NON-LENDING COPY
NOT TO BE REMOVED
FROM LIBRARY

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORDS 1968/98

061339

GEOLOGICAL INVESTIGATION OF COREE DAMSITE,
COTTER RIVER, A.C.T., 1967-1968.

by

D.A. BUCHHORN

BUREAU OF MINERAL RESOURCES
LIBRARY
-4 NOV 1968
COPY 2
CANBERRA, A.C.T.

The information contained in this report has been obtained by the Department of National Development as part of the policy of the Commonwealth Government to assist in the exploration and development of mineral resources. It may not be published in any form or used in a company prospectus or statement without the permission in writing of the Director, Bureau of Mineral Resources, Geology & Geophysics.

GEOLOGICAL INVESTIGATION OF COREE DAMSITE,
COTTER RIVER, A.C.T., 1967-1968

by D.A. Buchhorn

Records 1968/98

The information contained in this report has been obtained by the Department of National Development as part of the policy of the Commonwealth Government to assist in the exploration and development of mineral resources. It may not be published in any form or used in a company prospectus or statement without the permission in writing of the Director, Bureau of Mineral Resources, Geology & Geophysics.

CONTENTS

SUMMARY

Coree damsite is located on the Cotter River, A.C.T., and is a possible site for a water storage dam for Canberra. It has been geologically investigated by surface mapping, seismic traverses and diamond drilling.

Topography - For a main dam about 250 feet high, an auxiliary dam in a saddle on the left bank and about 80 feet high will be required; top water level would be at a reduced level of 2030 feet above mean sea-level. Because of the geological conditions in the saddle a fill-type auxiliary dam would probably be needed; such a dam, on account of the configuration of the saddle, would have a large volume. If a fill-type main dam is built a spillway could be excavated through a saddle on the right bank. For a dam with top water level at RL 2030 a considerable amount of excavation would be required for the spillway structure and approach channel.

Geology - The rock at the site is an acid volcanic rock; fresh rock, as a material, is strong, homogeneous and impermeable, but it has been considerably weakened by weathering near the surface and, to a lesser extent, structural defects where not weathered. As weathering is not deep in the gorge, it will probably be possible to build any type of dam, including a concrete arch structure, for the main dam. However, the upper part of the left abutment is fairly weak and would require special treatment for an arch structure; further, significant faulting, which requires further study, has been located in the lower left abutment of the main damsite. Weathering is deep in the left bank saddle but it should be possible to build an earth-and-rockfill or earth-fill dam without extensive deep excavation.

Materials for construction should be available at reasonable cost, but it will be necessary to transport sand and filter material moderate distances, or crush them near the site. Quality and quantity of prospective construction materials available remain to be proved.

Conclusions are summarized in greater detail, and detailed recommendations for further investigation are given, at the end of the report.

INTRODUCTION

Coree damsite is a possible site for a water-storage dam for Canberra. It is on the Cotter River, near the junction with Coree Creek, about four miles upstream from the Cotter Dam. Two other dams are already located on the river farther upstream: the Bendora and Corin Dams.

The proposed top water level is at RL 2030. A main dam about 250 feet high and 700 feet long, and an auxiliary dam in a saddle on the left bank about 80 feet high and about 800 feet long, would be required. On the right bank, 2000 feet downstream of the damsite, a saddle of height 2078 feet occurs which has been considered for use as a spillway. In this report the suitability of the site for both a concrete and a fill-type main dam is examined. The auxiliary dam would be of earth-and-rock or earth construction.

This Record reports geological investigations carried out for the Commonwealth Department of Works to assist in comparing the site with other possible sites near Canberra. Geological studies were done by the Bureau of Mineral Resources, a seismic survey and Gemco augering by the Commonwealth Department of Works, photogrammetry and diamond drilling* by the Snowy Mountains Authority, and surveying and photogrammetry by the Department of the Interior. Investigations were carried out between September 1967 and July 1968.

The only previous report on the site is Buchhorn & Carter (1968).

* Five diamond-drill holes totalling 793 feet were drilled and water-pressure tested. (Logs, Appendix 4; waterpressure tests, Appendix 3). NMLC barrels with split inner tube or plastic inner tube were used.

REGIONAL GEOLOGY

GENERAL

The regional geology is shown on Plates 1 and 2; it is based on mapping by D.A. Buchhorn, J.R. Mendum, I.D. Loiterton, G.H. McNally and R.C. Price, and on earlier reports of the Bureau of Mineral Resources (see References).

The oldest rocks in the region are Ordovician in age, and consist of sandstone, shale and chert, metamorphosed in part to quartzite and phyllite. The rocks are complexly folded and generally have steep dips.

Unconformably overlying these is the Tidbinbilla Quartzite, believed to be of lower Silurian age, which is more gently-dipping.

The next younger rock unit is the Paddy's River Volcanics, which consists mainly of foliated acid volcanics which appear to be steeply-dipping and may be folded. The age of the unit is middle Silurian; presumably there is an unconformable relationship with the Ordovician.

The Upper Silurian Uriarra Volcanics consist of acid volcanics with two beds of fine-grained airfall tuff. The acid volcanics probably consist of ash-flow tuffs and lavas. The rock has been divided into members, which are, starting with the oldest, the Vanity Member, Swamp Creek Member, Tarpaulin Member, and Walker Member. The Uriarra Volcanics seem to be folded in places but in general have a strike of about 180° magnetic* and dip 30°W.

Rocks of the Vanity Member and Swamp Creek Member are similar in composition and texture, but the former have white, and the latter pink, feldspar phenocrysts (Malcolm, 1954). Recent work has shown that a precise boundary cannot be found: there appears to be a transitional zone between the two members within which flow units of both type occur. Possibly the distinction between the two members is not justified.

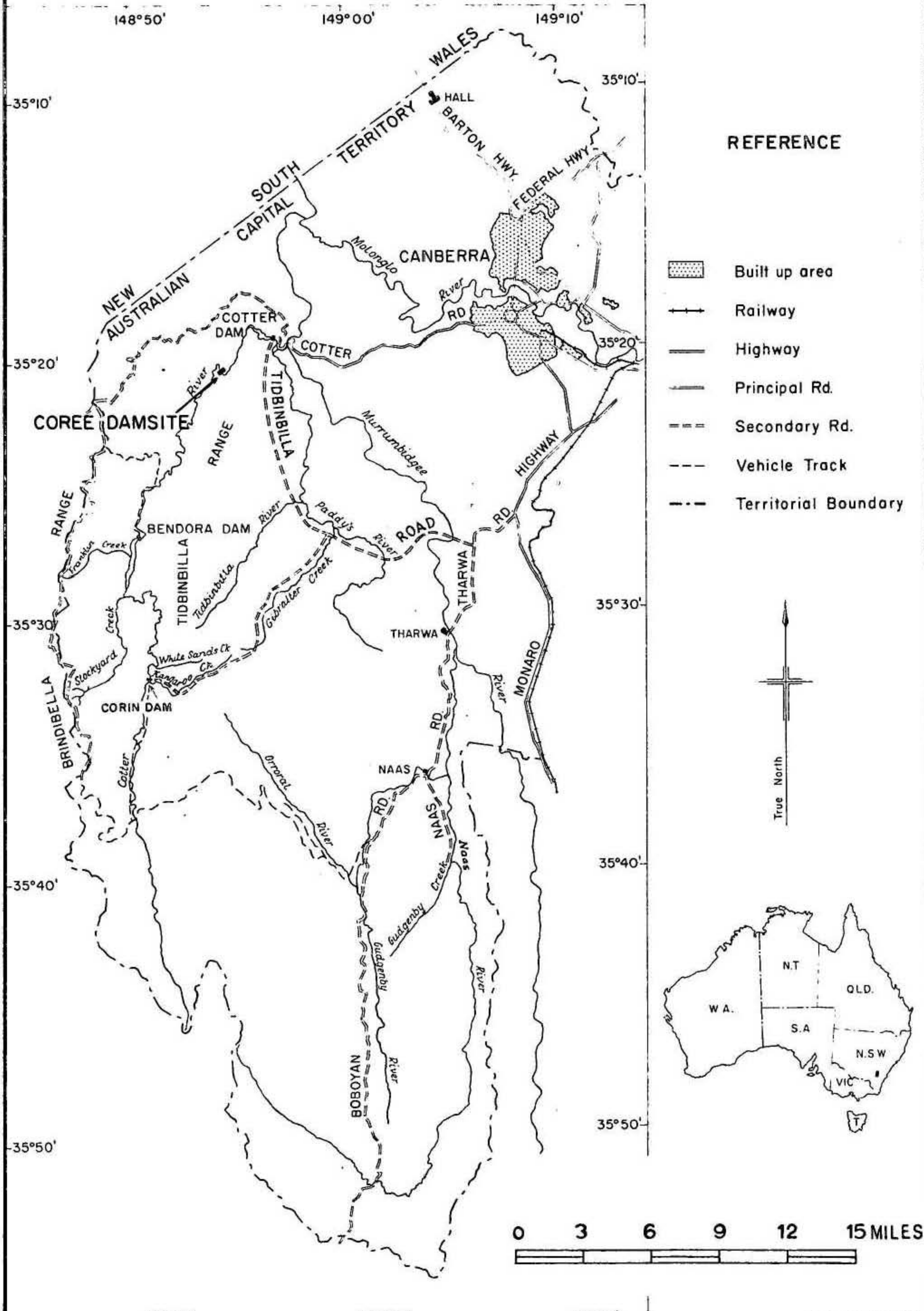
The older rocks are intruded by small porphyry intrusions of Silurian age and by large granite and granodiorite intrusions of Siluro-Devonian age. Most of the intrusions may be consanguinous.

The area is cut by several major, steeply-dipping faults including the north striking Cotter and Pig Hill Faults, the north-east-striking Winslade Fault, and the north-west-trending Murrumbidgee

* All bearings given in this report are magnetic bearings

Fig.1.

COREE DAMSITE, COTTER RIVER
LOCALITY MAP



To accompany Record 1968/98

Fault. The faults named are dip-slip faults and have given rise to horsts and grabens.

Other faults are shown on Plates 1 and 2; most are believed to be steeply-dipping. Not all of them have been proved but others doubtless exist. Minor faults may be expected to be common.

Petrographic descriptions of several specimens of rock are given in Appendix 2.

Small young deposits of alluvium occur along the creeks and rivers. The Cotter River has small deposits of sand, pebbles and cobbles. The sand is probably derived largely from granites some miles upstream, and the pebbles and cobbles are mainly derived from Ordovician sediments. Along the tributaries deposits are finer-grained, and clay deposits occur. Along Pierce's Creek, Paddy's River and Murrumbidgee River deposits of sand and gravel, particularly sand, are larger and more common. This is because these streams flow through granites and are more mature than the Cotter River and its tributaries.

SEISMICITY

Seismic activity in the region is fairly common but is of low magnitude. Precise instrumentation has only been available for the region since 1958 but in the period September 1958 to February 1962 44 tremors, of maximum magnitude 5 on the Richter scale, were recorded in the Snowy Mountains area (Cleary, Doyle and Moye, 1964) and in the period October 1958 to August 1961 98 tremors were located within about 65 miles of Yass, 52 of them in the Gunning area (Cleary, 1967) - maximum magnitude was 3½. The nearest epicentre to the proposed damsite recorded by Cleary (1967) was 5½ miles to the north; it had a magnitude of 1¾.

