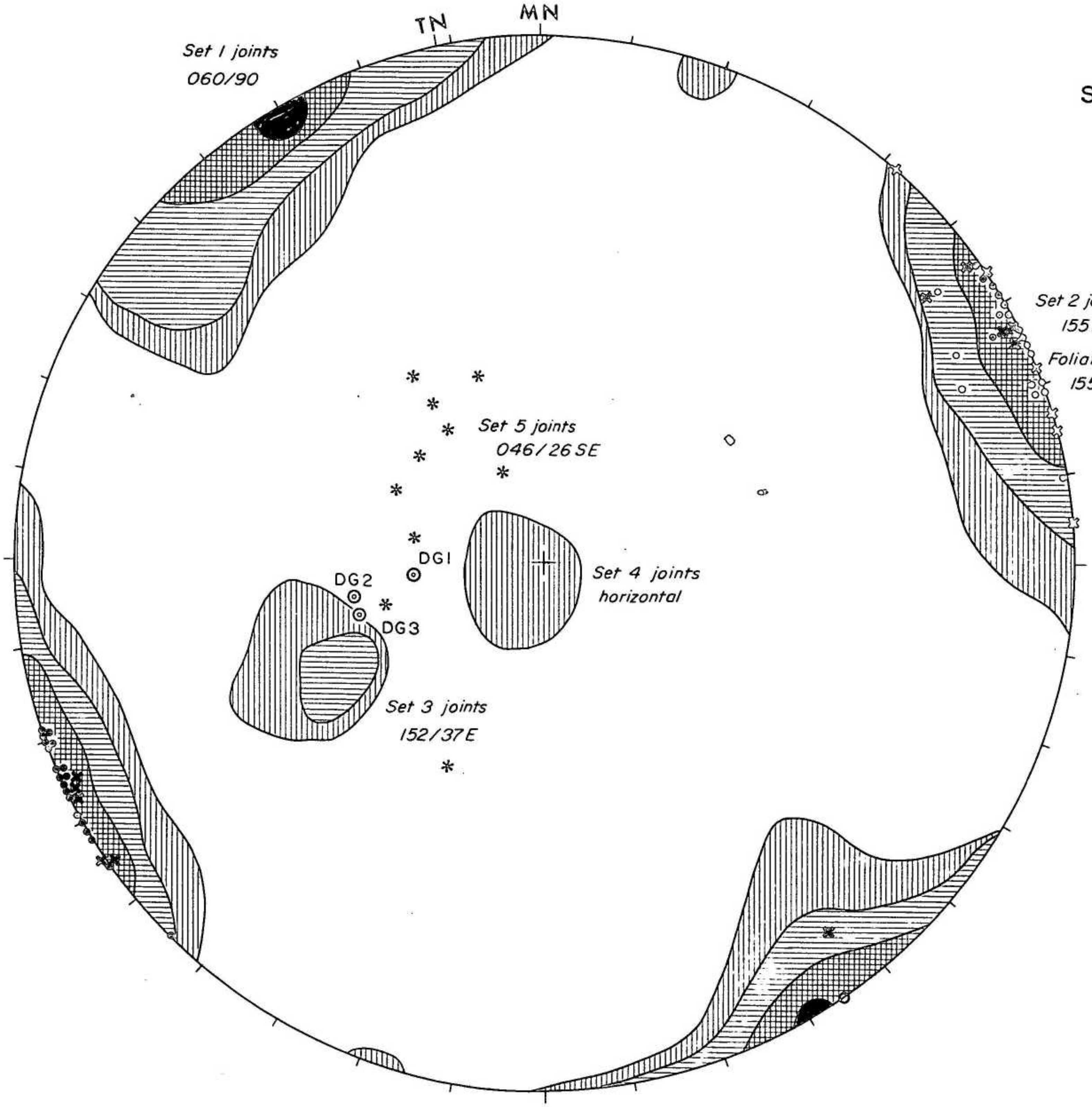
I55/A16/165

PLATE 5

TENNENT DAMSITE

STEREOGRAM OF STRUCTURAL ELEMENTS

Schmidt equal area net, lower hemisphere



Poles to joints shown by contours

- * *Poles to individual joints*
- ○ *Poles to foliation*
- ✲ *Poles to aplite dykes*
- **O** *Long axis of xenolith*
- ◎ *Drillhole*

□	▥	▤	▦	■
0-1	1-2	2-4	4-8	8-16

Percentage of points per percentage of area
840 points (poles to joints) were plotted.