Earlier, less precise, records show a long history of low intensity felt shocks and instrumentally-recorded shocks. It is concluded that the region has a persistent record of infrequent low-magnitude seismicity, and that there may be some slight activity on the Murrumbidgee, Cotter and Long Plain - Goodradigbee Faults. The ground accelerations associated with the recorded shocks would not be sufficient to affect most engineering structures significantly or to initiate slope failure, but it is considered that in the design of any structure sensitive to horizontal acceleration some allowance should be made for the possible incidence of earthquakes.

PHYSIOGRAPHY

The Cotter River flows in a northerly direction through mountainous country occupying the western part of the A.C.T. (see Fig. 1). To the west of the river near the damsite is the Brindabella Range and to the east the Tidbinbilla Range. The Cotter River is youthful and flows through V-shaped valleys with little alluvium. Entrenched meanders occur, and river alluvium (cobbles) may be found in many places about 80 feet above present river level. Paddy's River and the Murrumbidgee River are mature and flow through hilly country to the east of the Tidbinbilla Range. Paddy's River flows into the Cotter, and the Cotter into the Murrumbidgee, about 5 and 6 miles respectively downstream from the damsite.

The youthful topography suggests that in comparatively recent times (in geological terms, not human historical terms) a horst was uplifted between the Murrumbidgee Fault and another fault to the west, perhaps near the Goodradigbee River. In detail, there is no topographical evidence for fault displacement attributable to Recent times. In recent years seismic activity has occurred near the Murrumbidgee Fault (Cleary, 1967) suggesting that strain relief may still be occurring. The significance of current seismic activity is discussed above.

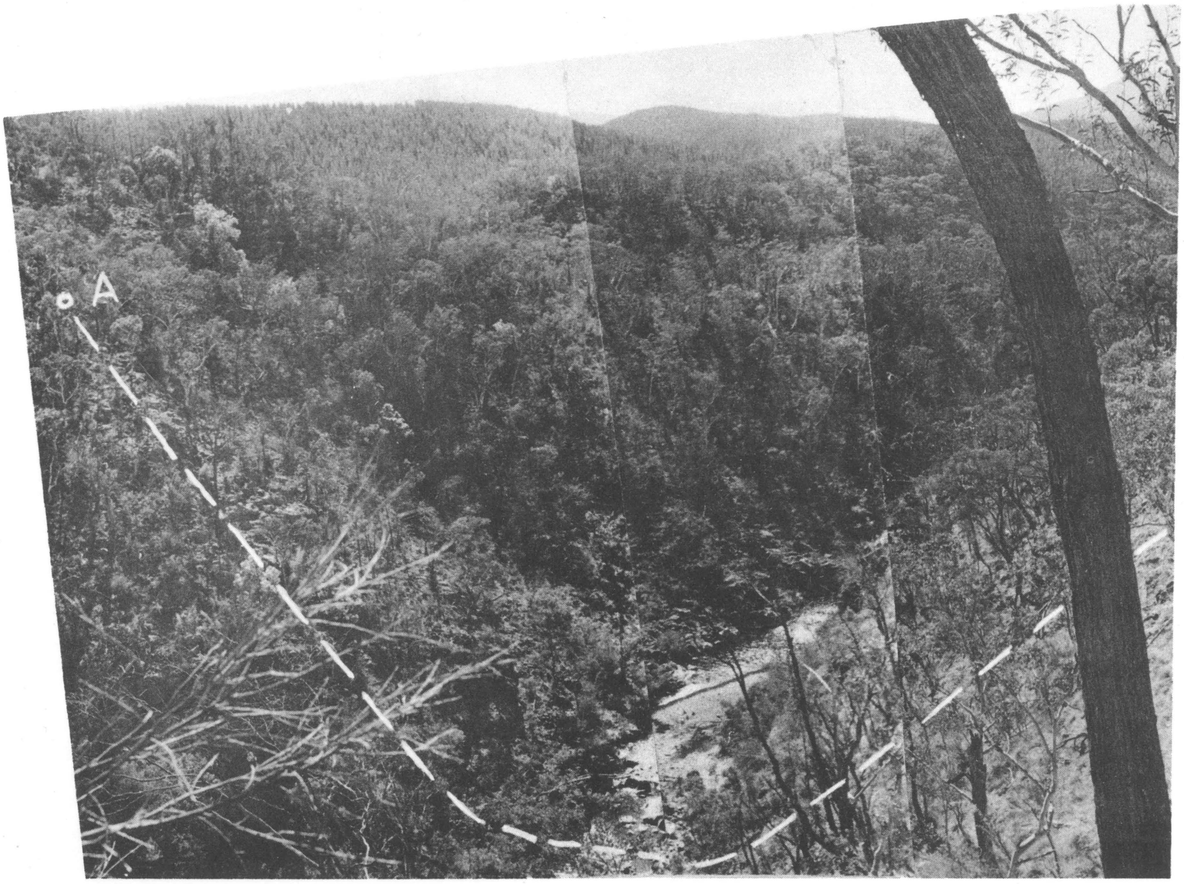
The contrast in relief in various physiographic units in the south-west of the A.C.T. may, however be explained by differing resistance to erosion of various rock types brought into juxtaposition by ancient faulting. On this interpretation the Cotter River flows through sediments of the horst and because of difficulty of erosion of the sediments, it is youthful. Paddy's River flows through granites in the horst; the river is mature because the granites weather deeply and are easily eroded. The Murrumbidgee River flows along the eastern side of the horst. The northerly trend of the rivers and ranges is related to the approximately northerly strike of faults, and of bedding in the sediments.

GEOLOGY OF DAMSITE AND ENVIRONS

GENERAL

The geology is discussed under four headings: general, petrology, structure, weathering. The area discussed is the area of Plate 3.

Two rock units are represented. Ordovician sediments (described in "Regional geology; general") occur south of the Winslade Fault; they have contributed to the alluvium in the Right Bank saddle and in the bed of the Cotter River. The Upper Silurian Uriarra Volcanics, representing one or the other of two members, the Swamp Creek Member and the Vanity Member, form the bedrock over most of the area. Outcrop is sparse to moderately abundant. Unweathered outcrops occur in parts of the river bed but most of the riverbed is of waterworn boulders or alluvium (cobbles and sand). On the slopes there is a transition in rock conditions between the good fresh exposure near the river and the conditions in flat areas, high above the river, where outcrops are weathered and very sparse.



COREE DAMSITE COTTER RIVER.

Figure 2. (top) Damsite, looking north-west (upstream). Seismic traverse AB, marked, is possible dam axis. A is at R.L. 2066.

Figure 3: (centre) Part of left bank saddle, looking north. Seismic traverse EF, marked; CD is perpendicular to EF and passes behind Land Rover.

Figure 4: (bottom). Right bank saddle, looking south-east. Part of seismic traverse KJ marked; GH is perpendicular and intersects KJ at bottom of photograph. Road from Pierce's Creek Forestry Settlement to Vanity's Crossing passes behind K.

Steep slopes near the river are covered between outcrops with scree or by soil overlain by a few scree boulders. Most of the area is shown as scree on Plate 3.

The gentle slopes consist of a cover of soil, over weathered rock. The cover is thin wherever it has been tested.

Further discussion of the geology of the damsite and its environs is restricted to the Uriarra Volcanics.

PETROLOGY

Apart from the Ordovician sediments, the rocks are acid volcanic rocks. They appear to be generally homogeneous and uniform, but two types can be distinguished in the field: those with pink feldspar, and those with white feldspar. It is not certain if the distinction is meaningful in terms of genesis but the two types may correspond to different flows, or upper and lower parts of the one flow. Malcolm (1954) thought that the two types corresponded to two members of the Uriarra Volcanics (see "Regional geology; general"). Probably a number of different flows are exposed in the area of Plate 3; this would explain the close admixture of the two types of rock. With the field evidence available to date, given on Plate 3 and in Appendix 4, it is not possible to distinguish what may be flow units. Careful and detailed field work may enable flows to be distinguished and the geological structure to be resolved.

The volcanic rocks include rhyolite, dellenite, rhyodacite and dacite.*

---

* Dacite is a fine-grained igneous rock consisting mainly of plagioclase feldspar and quartz; generally a volcanic.

Dellenite is a fine-grained igneous rock consisting mainly of plagioclase feldspar, alkali feldspar and quartz; plagioclase feldspar and alkali feldspar occur in roughly equil proportions. Generally a volcanic.

Rhyolite is a fine-grained igneous rock consisting mainly of alkali feldspar and quartz; generally a volcanic.

Petrographic studies indicate the rocks are probably welded ash-flow tuffs, but in the field a flow texture indicative of a lava has been found. (Riverbed, near line AB). Weld textures have also been found in the southern half of Plate 3. Most of the rock in the locality, however, is uniform in texture and no interpretation of the mode of emplacement can be made in the field. Some of the rocks may be intrusive; intrusive porphyries occur elsewhere (Plate 1).

In many places the rock contains coarse-grained cognate xenoliths, approximately round and of diameter 1-2 inches. Thin calcite and quartz veins occur.

Other minor features of the rock are described in the drill logs (Appendix 4). Petrographic descriptions of similar rocks outside the area of Plate 3 (CC5 and CC12) are given in Appendix 2.

STRUCTURE

Regional evidence suggests that flows have a general strike and dip of $180^{o}/30^{o}$W.* In the riverbed at the sharp bend, southern portion of Plate 3, layering was measured at $185^{o}/26^{o}$W, in reasonable agreement with the regional picture. It was not possible to obtain any other measurements of layering (such as those due to welding and flow) nor to distinguish flow units by lithology.

Joints

Joints near the damsite are moderately-spaced and of moderate size. At the surface they are clean or iron-stained, and no clay has been observed. In drill-holes joints are iron-stained or in some cases clay-filled as a result of weathering, but below the weathering zone joints are clean or coated with a thin film of white material.

In some outcrops a closely-spaced set of joints occurs; such occurrences are small. The closest spacing observed is 1 inch in a set of orientation $115^{o}/80^{o}$S at 50 feet south of slope chainage 510 of section line BA. In most outcrops only one closely-spaced set of joints occurs but moderately-spaced joints generally occur in two or three orientations.

In parts of the riverbed, and in the road-cutting in the southern portion of Plate 3, closely-fractured zones occur. They are not made up of closely-spaced planar joints, but are probably similar to many of the highly-fractured zones in drill core. The latter are attributable in some cases to leaching of calcite veins, and in others, to fracturing near fault-zones.

---

* That is, strikes 180^{o} magnetic and dips 30^{o} to the west.

Large joints also occur. Near Section BA, close to the river, large joints of orientation about 125°/90° occur, and one of orientation 080°/90° occurs.

No well-developed pattern of joints occurs but locally poorly-developed sets occur (Plate 5). High-angle joints are more common than low-angle ones. Comparison of joint measurements in drill-holes DC2 and DC4 also suggest this; the core from the steeper drill-hole (DC2) displays joints at a higher angle than that from DC4. The joint angle frequency maxima cannot be correlated with any certainty with the orientations of joints at the surface.

By comparing stereogram maxima and certain joint measurements the following main directions are derived. They are round figures as a fair amount of variation occurs. Not all sets are present in a given locality, and other sets may occur. They apply mainly to the river valley, near the river, and near the proposed dam axis. In order of prominence they are:

Set 1	130°/85°NE
Set 2	060°/90°
Set 3	130°/30°SW
Set 4	130°/45°NE
Set 5	025°/20°S

For comparison, the section line BA has an orientation 051°; the river at BA flows in direction 125°; the river in the whole straight reach near the damsite flows in direction 140°.

Joint sets 1, 3 and 4 may exert control on the course of the river, especially as some set 1 joints are large. The three sets are not very distinct and there could be some more definite control of the river.

Sets 1, 2, 5, 3 and 4 occur on the left bank of the river valley, in that order of abundance. Three sets trend near-parallel to the river; one near-vertical, one dips 30° into the bank, and one dips 45° toward the river. Another set is vertical and nearly parallel to the proposed dam axis, and another (set 5) dips obliquely downstream at 20° and towards the river.

Sets 2, 4, 1 and 3 occur on the right bank of the river valley, in that order of abundance. One set is nearly parallel to the dam axis and vertical (one of the joints in the set is large) and three other sets trend near-parallel to the river at various dips (some of the joints in one set are large).

Set 3 occurs in the river bed at the bend at the downstream end of the straight reach. Three other sets also occur which do not fit in with the five sets listed above. The pattern is very well-developed. The sets and spacings are:

120°/25°S	Spacing $^{1}/6$ - 3 feet
100°/65°N	Spacing 3 feet
040°/60°SE	Spacing 1 - 10 feet

In the left bank saddle very few joint measurements are obtainable. Sets 1, 3 and 4 could possibly occur, as third-layer seismic velocities are significantly higher in traverse EF than in traverse CD (EF bears 148°; CD bears 051°). The velocity anisotropy does not occur in fresh rock.

In the right bank saddle few joint measurements are obtainable, but one common direction is 060°/70°S. This direction could be compared with set 2 or with the third set (above) exposed in the riverbed below the saddle. Sets 1, 3 and 4 could occur, as second-layer seismic velocities are significantly higher along traverse KJ (bearing 302°) than along HG (bearing 213°). Again, the velocity anisotropy does not occur in fresh rock.

Faults

Some faults are known in the area. A major regional fault, the Winslade Fault, passes south of the right bank saddle. It trends about 050°, is steeply-dipping and is the boundary between Uriarra Volcanics and Ordovician sediments. The fault zone contains breccia derived from both formations and is from 3-20 feet wide. Quartz-veins are commonly associated with the fault elsewhere.

A possible steep-dipping fault cuts across the river just downstream from the traverse line BA (Plate 2); it bears 065°. Its existence is suspected because the color of the feldspars in the rocks changes across it, and it corresponds with watercourses.

A fault was intersected by DC2 in the left bank on the line BA, but its orientation is unknown. The colour of the feldspars in the rocks changes across the fault. The fault zone is clayey and the rock on either side is highly fractured (Appendix 4).

A slickensided plane occurs near slope chainage 300 of traverse line ML. The plane is about 12 x 3 feet and has orientation 015°/55°N. Slickensides plunge 280°N. The plane does not pass through the fault just described but may be related to it or some other fault. Another slickensided plane in area 1, right bank, (Plate 3), has orientation 133°/215°W. Slickensides plunge 29°N.

The course of the river is possibly influenced by a fault along the riverbed, and another fault may pass through the left bank saddle. Drillholes DC5 and DC1, however did not reveal any prominent faults but DC5 had highly fractured rock from 36'9" to 38'6", and DC1 had occasional slickensides from 25'4" to 50'.

WEATHERING

Both mechanical and chemical weathering affect rocks near the surface; five degrees of chemical weathering are defined in Appendix 1. Mechanical weathering causes weakening, by physical separation of blocks, fragments and grains in outcrops, particularly in the river valley. Chemical weathering is of much greater importance. It is brought about by the action of air and water, which penetrate the rock mass along joints, as the fresh rock material is impermeable. It may also proceed along faults, shears or cleavage.

One of the products of weathering is clay, which is often leached into joints or into completely weathered zones. Clay is common in drillhole DC4 but is uncommon in other drillholes.

When weathering proceeds along joints of moderate spacing, such as occur in the acid volcanic rocks, the weathering is quite heterogeneous and tors are commonly formed. Weathering can occur at moderate depths (although in holes drilled to date negligible weathering occurs below perpendicular depth 90 feet). These effects are not so pronounced as with granites, in which joints are widely spaced.

Weathering is not extensive in the river valley, as erosion is active. In the left and right bank saddles however weathering extends deeply, as erosion has not removed the products of weathering. Seismic and drilling results indicate moderate weathering in parts of the saddles to depths of more than 50 feet.

ENGINEERING GEOLOGY

MAIN DAM

The dam is sited in a straight reach of river, the valley of which as a V-shaped profile, with fairly uniform slopes of about 40°. The river at the damsite flows east-south-east. A possible axis BA and lines PN and ML 100 feet upstream and downstream respectively have been marked on the ground and are shown on Plate 3.

Between the lines PN and ML about 30% of the left bank and about 40% of the right bank is reasonably sound outcrop. The remainder of the area consists of outcrops of weak rock and loose rock and soil. Most of the outcrops are only slightly weathered. Between outcrops more advanced weathering can be expected, possibly extending deeply. Drillhole DC2 revealed mostly fresh or slightly weathered rock with some more complete weathering. The deepest weathering of importance is from 187' to 189'7", which is 68 feet from the nearest point on the surface. The rock is moderately weathered; the true thickness of the weathered zone is not known.

The seismic survey along the line BA detected a main refractor of velocity 13,000 - 16,000 feet/second. Above this refractor a velocity of 2500 - 3400 was obtained, except high on the left bank where most of the rock had a velocity of 7800 feet/second. The rock with velocity 7800 feet/second was intersected by DC2 and was found to consist of fresh to slightly weathered rock, moderately weathered in part, and further weathered in zones up to one foot wide along some joints. The rock corresponding to the main refractor is not very different from that in the 7800 feet/second layer but weathering is generally less thorough and less extensive. Rock giving a velocity of 16,000 feet/second is probably generally fresh, and tightly jointed, but with sparse, narrow zones of weathering along some joints. On the left bank the perpendicular depth to the refractor ranged from 4 feet near the river to a maximum of 48 feet high on the bank, a little higher than the proposed dam crest. On the right bank the depth to the refractor ranged between 3 feet near the river to a maximum of 28 feet half-way up the right bank. The perpendicular depth high on the right bank is 23 feet.

On the right bank, 50 feet south of slope chainage 510 of BA, close-jointing was observed in a four-foot wide zone. The joints have an orientation 115°/80°S and a spacing of 1 inch. This zone is exposed only in one place but probably extends 120 feet north-westerly along strike, and may extend south-easterly along strike. The zone does not appear to be weathered or to have any clay where exposed, but is possibly weathered where not exposed.

Drillhole DC2 intersected at 306'3" a clay-filled fault zone which extended to 309'7". The clay is a fault pug and is not a product of weathering. Most of the core was lost. The true thickness of the fault zone is not known. The rock near the fault is considerably fractured, the fracturing extending from 295' to 317'. Water loss during testing of this section of hole was not noticeably greater than in other sections of the hole. The fault was intersected at slope chainage 185 of the line BA, at a vertical depth below the surface of 147 feet (RL 1792). It has not been located on the surface.

The riverbed consists of fresh to slightly weathered outcrop, alluvium (sand, cobbles, boulders) and some boulders which have fallen down the slopes of the valley. Most of the cobbles are of Ordovician sediments and therefore must have been transported some distance. Some of the outcrops in the riverbed have numerous fractures which have apparently been re-cemented; the outcropping rock mass therefore appears to be as strong as fresh, unfractured rock. The lack of outcrop over much of the riverbed and the straightness of the river suggests a weak zone underneath the river. Drillhole DC5 which crossed the river near BA only detected highly fractured rock from 36'9" to 38'6".

Another possible fault, probably with a steep dip, crosses the river 300 feet downstream from BA. It is shown on Plate 2. Little is known about it other than what is described in "Local geology; structure".

Suggested foundation treatments are given below. They are preliminary only and may need substantial revision when more information on rock conditions becomes available.

(a) Concrete-arch dam. In the vicinity of DC2 excavation to a depth of 3 feet would probably be sufficient. Some of the "reasonably solid outcrop" mentioned before would suffice for a foundation without excavation; the depth of excavation would therefore be determined by the need to key the arch into the rock and to shape the foundations. However excavation to provide sound foundations will be needed over most of the site, judging from the surface appearance of the rock, seismic velocities, and weathering in DC2 some distance from the collar. It is not possible at this stage to say how much excavation would be required but depths to the refractor given above would be maxima, and the depth of excavation actually required would probably be somewhat less. Localised excavation of weathered, closely-jointed or faulted rock may be required. Some such areas are described above but others may exist.

(b) Rockfill dam. Excavation required will be similar to that indicated for a concrete-arch dam, but somewhat less excavation will be required. However prominent rock masses will require smoothing. Dental treatment of weathered, closely-jointed or faulted rock will be required; some areas in which this may be required are described below. All surfaces should be made watertight by gunite or mortar.

With either type of construction normal curtain and blanket grouting will be required. Grout consumption is expected to be generally low to very low. Moderate amounts of grout will probably be required in a few localised zones such as those listed above but no serious grouting problems are expected.

The fault intersected in drillhole DC2 is a possible cause of instability in the site; it will require further investigation. Another feature which requires closer study is a joint set on the left bank, of orientation 130°/30°SW, i.e. dipping 30° toward the river and slightly downstream. The joints of this set appear to be clean on the surface; in drillhole DC2 it is not possible to identify the true orientation of joints, but very few joints have any clay on them. The joint set therefore probably does not constitute a serious problem, but may require some additional treatment e.g. deeper excavation and, or, rock bolting to ensure the stability of the structure.

It will probably not be necessary to make allowance in dam design for earthquake-produced accelerations but see the section on seismicity under "Regional geology".

AUXILIARY DAM

For a reservoir of RL 2030 an auxiliary dam about 80 feet high would be required, in the left bank saddle. An earthfill or earth-and-rockfill structure could be built. The saddle is not suited for use as a spillway because of its elevation and deep weathering.

The saddle adjoins the main dam, and is separated from it by a knoll of height 2080 feet. The line DC marks a possible dam axis; the lowest point is RL 1959, and the length of the saddle at RL 2040 is 800 feet.

Outcrops account for only about 1% of the saddle area, and are broken and weathered. Seismic results in the saddle gave the following depths. (Core from DC1, near the centre of the saddle, has been compared with the seismic depths obtained at that location to interpret layer velocities):

1000 feet/second, at surface. Soil and completely weathered rock.

3300-5200 feet/second, below depth 0-5 feet. Completely to highly weathered rock.

6500-8300 feet/second, below depth 5-26 feet. Highly to slightly weathered rock.

13000-17,500 feet/second, below depth 49-75 feet. Fresh; rock along joints moderately weathered to fresh.

The greatest depths of each range are west of the low point of the saddle, between slope chainages 150 and 350. The lower velocities of each range, however, are near the low point of the saddle, between slope chainages 400 and 650, and this is probably where weathering is deepest. Auger holes between chainages 400 and 650 penetrated 49 and 53 feet, while in four holes drilled outside this area the maximum depth reached was 7 feet.

Information from drillhole DC1, located near the low point of the saddle, suggests that dam foundations between chainages 400 and 650 could be placed at depths between 9 and 32 feet, depending on the type of structure and the particular part of the structure. Seismic results suggest that little variation occurs away from DC1.

Seismic and auger results suggest that dam foundations outside chainages 400-650 could be placed at shallower depths than those just given. A maximum depth of 5 feet is indicated, but this figure may not be reliable.

Foundation treatments required can only be determined after further testing. As the foundation rock is more weathered than in the main dam and the head of water at foundation level would be less, it will probably require less treatment to make the foundations watertight than for the main dam. This is confirmed by the extremely low joint permeabilities obtained in DC1.

No faults are known in the saddle, but the deep weathering between chainages 400 and 650 may be due to a fault or some other geological structure.