Magnetic declination 11° 30' in 1967

To accompany Record 1968/88

155/A16/173

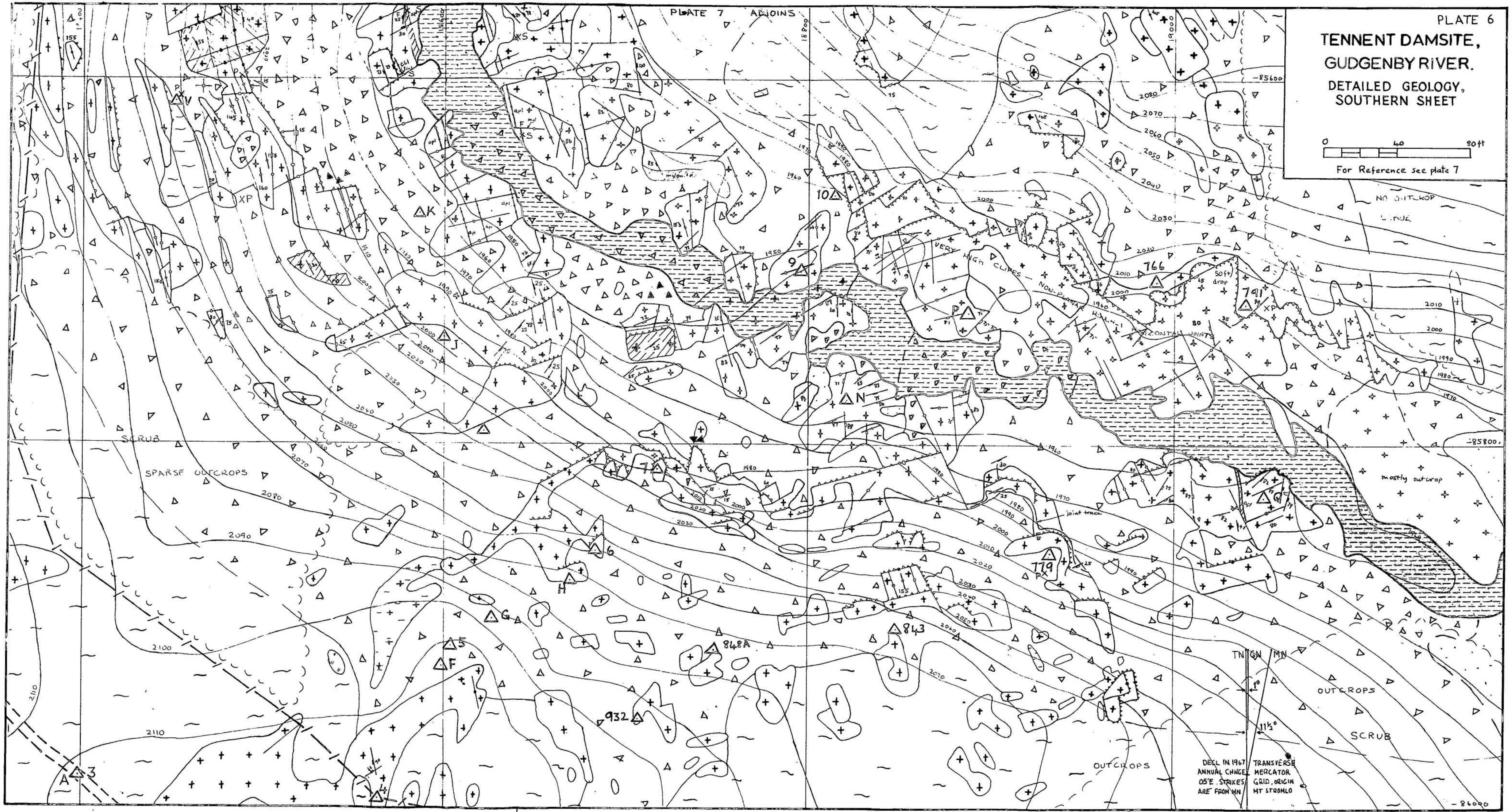
PLATE 6

TENNENT DAMSITE, GUDGENBY RIVER.