Allowance should be made for earthquake activity and the design of the auxiliary dam.

SPILLWAY

A spillway could be located in the right bank saddle but a large amount of material would have to be excavated. Thus a concrete main dam in which the spillway can be incorporated may prove the most satisfactory. If a separate spillway is required it may be more economical to locate it on either the left or the right bank of the river valley than in the right bank saddle. No difficulty should be experienced in obtaining sufficiently good foundation; for a description of probable rock conditions see "Main dam". A seismic design may be required in a gated structure.

The following is a description of the right bank saddle:

The saddle is at RL 2078 and is shorter than the left bank saddle. On the upstream side (the south-west) the ground is gently-sloping, but downstream the slope averages 40°. The site would be well suited for a spillway, except that very large quantities of material would have to be excavated from the upstream side to provide an approach channel to the spillway chute.

In the saddle slightly to moderately weathered rock crops out over about 1% of the area.

Seismic results in the saddle gave the following depths. (Core from DC3, near the centre of the saddle, has been compared with the seismic depths obtained at that location to interpret layer velocities):

800-1600 feet/second, at surface. Soil and completely weathered rock.

6000-7600 feet/second, below depths 5-9 feet. Moderately, and partly highly, weathered rock.

10,500-17,500 feet/second, below depths 30-65 feet.* Moderately weathered rock in the top 20 feet, fresh to slightly weathered below that.

Auger holes generally penetrated nearly as deep as the top of the third layer.

---

* The shallower depths appear to be unreliable since the intersecting traverse gives depths about 13 feet deeper. The diamond-drill and auger hole results accord best with those from the intersecting traverse.

To provide a spillway a considerable amount of material would have to be excavated from the sill area and from the upstream side of the saddle. Most of the excavation would be in the first or second layers. Near the centre of the saddle, where the third layer is shallowest, some of the third layer, which has a seismic velocity of 11,500 feet/second would have to be excavated. In the drillhole the rock is moderately weathered to approximately RL 2022; excavation should not be as difficult as in fresh rock, but explosives would be needed. Below RL 2022 the rock is fresh to slightly weathered and strong enough for the foundations of a spillway sill.

On the north-eastern slope of the saddle, outcrops form about 5% of the surface. Near the river fresh, strong rock is exposed, but the slope is partly covered by boulders.

It is expected that the depth of weathering would decrease between the saddle and the river, but there is too little information to date to predict foundation conditions for a spillway chute.

For the shortest spillway alignment water would discharge into the Cotter River just upstream from a sharp bend, and approximately 1400 feet downstream from the toe of a fill dam at BA. Discharge should not cause unacceptable erosion of the river bed.

Joint permeabilities in DC3 are very low below depth 20 feet and indicate that grout consumption would be negligible. Since RL 2030 is at hole depth of 60 feet where rock is fresh, very little grouting will be required. Possibly grouting would be required along some weakness not yet detected, but this is unlikely. Leakage along the Winslade Fault, about 400 feet south-east of the centre of the saddle, is unlikely to occur.

If the saddle is not used as a spillway no treatment of the saddle will be necessary.

DIVERSION AND OUTLET WORKS

For construction of an earth and rockfill dam a diversion tunnel will be required. There are three possible locations: through the left abutment of the dam, through the right abutment, or through the right bank, with the inlet portal upstream of the bend north of the damsite. Each alignment is of the order of 1200 feet in length. It is expected that in general tunnelling conditions would be good and lining would be unnecessary; however local poor conditions can be expected, such as the fault zone in DC2, and weathering near the portals. Lining will probably be required in these zones, and also at portals. Light support, mainly rock bolts may be needed in a few narrow zones.

Valve tower construction should not be difficult, but it will be necessary to allow for minor earthquakes in its design.

Coffer dam construction should not be difficult: see "Main dam".

CONSTRUCTION MATERIALS

Introduction

Core material, rockfill and rip-rap should be obtainable without difficulty. Filter material, fine aggregate and coarse aggregate may not be readily obtainable near the damsite.

A geological reconnaissance has been done, and possible deposits of core material have been tested by seismic surveys and mechanical augering. No laboratory trests have been done and much more field work is needed. The geological reconnaissance is summarised in the Table given below, which lists 32 possible sources of construction materials, most of which are not suitable. Many other deposits could be found but it is probable that these would be smaller or more distant than those already found. The auger drilling results are given in an unpublished report by the Commonwealth Department of Works (1967).

Core material

(a) Weathered volcanics (Paddy's River Volcanics and Uriarra Volcanics) appear to be generally suitable. Similar material has been used successfully at Corin Dam. The volcanics weather readily into a workable material of low permeability but tors often occur within the weathered material; it is therefore difficult to obtain a large uniformly highly weathered deposit. Poorer quality material could be used for the auxiliary dam if an earth-fill structure is built. The deepest weathering occurs in higher areas of gentle topography (e.g. Deposit 18).

Investigation of a site in Deposit 18 revealed at least 100,000 cubic yards of suitable material, about 2 miles by road from the damsite (between blocks 50 and 52 of Uriarra Forest). As the site is geologically typical of a fairly large area it is expected that the deposit will extend over a larger area or that other similar deposits could be found. It may be possible to find comparable deposits closer to the damsite.

Investigation of Deposit 7, within the proposed reservoir revealed insufficient material. It is unlikely that deposits of weathered volcanics, suitable for core material, will be found in the reservoir area but scree deposits, such as 32, may be suitable.

(b) Weathered granite (Shannon's Flat Granodiorite). Quarries and road-cuttings indicate that the nearby granite weathers very deeply, and it occurs over large areas. However the weathering is not generally complete enough for the granite to provide a good core material. Granite is exposed within three-quarters of a mile of the damsite but the distance by existing roads is considerably longer.

(c) Scree. These deposits consist of accumulations of weathered rock fragments at the foot, and on the lower flanks of slopes.

The most promising deposit is one of volcanic scree, covering old, high-level, Cotter River alluvium (32). It has been augered (CDW, 1967) but only along a firebreak, as access could not be obtained to permit drilling away from the firebreak. If it extends reasonably perpendicular to the firebreak it would provide several hundred thousand cubic yards of material. Seismic traverses across the firebreak should be able to detect the former riverbed and thus indicate the extent of the deposit without having to clear trees.

Deposits of scree of Ordovician sediments occur at 29 (5 miles upstream from damsite) and at 31 (nearer to the damsite). The first one is perhaps too far distant to be economical, whilst the second is probably too small.

(d) Alluvium. Along the Cotter River the alluvium is generally too coarse, permeable and lacking in cohesion for core material. On the tributary creeks clayey alluvium occurs in very small quantities.

Filter Material

(a) Alluvium. The Cotter River has very small deposits of material that range in particle size from sand to cobbles. The Murrumbidgee and Paddy's Rivers have large deposits of sand, but the occurrence of coarser material has not been examined. Pierce's Creek has a deposit of moderate size consisting of sand, silt and gravel (19), which could be used as a source of part of the filter requirements.

(b) Crushed rock. It may be necessary to crush filter material from one of the rocks suggested for rockfill.

Rockfill and Rip-rap

(a) Rock of the Uriarra Volcanics appear to be the most suitable, as it is available near the damsite and is strong when fresh, is chemically stable and is massive. Joints have moderate-spacing and the rock should break to give a satisfactory range of fragment sizes. Partly weathered material could be used in the auxiliary dam, but better material is required for the main dam. No quarry sites have been selected but there appears to be a number of suitable locations. The same quarry could provide rock for crushing to filters, coarse aggregate and even fine aggregate.

TABLE OF POSSIBLE CONSTRUCTION MATERIALS

NUMBER (Plates 1 & 2)	LOCATION	MATERIAL	POSSIBLE USE	ESTIMATED QUANTITY
1	Left bank saddle, near damsite	Weathered Uriarra Volcanics	Earth fill	Moderate
2	Upstream of damsite	Uriarra Volcanics	Rock-fill	Moderate-large
3	"	"	"	Large
4	Near Vanity's Crossing	Sand and gravel	Fine aggregate	Small
5	"	High-level alluvium: sand and cobbles	Filter	Very small
6	"	Alluvium: sand	Fine aggregate	"
7	Near Vanity's Crossing at road junction in block 195	Weathered Uriarra Volcanics	Core	Small
8	West of Vanity's Crossing	Scree. Weathered Uriarra Volcanics	Core	Small
9	"	"	"	Small
10	"	"	"	Moderate
11	Near river crossing, 3 miles upstream of damsite	Alluvium: sand	Fine aggregate	Very small
12	Near Mount Hardy	Weathered granite (existing quarry)	Earth fill	Large
13	Right bank saddle	Weathered Uriarra Volcanics	Rock-fill or earthfill in auxiliary dam	Small

14	Mount Condor	Uriarra Volcanics	Rock-fill	Large
15	Near Mount Condor	"	"	"
16	Near Lees Creek	Paddy's River Volcanics	"	"
17	Coree Creek Crossing	Alluvium: clay	Core	Moderate
18	Between Cotter River and Brindabella Road; large area	Weathered Uriarra Volcanics	Core	Large
19	Pierce's Creek	Alluvium: gravel, sand and silt	Filter	Moderate
20	Near Pierce's Creek	Weathered granite (Ref. CDW, 1965)	Earth fill	Moderate
21	Near Tidbinbilla Road. This location is a road-cutting but is probably typical of a large area	Weathered granite	"	Large
22	Casuarina sands	Alluvium: sand	Fine aggregate	Moderate
23	Mugga Quarry	Porphyry	Coarse aggregate	Large
24	Point Hut	Alluvium: sand	Fine aggregate	Large
25	Murrumbidgee River	"	"	"
26	Murray's Corner, Paddy's River	Alluvium: sand and gravel		
27	Upstream of 26, Paddy's River	"		

28	Between Tidbinbilla Road and Pierce's Creek; existing quarry, but large area nearby is probably similar	Weathered granite	Earth fill	Large
29	Cotter River Crossing about 5 miles upstream of damsite	Scree: Ordovician sediments	Core	Large
30	Near damsite	Alluvium: clayey sand	Core	Small
31	Pierce's Creek - Vanity's Crossing Road	Scree: Ordovician sediments	Core	Small
32	Vanity's Crossing Road	Scree: Uriarra Volcanics. Also some alluvium	Core	Moderate

(b) Lavas of the Paddy's River Volcanics are altered, have a foliation and crop out farther from the damsite than the Uriarra Volcanics; the latter are therefore more suitable for use as rock-fill and rip-rap.

(c) Ordovician sediments consist of interbedded sandstone and slate. The sandstone could be used but is generally intermixed with unsuitable shale; it is therefore unlikely that a useable source of rock-fill could be found in these rocks.

(d) Granite is generally deeply weathered and is too far from the damsite for economic use.

Fine aggregate

(a) Alluvium. Deposits on the nearby rivers and creeks are too small and dirty for use. Large clean sand deposits occur on the Murrumbidgee River, for example just above its junction with the Cotter River. Most other sand deposits on the river are difficult to reach. The nearest deposit being worked is at Point Hut, about 28 miles away.

(b) Finely crushed rock, could be produced from one of the sources suggested for coarse aggregate, below.

Coarse aggregate

(a) Crushed Uriarra Volcanics. In general this rock is suitable as it is hard, massive, easily obtained and is expected to crush into a suitable shape. Somewhat similar rock from Mugga Quarry is widely used as concrete aggregate. However it is possible that the Uriarra Volcanics may be reactive with cement; the glass which originally made up the groundmass is devitrified but one of the products of devitrification is cryptocrystalline quartz, which could be reactive. Thin-section study of one specimen also revealed a high proportion of clay minerals in the rock (Appendix 2. In specimen CC12 vermiculite makes up 15% of the rock, and other clay minerals also occur). If the clay minerals are a product of weathering, as seems likely, fresh rock would not contain the clay minerals but the cryptocrystalline quartz would still be found. Standard acceptance tests will be necessary to determine the suitability of the rock.

(b) The Paddy's River Volcanics (crushed) do not provide a suitable source of coarse aggregate. The rock is so altered that it usually appears to be weathered; further it is located farther from the damsite than the Uriarra Volcanics.

(c) Ordovician sediments (crushed). Silicified sandstone could be used but it is interbedded with slate and therefore could not be quarried economically.

(d) Known surface exposures of granite are deeply weathered.

(e) Mugga Porphyry is being crushed at Mugga Quarry, about 24 miles by road from the damsite.

(f) Alluvium deposits may be found to be suitable but most seem to be too small and too dirty, and to lack the required particle sizes. Some deposits are described in "Filter material" above.

CATCHMENT AREA

The catchment area lies in granite, Ordovician sediments, and Silurian sediments and volcanics. It is mountainous, the highest peak being Mount Bimberi, 6274 feet above sealevel. The higher parts of the catchment are snow-covered in winter, and melting snow contributes appreciably to the flows of the Cotter River in some seasons.

The catchment covers 172 square miles, lies almost entirely within the A.C.T., and is uninhabited. No economic mineral deposits are known within the catchment but sulphide mineralization has been reported from the head of Coree Creek.

RESERVOIR AREA

The reservoir area, for a top water level of RL 2030 feet, extends more than four miles up the Cotter River, and also up Coree and Lees Creeks. It has a volume of 15,000 million gallons (54,800 acre feet). Most of the reservoir area is underlain by Upper Silurian Uriarra Volcanics but the upper part of the reservoir area, and other parts south of the Winslade Fault, are on Ordovician sediments. The Lees Creek and Coree Creek arms of the reservoir are cut by the Pig Hill Fault, west of which Middle Silurian Paddy's River Volcanics occur. The terrain is steep.

A field study of the area did not show any geological features that would make the area in any way unsuitable as a reservoir. No mineral deposits are known to occur within the reservoir area. The following possible means of reservoir failure investigated in the field but all are regarded as unlikely to cause trouble.

(a) Leakage along Pig Hill Fault. The nature of the fault is not known; it is not apparent at the surface in most places but where it crosses the divide of the catchment area it is evident as a small very short saddle. The possible leakage path is 2½ miles long.

(b) Leakage through limestone caverns. Limestone is known to occur in the Paddy's River Volcanics elsewhere, but does not occur in or near the reservoir.

(c) Leakage along Winslade Fault. The leakage path is about one mile long and under a low head. The fault zone probably has a maximum width of 20 feet, and is thought to be a generally impermeable breccia. Adjacent rock is not highly fractured.

(d) Leakage through a suspected fault downstream of the damsite, nearly parallel to the Winslade Fault, and cutting through a meander in the Cotter River (see Plate 2). The possible existence of the fault is inferred from colour changes in the adjoining rock and the alignment of gullies. The possible leakage path at top water level is about 800 feet. Further investigation will be necessary.

(e) Landslides in Paddy's River Volcanics. Although slopes are very steep, there is only very thin scree cover and the rock does not have any weak zones along which slides could occur. Minor slips will probably occur but these should not affect the reservoir unduly.

(f) Landslides in Uriarra Volcanics. Slopes in places are steep, but scree cover is thin. Major slides are unlikely to occur but one area which should be examined more carefully in future investigations is the right bank of the Cotter River at W38140/S13340.

(g) Landslides in Ordovician sediments. Scree cover within the reservoir is not very thick and slopes are gently-sloping. Minor slips could occur. Bedding planes in the sediments are possible causes of slips, although there are no soft beds. The beds generally dip towards the river, but in most of the reservoir area they dip at angles greater than 57°, steeper than any natural surface. In the upstream part of the reservoir (south-east corner of Plate 2) the bedding dips at lower angles than the natural surface. Field examination of this area in any future investigation is warranted. Slides of a magnitude sufficient to impair the reservoir are not expected.

(h) Slip in alluvium. No alluvial terraces occur so no problem exists.

CONCLUSIONS

1. The proposed damsite and environs, including much of the reservoir, is in strong, massive acid volcanics of Upper Silurian age. The volcanics are faulted and jointed, and probably folded. Soil cover generally is slight and rock exposure extensive; the bedrock is mainly fresh at river level to slightly to deeply weathered (more than 50 feet in places) at and above the proposed top water level.

2. The region has a record of minor seismic activity. It is not expected that any earthquake shocks likely to be experienced would seriously affect dam embankments or reservoir banks but some allowance should be made for earthquakes in the design of any earthquake-sensitive structures.

3. The main damsite has an attractive configuration for a top water level at RL 2030, the valley being roughly V-shaped with about 40° slopes. However a saddle to the north-east of the damsite (left bank) would require an auxiliary dam about 80 feet high and 800 feet long at the crest. This saddle is not suitable for a spillway but a spillway could be constructed in a saddle in the right bank, about 1400 feet downstream

from the proposed axis of the damsite, across the base of a complex bend in the river.

4. The main damsite is in generally strong, massive and jointed acid volcanic rock with little soil cover. Exposed rock is generally fresh to slightly weathered on the lower slopes but is deeply and irregularly weathered in places, in the upper part. Weathering appears to be mainly along joints and appears to have seriously affected the top left abutment. The right abutment has not been tested by drilling but a drillhole down the left abutment revealed a pug-filled unweathered fault near river level which will require further investigation.

Geologically, the best axis for a dam is possibly through points A and P (Plate 3). The site appears, on present evidence, suitable for either a concrete arch type of dam or for all types of gravity structure; however an arch dam would probably require a large thrust block in the upper left abutment and may be affected by the fault in the lower left abutment. Further studies would also be needed of the incidence, orientation and weathering of all faults and joints on the site to confirm the feasibility of an arch-type dam. Any defects on the site are likely to affect only the extent and type of foundation treatment for any gravity-type dam, and not the feasibility. Permeability of the abutments and foundation is generally very low.

5. Foundations for the auxiliary dam in the left bank saddle are deeply, and possibly irregularly, weathered. However the weathered material is generally strong enough at shallow depth to support an earth-fill, and probably an earth-cored rock-fill, dam. The foundations have a low permeability. A fill-type dam therefore appears to provide the best type of structure; however, because of the configuration of the saddle large volumes of fill material would be required. Further investigation may show that a composite fill-concrete structure would be the most economical.

A possible fault through the saddle should not seriously affect the suitability of the site but may have an influence on design and foundation treatment.

6. If a fill-type main dam is built a spillway could be put through the right bank saddle. Suitable foundations for a sill should be found at a shallow depth below RL 2030. Extensive excavation would be needed to provide an upstream approach channel. The quality of the excavated material is likely to vary from point to point and with depth; the material could probably be used in the auxiliary dam (if a fill-dam and transport to the site proves economical) or the coffer dam, but allowance should not be made for use in the main dam without extensive testing. The foundation conditions for a spillway chute have not been examined but should prove satisfactory with minimum excavation.

Alternative spillway sites on either side of the main dam may prove cheaper than the saddle site if the excavated rock could be used as fill for the dam.

7. No serious problems are expected in providing any necessary diversion works in view of the general freshness and strength of the country rock at river level. Further investigation will be needed to determine the best location, and support requirements, for any diversion tunnel and related post-construction outlet works.

8. No problems are expected from reservoir leakage or serious bank instability. The existence and properties of the possible fault in the ridge forming the right bank, a short distance downstream of the axis of the proposed damsite should be investigated.

9. Construction materials. Considerable additional investigations are needed but there appear to be: ample readily available rock for rock-fill, rip-rap, and probably (subject to reactivity tests) for concrete aggregate.

Satisfactory earth material for an earth core or embankment for the auxiliary dam. Probably sufficient suitable material could be found for an earth-cored main dam but it is not known whether enough could be found, at economic distance from the site, for a main embankment of earth.

Nearby sources of natural fine sand and filter material are poor and probably unsatisfactory; these materials would probably have to be obtained from the Murrumbidgee River, from existing suppliers in Canberra or by crushing rock near the site.

RECOMMENDATIONS

Should further consideration be given to the Coree damsite, the following additional investigation is recommended to provide detailed feasibility and preliminary design data; further work again would probably be required to complete the detailed design and to prepare tender documents:

1. Outcrop mapping of the immediate environs of the main dam, auxiliary dam, spillway and ancilliary structures at 1 inch : 40 feet

2. Outcrop mapping of the area of Plate 3, at scale 1 inch : 100 feet. Some additional reservoir mapping may also be necessary.

3. Stripping, sluicing and/or hand-clearing of a zone 10 feet wide along the preferred axis of the dam, to give an unbroken exposure of bedrock. If the comparative costs of an arch dam and a gravity dam are to be estimated, axes for both types of dam may require stripping. Areas stripped should be mapped at 1 inch : 10 feet.

4. Diamond drilling should be carried out on the damsite to further check the soundness of the abutments, and explore and define known structures and those revealed by stripping. If an arch dam is considered the upper left abutment will require further testing; possibly a short-tunnel in one abutment, to verify geological conditions and permit jacking tests to be carried out, would be justified.

5. To give further information on the uniformity, or diversity, of foundation conditions for the auxiliary dam on the left bank saddle, costeans or pits should be dug in those parts where the power auger could only penetrate a few feet and further auger or diamond-drill holes should be sunk along the remaining parts of the axis. Undisturbed samples should be collected for laboratory testing and in situ bearing and permeability tests conducted. Testing should be extended over the whole of the prospective foundation area, on both sides of the axis.

6. If a fill dam is considered, and assuming that no other spillway site is considered to be more attractive, the right bank saddle spillway site should be further investigated by (a) stripping, sluicing and/or hand-cleaning the centre line of the spillway chute, at least in the lower parts where overburden is shallow; if selected at this stage, the site for any deflector device should be cleared and tested more extensively than elsewhere.

   (b) in those areas of the chute where weathering is deeper (i.e. the upper part), in the crest and approaches and where the spillway chute would discharge into the river, power augering should be undertaken to determine the depth of rippable or erodable material. Some diamond drilling would also be required in the deflector and crest areas, and probably in the chute and approach channel areas (the latter to determine the suitability of any rock as fill for the dams). The significance of the two gullies west of the saddle crest should be determined.

   If a concrete dam with over-dam spillway is considered, the spillway and apron area of the dam would require investigation by sluicing and probably diamond-drilling.

7. Investigations recommended under Items 3-6 above should be supplemented by geophysical, particularly seismic, traverses. If an arch dam is considered, appropriate seismic testing will give information on in situ strength and elasticity of the foundation rocks. The field tests should be supplemented by laboratory testing of drill core.

8. Depending on the detailed surface mapping, some trenching and/or diamond-drilling may be needed to check the existence and properties of the possible fault referred to in Item 8 of "Conclusions".

9. A preferred location and alignment for the diversion and outlet works, including tunnel, tower and coffer dam should be selected and investigated in sufficient detail to ensure that no gross defects occur. At this stage stripping, detailed mapping and seismic testing would probably be involved but some diamond drilling may be advisable.

10. Construction materials. Further exploration should be carried out to ensure that the nearest available adequate sources of all types of construction material are located, followed by field proving of selected deposits and laboratory testing of representative samples of the materials.