DETAILED GEOLOGY, SOUTHERN SHEET

0 40 80 ft

For Reference see plate 7

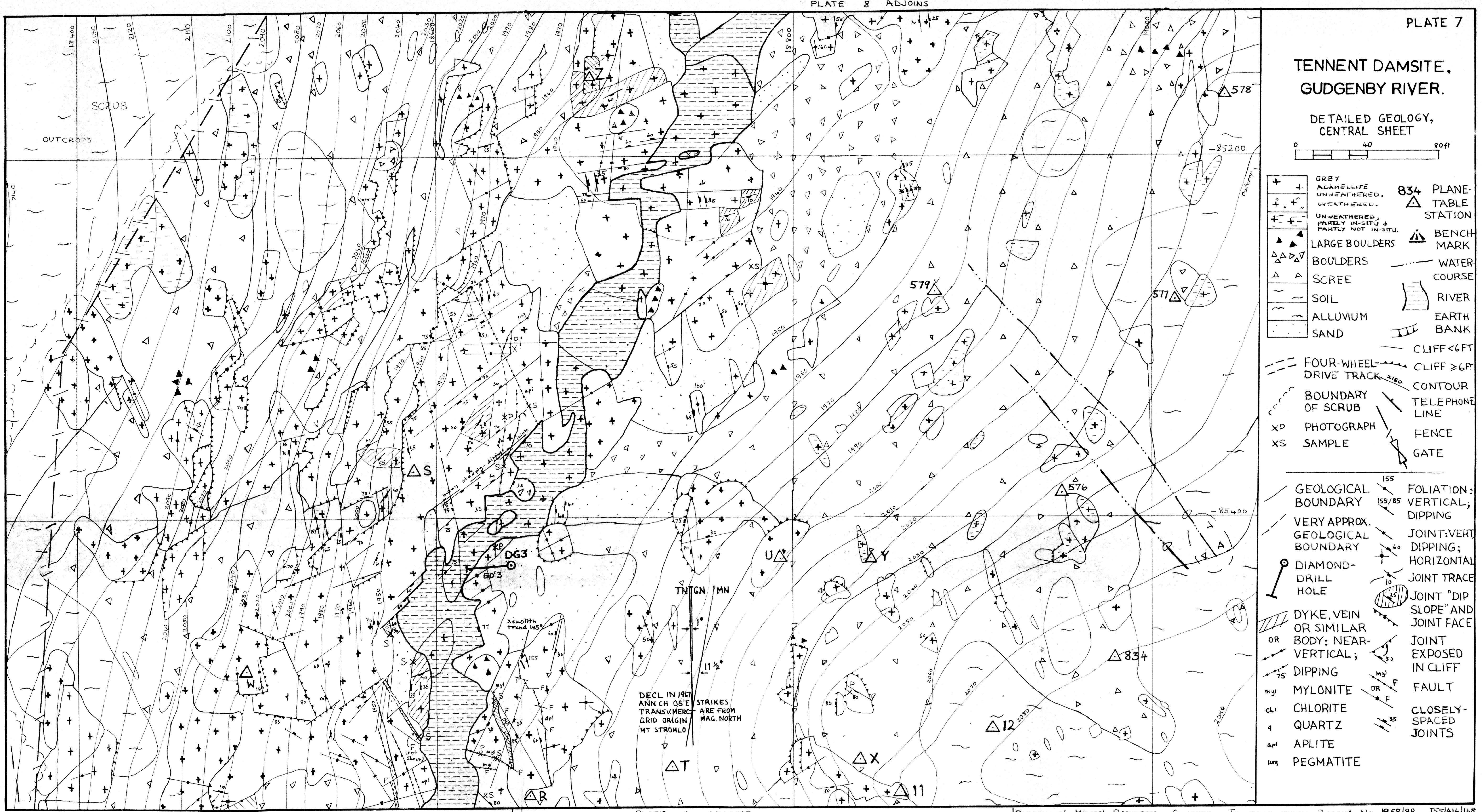


Bureau of Mineral Resources, Canberra. To accompany Record No. 1968/88 I55/A16/167

PLATE 7

TENNENT DAMSITE, GUDGENBY RIVER.