11. Investigation of access road locations and proving of road-making materials may be advisable at this stage.

REFERENCES

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

CLEARY, J.R., 1967 - "The Seismicity of the Gunning and surrounding areas, 1958-1961". Geol. Soc. Aust. v 14(1).

CLEARY, J.R., DOYLE, H.A., & MOYE, D.G., 1964 - Seismic activity in the Snowy Mountains region and its relationship to geological structures. J. geol. Soc. Aust. 14(1), 23-29.

C.D.W., 1965 - Geological investigation Bendora Water Main. Comm. Dept Works. Unpubl. rep.

C.D.W., 1967 - Major water storage sites; auger drilling investigation. Comm. Dept Works. Unpubl. rep.

FISHER, N.H., 1966 - Pyroclastic flows. Bur. Miner. Resour. Aust. Unpubl. rep.

MALCOLM, D.K., 1954 - The geology of the Cotter River and Uriarra area, Australian Capital Territory. Bur. Miner. Resour. Aust. Rec. 1954/71 (unpubl.).

NOAKES, L.C., 1946 - Damsites on the upper Cotter Valley between Bushranger's and Collin's Creeks. Bur. Miner. Resour. Aust. Rec. 1946/12 (unpubl.).

NOAKES, L.C., 1948 - Summary of the regional survey of the Cotter River area carried out by student geologists W.J. Orme and M.M. Harris. Bur. Miner. Resour. Aust. Rec. 1948/31 (unpubl.).

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

APPENDIX 1

DEFINITIONS OF TERMS

Degrees of Chemical 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 up 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 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

Joints

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

Joint sizes
Small joints = size < 1 x 1 ft.
Moderate-sized joints = size 1 x 1 - 6 x 6 ft.
Larse joints = size > 6 x 6 ft.

Joint spacings	Closely-spaced joints: spacing < 1 ft. Moderately-spaced joints: spacing 1 - 6 ft. Widely-spaced joints: spacing > 6 ft.
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 $> 60^\circ$ to the horizontal, or in drillcore, at angle $> 60^\circ$ to the plane perpendicular to the core axis.

APPENDIX 2

SAMPLE DESCRIPTIONS

by C.E. May

67360083 Deformed Quartz Dellenite

Field No. CC4 Pady's River Volcanics

In handspecimen the rock is very iron stained, but on fresh surfaces it is light coloured with large deformed quartz grains roughly aligned, most of them showing typical strain shadows of chlorite. Biotite grains are also parallel to this foliation.

Under the microscope the quartz grains (25%) are moderately to strongly resorbed, show strong undulose extinction, strain lamellae and many have been fragmented with narrow crush zones between the fragments. The strain shadows visible in hand specimen are composed of biotite (15%), or a clay mineral (5-8%) possibly vermiculite. Many of the biotite grains are partly degraded to chlorite and contain grains of an opaque mineral along the cleavage planes; they have been strongly warped and kinked.

Former plagioclase phenocrysts in the groundmass now consist of fragments which have been stretched out parallel to the lineation. Alteration has taken place around the edge of the fragments so that part of each grain is quite fresh while the rest may consist of sericite, chlorite and clay minerals.

The original equidimensional, fine-grained, groundmass now consists of elongate grains, paralleling the same general trend as the phenocrysts. Mineralogically the groundmass consists of quartz, potash feldspar (10-15%), chlorite, and sericite. Patches and veins of a colourless clay mineral also occurs as an alteration product.

The rock is a calcic quartz dellenite that has been tectonically deformed after emplacement.

67360084 Devitrified moderately welded dellenitic ash flow tuff

Field No. CC5 Uriana Volcanics, Swamp Creek Member

In hand specimen this is a fine-grained, dark, greyish rock with prominent phenocrysts of reddish pink feldspar, and large scattered black rock fragments. The rock is massive and shows no visible foliation in hand specimen.

Under the microscope the rock can be seen to consist of quartz (20-25%), plagioclase (20-25%), pumice fragments (15%) rock fragments (3-5%), biotite (1-2%), and opaque minerals (1-2%) set in a groundmass (35-40%) of devitrified material. The pink colour of the feldspar, seen in hand specimen, is produced by tiny grains of hematite scattered through the slightly weathered plagioclase: the hematite was probably exsolved during crystallisation. The grains have an average composition of sodic andesine and show slight alteration to sericite; some calcite has developed. The small quartz grains are angular while the large ones are sub-rounded and strongly resorbed. Most former biotite grains have weathered to chlorite and a few have epidote developed along the cleavage planes. Rock fragments up to 5 mm across are common; they vary in composition but are all acid igneous rocks, both volcanic and plutonic.

The pumice fragments have been deformed: the tubular structure is compressed although still visible. They have been altered to chlorite and calcite. Rare, well-formed, shards with well defined curved boundaries also occur in the groundmass. The rest of the groundmass is devitrified and consists of: quartz (8-10%), potash feldspar (17-20%) in part strongly altered to chlorite (10-12%), and minor calcite. Although devitrified, the groundmass still retains much of the ash flows characteristics, with evidence of shards moulded onto the phenocrysts. No vesicles were seen.

The rock is a ferromagnesian-poor, basic dellenitic rock with textures indicative of a devitrified, moderately welded ash flow tuff.

This rock differs from the specimen of the Vanity Member of the Uriarra Volcanics (specimen 67360088) in the following respects: (i) it contains less ferromagnesian minerals, (ii) it contains a smaller percentage of potash feldspar, (iii) the ferromagnesian mineral is biotite not amphibole, (iv) it contains abundant rock fragments and pumice fragments which are absent from specimen 6760088.

67360088 Haematised, devitrified, welded quartz rhyolite ash flow tuff

Field No. CC12 Uriarra Volcanics, Vanity Member

In hand specimen this is a light purplish-colored rock with a layering defined by ferromagnesian prisms and aligned feldspar grains. Vesicles are stretched parallel to the layering.

In thin section it can be seen that the purplish color is due to extensive development of hematite. Former ferromagnesian grains (15-20%) - probably originally hornblende - now consist of hematite, sphene, kaolinite, and minor chlorite. The quartz grains (25-30%) are cracked and many are strongly resorbed; the cracks are infilled by hematite and the grains are mantled by the same mineral. The feldspar grains (15%) are mostly anhedral and occur largely as broken, altered, aggregates of vermiculite. After staining the slide, the feldspar was identified as plagioclase.

The groundmass is very altered; it consists of a little quartz and potash feldspar (25-30%) altered to chlorite and kaolin and is heavily hematised. Clay minerals occur in the groundmass in cuspate-shaped aggregates, which suggests that they may have been glass shards.

Alteration of the groundmass and dense welding has destroyed most of the texture but a distinct lineation alignement of the phenocrysts is apparent. The rock is veined and appears to have been mechanically disrupted. Possibly the rock was a flow but because of the shard-like structures it has been named an ash flow tuff.

67360089 Leucocratic Ash

Field No. CC13. Uriarra Volcanics, Vanity Member

In hand specimen this is a whitish rock with reddish-brown ovoid inclusions. It is fine-grained and compact, shows rough bedding and contains small discordant iron-stained veins. In thin section it appears very uniform, consisting of very finely crystalline quartz and kaolin with small stringers of sericite throughout. An ovoid inclusion has tiny crystals of biotite in an even finer groundmass. Around the includsion is a fine-grained tail of biotite; within it are two parallel lines of en echelon cracks filled with biotite. The inclusions are possibly very small bombs and would fall in the lapilli size range. The rock is a consolidated ash.

APPENDIX 3

WATERPRESSURE TESTS

Method of Calculation of Joint Permeabilities

In water pressure tests a section of a drillhole is sealed off and water pumped into the test section. Water pressures and water losses are recorded, and joint permeabilities calculated.

Test sections were usually about 20 feet long, but 10-foot sections were used shen the required test pressures could not be reached by the pump. Tests were of 5 minutes duration and were repeated once or twice; repetitions rarely showed any variation in flow. Gauge pressures of up to 100 pounds per square inch (psi) were reached. Water was supplied direct from Mindrill 750 or 1200 reciprocating pumps, and mechanical packers of length 20 inches (two rubbers) were used. Test sections in most cases were the bottom 20 feet of the hole at that stage in the drilling and packers were only used at the tops of the test sections.

The following procedure was used to calculate joint permeabilities; the symbols are defined below:

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 N-size hole was calculated by the formula:

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

The value of k was read off a graph. The factor is theoretically derived and allows for leakage paths at the ends of test sections different from those at the centre of the test sections.

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

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

1. $l > b$ $\quad p = 0.44 \sin\theta \left(\frac{a}{2} + \frac{b}{2} + m\right)$
2. $a < l < b$ $\quad p = 0.44 \sin\theta \left(\frac{2lb - a^2 - l^2}{2(b-a)} + m\right)$
3. $a > l$ $\quad p = 0.44 \sin\theta \,(l + m)$

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 was screwed into the collar. This occurred with DC5 but it was not possible to measure the (negative) value of l because water was coming to the surface from outside the standpipe. For this hole a value of l = 0 was used, although a positive value of l was probably more accurate above the depth 77'6" before the hole started making water and a negative value more accurate below hole depth 77'6".

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 empiirical 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 joints 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:

a	slope depth to top of test section	feet
b	slope depth to bottom of test section	feet
d	gauge pressure	psi
h	leakage rate, in imperial gallons per minute	gpm
i	length of test section = b-a	feet
k	conversion factor equivalent to 20 feet of NX hole	no units
l	slope depth to water table	feet
m	slope height of gauge above collar	feet
n	length of supply line	feet
p	water column pressure, average for test section	psi
q	friction loss in supply line	psi
r	friction loss in peaker	psi
s	effective test pressure	psi
t	linear leakage rate	gpm/foot
Ro	radius of hole	inches
Θ	plunge of drill hole	degrees
U	joint permeability	feet/year

Table of Joint Permeabilities

The following joint permeabilities were calculated. The lefthand column gives the test sections (feet) and the righthand column the joint permeability (feet/year).

DC1

l = 82	m = 0
23'8- 43'8	30
43'1- 63'1	70
62'8- 82'8	0
82'5- 102'5	30
102'2- 122'2	0

DC2

l = 302	m = 5
18 - 38	410
38 - 58'4	530
38 - 48	850
48 - 58	840
58 - 78'8	380
58 - 68	320
68 - 78	240
78'8- 98'10	30
98'10-119'2	10
119'2 -139'4	10
139'4 -159'8	0
159'8 -179'10	20
179'10-199'8	40
199'8 -220	10
220 -240	80
220 -230	10
230 -240	150
240 -260	160
240 -250	140
250 -260	240
260 -280	130
260 -270	190
270 -280	230
-280 -290	210
290 -300	180
300 -312'7	80
312'7 -324'3	not tested

DC3

l = 67	m = 0
19'7 - 39'7	10
39'11 - 59'11	40
60'8 - 80'8	10
75'2 - 95'2	10

DC4

l = 27'2	m = 0
2'11 - 41'11	0
41'11 - 62'6	10
62'6 - 83'4	10
83'4 -103'11	10
103'11 -129'11	10
129'11 -151'10	10

DC5

l = 0	m = 0
7 - 30	90
30 - 50'2	60
49 - 69	30
69 - 92'5	30
90 100	160

Maximum gauge pressure 100 psi, in test sections, 220'-230' and 230'-240' of DC2.

Maximum effective pressure 187 psi in test section 220'-230' of DC2.

Maximum leakage rate 13.0 gpm in test sections 48'-58' and 240'-260' of DC2.