DETAILED GEOLOGY, CENTRAL SHEET



Bureau of Mineral Resources, Canberra. To accompany Record No. 1968/88 I55/A16/168

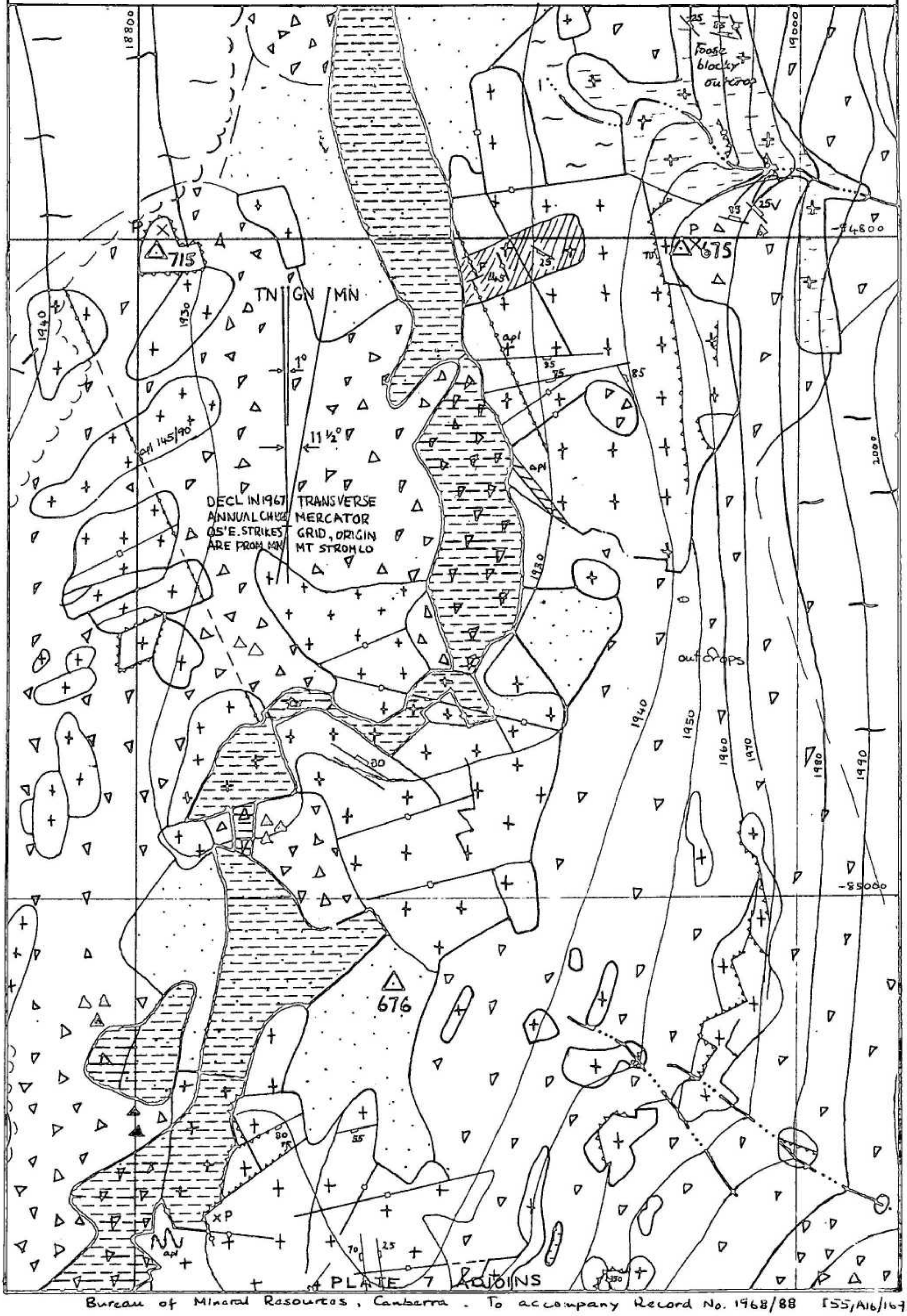
PLATE 8

TENNENT DAMSITE, GUDGENBY RIVER.