Maximum joint permeability 850 feet/year in test section 38'-48' of DC2.

Average joint permeability 130 feet/year

Comment on Results

Except for test sections between 230' and 312'7" of DC2, the corrections and assumptions made in the calculation of joint permeabilities appear to be valid. A plot of linear leakage rates against effective test pressures shows an approximately linear curve passing through the origin. Hysteresis does not occur.

Between 220' and 312'7 assumptions made in the calculation of joint permeabilities are not valid. Results plot on an approximately linear curve which cuts the pressure axis at a pressure of about 100 psi. That is, at effective test pressure of 100 psi, a linear leakage rate of 0 is indicated by extrapolation. It would be expected from theoretical considerations that a finite leakage would occur at that pressure, and that leakage of 0 would occur at a pressure of 0. The empirical relationship is $t = \frac{U}{31,200}(S - 100)$ whilst the theoretical realtionship is $t = \frac{U}{31,200}S$. A joint permeability (U) calculated from the first formula would be of the order of 1000 feet/year, whilst joint permeabilities calculated from the second formula are of the order of 200 feet/year. Thus the joint permeabilities given for hole DC2, 230' - 312'7", are unreliable figures.

The unusual results may be due to the higher water pressures causing opening of fractures, or cleaning out of clay from fractures, thus allowing higher leakage rates. An alternative explanation is that saturation of rock adjacent to the drillhole occurs, producing a false water table. However this is an unlikely explanation as the rock is too permeable to become saturated easily.

Joint permeabilities are low in highly weathered rock and in fresh rock. Higher joint permeabilities are obtained in slightly to moderately weathered rock, and in fractured fresh rock.

Joint permeabilities may be a guide to grout consumption required in dam construction. Rock of joint permeability less than 600 feet/year should involve low grout consumption, 600 - 2000 feet/year moderate grout consumption, and greater than 2000 feet/year high grout comsumption.

APPENDIX 4

LOGS OF DIAMOND-DRILL HOLES

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT COREE DAMSITE, COTTER RIVER, A.C.T.
LOCATION LEFT BANK SADDLE SLOPE CHAINAGE 605 OF LINE CD (SMA DRAWING No. 3701)
ANGLE FROM HORIZONTAL 60°
DIRECTION 231° mag.
COORDINATES W 33285/S 7870 STROMLO GRID
R.L. 1963

HOLE NO. **DC1**
SHEET 1 OF 2

RL / DEPTH	DEPTH & SIZE OF CORE
1963 / 0	NX CASING
	10'3
1954 / 9	NMLC 11'9
	12'11
	18
1946 / 17	20
	26'8
1937 / 26	30
	36'6
1928 / 35	40
1920 / 43	50
	52'6
	53'6
	56
	56'6
1911 / 52	60
1903 / 60	70
1894 / 69	80

ROCK TYPE

ACID VOLCANIC ROCK

Crystals of feldspar and quartz and occasionally biotite in a glassy matrix.

Crystals predominate over matrix.

Feldspar white.

No xenoliths.

DESCRIPTION

Completely weathered; also soil; mixed-up. colours grey & brown respectively

Highly weathered & completely weathered (clayey) Brown.

Highly weathered brown, clayey

Compl. weath. clayey

Moderately weathered, brown.

Highly weathered, brown.

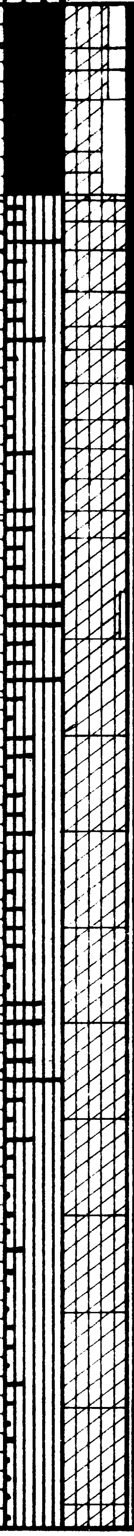
Slightly & moderately weathered; blue-grey, grey-brown, brown.

Highly weath., brown

Highly weath., brown

Fresh, blue-grey; slight & mod. weathering along joints, up to 6 in. width.

FRACTURE LOG | LIFT & % CORE RECOVERY | CASING



STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES

Fractures due to drilling, very few recognisable as joints. More intensely fractured parts are more weathered.

13 Clay spread along plastic tube, but occurs only along some joints. 20

17 Fractures are joints, mostly low-angle except for one high-angle joint. 24

25'4 Drilling fractures

Fractures are joints. 31

Fractures due to drilling 33

Fractures are joints 35'6

Fractures are joints as well as drilling fractures. 40

Fractures joints.

Joints are mainly low-angle, 2 at a moderate angle. 28-9 ft. one parallel to core. Joints uneven surface iron stained. Some moderate-angle joints slickensided. Green seam 0.2 inch. No veins.

Fractures are joints even where closely-fractured (except for 56-56'6 where weathering has helped cause drilling fractures). Joints are at all angles, iron-stained red and black, slightly weathered. No veins.

WATER LEVEL

DRY

WATER PRESSURE TEST Loss in gallons per minute per foot

10'3 - 25'4 cored in plastic except 11'7 - 12'11.

10'3 - 11'7, 12'11 - 14'9, 15 - 16'10, 23'7 - 25'4 taken by CDW and not put in corebox.

CORED IN PLASTIC

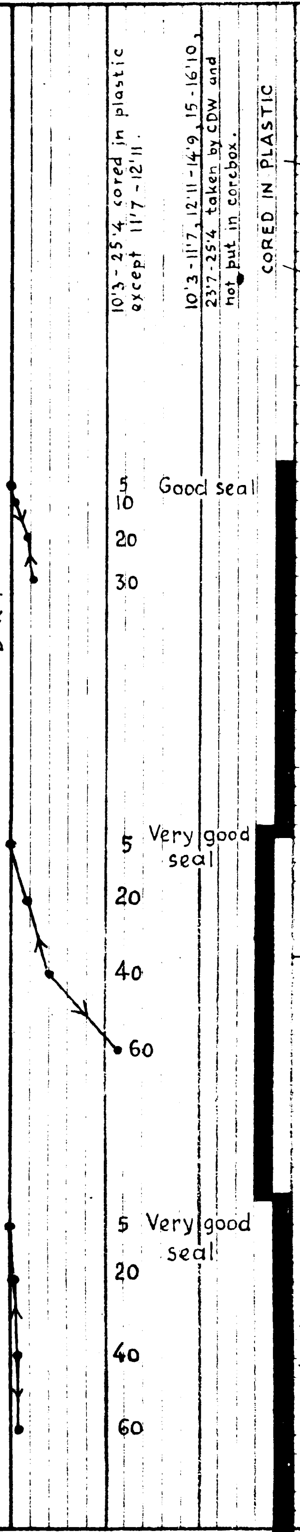


PHOTO REF. NO.

NO PHOTOS

M/715/21

M/716/20

M/715/21

NO PHOTO

M/716/21

M/716/22

M/716/23

M/716/24

M/716/25

M/716/26

M/716/27

M/716/28

M/716/29

M/716/30A

M/716/31A

M/716/32A

DRILL TYPE BOYLES BBS2
FEED HYDRAULIC
CORE BARREL TYPE NMLC SPLIT INNER TUBE AND PLASTIC INNER TUBE
DRILLER M.R. PARCELL
COMMENCED 25.2.68.
COMPLETED 7.3.68.
LOGGED BY D.A. BUCHHORN
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

Full water return obtained troughout hole

Veins are calcite and/or quartz. Calcite often leaches out and in some cases leaves quartz, coated with iron oxide. A small cavity is formed.

Degrees of weathering defined in text.

WATER PRESSURE TESTS
PACKER TYPE MECHANICAL
SUPPLY LINE N-ROD, STREAMFLOW 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 BMR FILM No & FRAME No.
COLOUR

I 55/A16/471-1.

BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

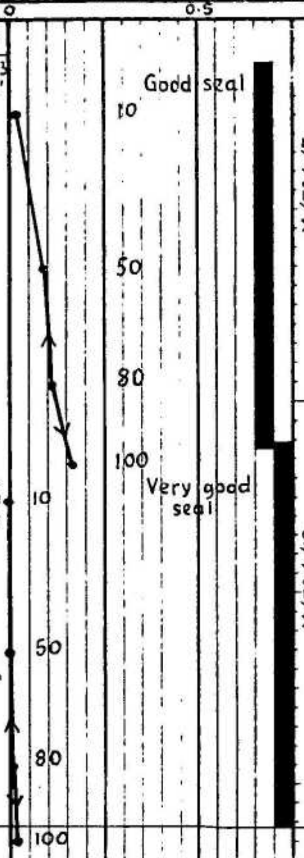
GEOLOGICAL LOG OF DRILL HOLE

PROJECT COREE DAMSITE, COTTER RIVER, A.C.T.
LOCATION LEFT BANK SADDLE SLOPE CHAINAGE 605 OF LINE CD
(SMA DRAWING No. 3701)
ANGLE FROM HORIZONTAL 60°
DIRECTION 231° mag.
COORDINATES W33285/S7870 STROMLO GRID
R.L. 1963

HOLE NO
DC1
SHEET 2 OF 2

[illegible] TYPE	DESCRIPTION	RL / DEPTH	DEPTH & SIZE OF CORE	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL
		1894			
ACID VOLCANIC ROCK Feldspar white, no xenoliths	Fresh, slight weathering along joints. Blue-grey.	69	80 NMLC 84	Fractures are joints Joints are all angles, slightly weathered.	DRY 27.3 82'
85 ACID VOLCANIC ROCK	Moderately weath. Brown.		84'6	84 Fractures - 10% due to drilling, esp. in weathered part, 60% joints, 30% veins. Joints - all angles, slightly weathered, stained.	
Feldspar, pink & white. No xenoliths.	Fresh, blue-grey.	1885 78	90	90 Veins - of calcite and quartz, but calcite leached out. About 20. Half of them are broken. < 0·3 in. Moderate angles.	
		1877 86	100	Fractures consist equally of drilling fractures, joints and veins. Joints - all angles, stained. Veins - about 35, up to 0·5 inch. Some leached, and some of those broken. Moderate and high angles.	
100 ACID VOLCANIC ROCK Feldspar pink. No xenoliths.		1868 95	110	110 Fractures - mostly veins, esp. 118 - 120'6, some joints. Joints - all angles, fresh, some ironstained. Veins - 3 unleached, 13 leached, up to 0·25 inch. High angles. Also 8 veins, calcite & quartz, up to 0·1 inch, unleached, low angles.	WET
		1859 104	120		
		1857 106	122'2		

END OF HOLE



M/734/7
M/734/10
M/716/32A
M/716/33A
M/716/34A
M/716/35A
M/716/36A
M/716/37A
M/735/1
M/735/2
M/735/3

DRILL TYPE BOYLES BBS2
FEED HYDRAULIC
CORE BARREL TYPE NMLC
SPLIT INNER TUBE AND PLASTIC INNER TUBE
DRILLER M.R. PARCELL
COMMENCED 25-2-68.
COMPLETED 7-3-68.
LOGGED BY D.A. BUCHHORN
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

See sheet 1.