DETAILED GEOLOGY, NORTHERN SHEET

For Reference see plate 7

0 40 80 ft



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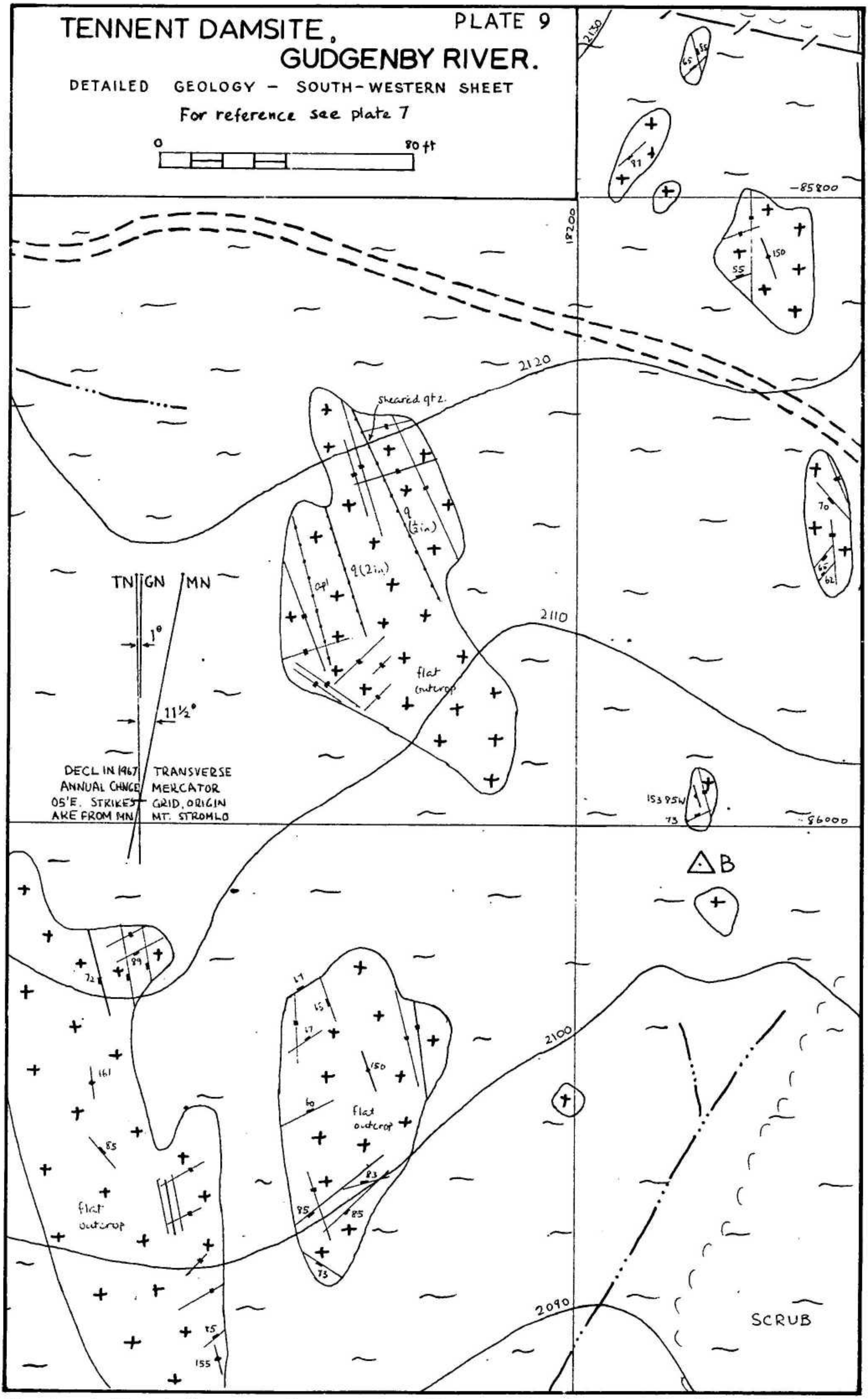
TENNENT DAMSITE, GUDGENBY RIVER.

PLATE 9

DETAILED GEOLOGY – SOUTH-WESTERN SHEET

For reference see plate 7



Bureau of Mineral Resources, Canberra ACT. To accompany Record No. 1968/88 I55/A16/170