WATER PRESSURE TESTS
PACKER TYPE MECHANICAL
SUPPLY LINE N-ROD, STREAMFLOW COUPLINGS
VERTICAL SCALE 50 PSI/IN
Figures given are gauge pressures
Test sections are indicated graphically by [illegible]
PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE BMR FILM No.
\ FRAME No.
COLOUR

I 55/A 16/471-2.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT COREE DAMSITE, COTTER RIVER, ACT
LOCATION HIGH ON LEFT BANK, ON DAM AXIS.
SLOPE CH. -10 OF BA (SMA PLAN NO. 3701)
ANGLE FROM HORIZONTAL 60°
DIRECTION 231° mag.
COORDINATES W33785/ S 8220 STROMLO GRID
R.L. 2057

HOLE NO. **DC2**
SHEET 1 OF 5

ROCK TYPE | DESCRIPTION | RL / DEPTH | 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 NO. CORE BOX, CORE BARREL

ROCK TYPE

ACID VOLCANIC ROCK
Crystals of feldspar and quartz and lesser biotite in an aphanitic matrix.
Crystals predominate over matrix.
Feldspar white.

DESCRIPTION

Moderately-completely weathered, brown.

Slightly weathered (brown) but some is fresh (grey). Moderate weathering (½ inch) along joints.

Moderately weathered, brown

Moderately to completely weathered along joints, some clay developed

Fresh (grey) with slight to moderate weathering up to ¾ in and clay up to ½ in along joints. Clay slippery when wet

Fresh to slightly weathered, grey, grey-brown brown.

Moderately weathered, brown.

Highly weathered

Highly weathered, clayey (3/8 in clay)

Fresh, grey, slight weathering up to ¼ in along joints

Highly weathered

Slightly weathered, moderate weathering along joints.

Fresh, slight weathering 1/10 inch – 12 inch near joints.

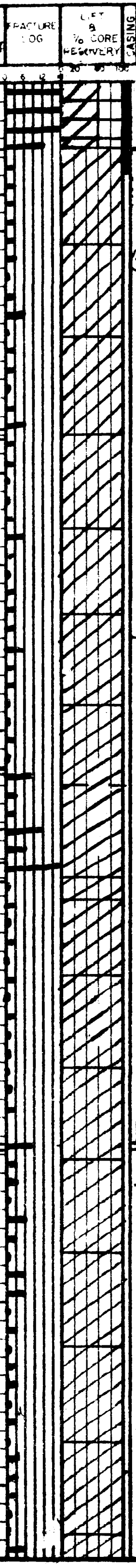
Fresh, slight weathering up to 3 in along joints.

RL / DEPTH

RL	Depth
2057	0
2048	5
2040	10
2031	14
2022	18
2014	21
2005	24
1997	27
1988	30

DEPTH + SIZE OF CORE

NX casing
3'7
NMLC 6
8
10
18'10
19'3
21
26
30
35
40'6
42'3
43'3
50
57'6
57'9
66
70
76
80



STRUCTURES

Fractures & core loss due to weathering.

Fractures – joints.
Joints – ironstained, Some highly weathered (<0·25 in.) and a few of these with clay (<0·05 in) Other joints are cemented by clay and are unbroken.
Veins* – leached, mostly unbroken, <0·10 in, high angle, about 20. in number.

Fractures – joints, some along leached veins, except 37-43 (drilling fractures).
Joints – iron-stained, some iridescent or dendritic. No clay except 40'6 – 42'3.
Veins – a few quartz veins at 45 ft. Leached veins, very thin, up to 2 per foot 30-44 ft. These are iron-stained and may represent iron-cemented joints.

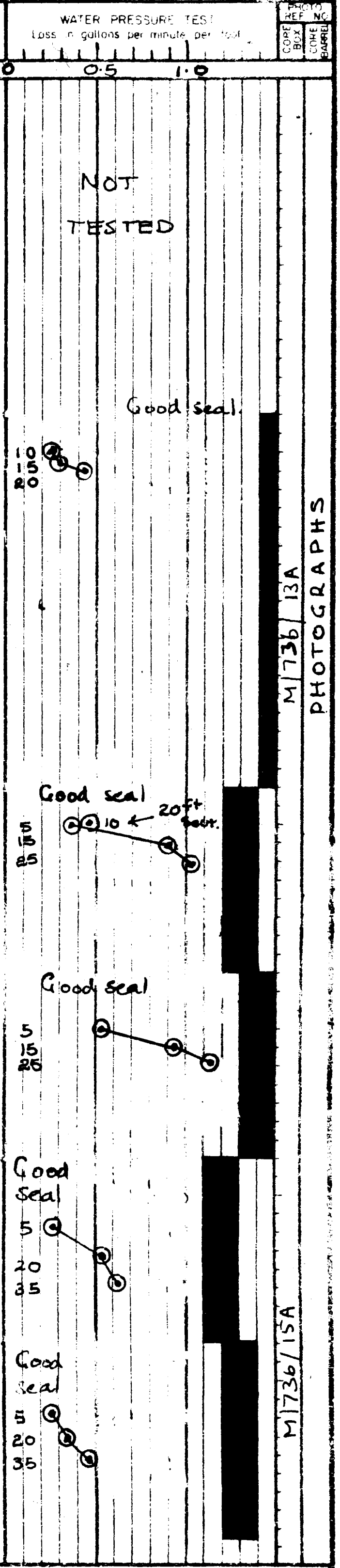
Fractures due to weathering

Fractures – mostly joints
Joints – ironstained, some clayfilled.
Veins – leached. Broken ones at 55'3. Unbroken ones, cemented by iron oxide, very thin, about 3 per foot (may be cemented joints)

WATER LEVEL

DRY

WATER PRESSURE TEST



DRILL TYPE MINDRILL F55
FEED HYDRAULIC
CORE BARREL TYPE NMLC
SPLIT INNER TUBE
DRILLER M. DZIWULSKI
COMMENCED 24-2-68
COMPLETED 26-3-68
LOGGED BY D.A. BUCHHORN
VERTICAL SCALE 10 FT/IN.

NOTES See also sheet 2.

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

*Veins are believed to be calcite and/or quartz as in DC1. Calcite leaches out and in some cases leaves quartz. The small cavity so formed is coated with iron oxide; very thin ones may be filled with iron oxide. In this hole many of the unleached veins are quartz only.
Leached veins are often indistinguishable from joints.
Degrees of weathering are defined in text.
No water return obtained in this hole.

WATER PRESSURE TESTS
PACKER TYPE MECHANICAL
SUPPLY LINE N-ROD, STREAMFLO COUPLINGS
VERTICAL SCALE 100 PSI/in
Figures given are gauge pressures
Test sections are indicated graphically by blocks

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

M(Pf)99

I 55/A16/471-3

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT COREE DAMSITE, COTTER RIVER, ACT.

LOCATION HIGH ON LEFT BANK, ON DAM AXIS. SLOPE CH. -10 OF BA (SMA PLAN NO. 3701).

ANGLE FROM HORIZONTAL 60°

DIRECTION 231° mag.

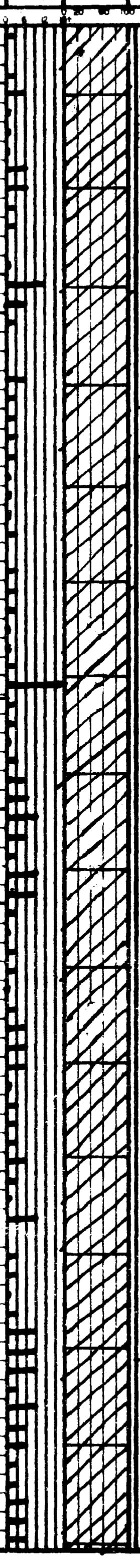
COORDINATES W33785/S8220 STROMLO GRID

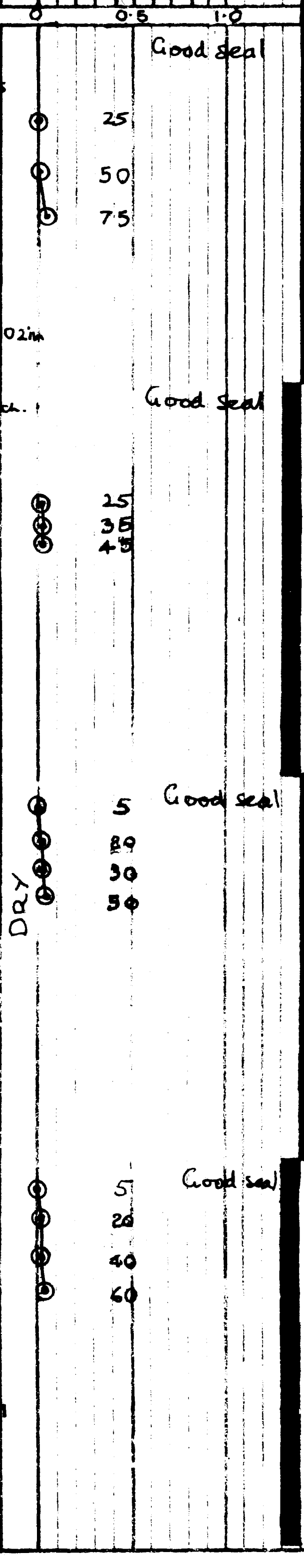
R.L. 2057

HOLE NO DC2

SHEET 2 OF 5

ROCK TYPE	DESCRIPTION	RL / DEPTH	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 NO. CORE BOX	CORE BARREL
ACID VOLCANIC ROCK Feldspars white	Fresh with minor slight weathering, up to 6 inches, along joints. Grey.	1988 30	80 NMLC 83				Fractures - joints, except 93-95, both joints & drilling fractures due to weathering. Joints - Iron-stained, but one coated with white clay, and one clean. Very high-angle ones 93-97, 98-99. Veins - very thin leached veins, iron-stained, some filled with iron oxide, <0.02in. high angle, 1.0/ft, some broken. Also quartz veins, low angle, 0.3/ft., <0.10inch.			M/736/15A	
ACID VOLCANIC ROCK Feldspars white. Occasional coarse-grained xenoliths.		1979 34	90 93								
	Moderately weathered		95								
		1971 37	100				Fractures - joints or leached veins. Joints - Some fresh, some coated white clay, many iron-stained, many also weathered. Very high angle ones 124-126, 129'40-130. Low-angle closely-spaced, 148-149 Veins - leached and iron-stained, < 0.01 in., high angle, possibly as many as 1/ft, 20% of them broken, but many may be iron-cemented joints.			PHOTOGRAPHS	
		1962 41	110 114								
	Moderately weathered, grey-brown. Completely weathered, 0.5 inch, red-brown, at 114'.		115'3								
	Slightly to moderately weathered, mostly moderately weathered, grey-brown.	1953 45	121					DRY		NO	
	Fresh, slightly weathered up to 4in. along some joints.		126							M/736/17A	
		1945 49	130								
		1936 52	140								
		1927 56	150				As above, but leached veins 3/ft, many < 0.01			M/736/19	
		1919 60	160								





DRILL TYPE MINDRILL F55

FEED HYDRAULIC

CORE BARREL TYPE NMLC SPLIT INNER TUBE

DRILLER M. DZIWULSKI

COMMENCED 24-2-68

COMPLETED 26-3-68

LOGGED BY D.A. BUCHHORN

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.

See sheet 1

Measurements of the angles of 462 joints in this hole gave maxima of 54°, 21°, 90°. 75% of measurements lay between 28° and 69°.

WATER PRESSURE TESTS

PACKER TYPE MECHANICAL

SUPPLY LINE N-ROD, STREAMFLOW COUPLINGS

VERTICAL SCALE 100 PSI/in

Figures given are gauge [illegible]

Test sections are indicated [illegible] by blocked [illegible]

PHOTOGRAPH REFERENCE SYSTEM

BLACK AND WHITE BMR FILM NO. & FRAME NO.

COLOUR —

M(Pf)99

I 55/A16/471-4

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

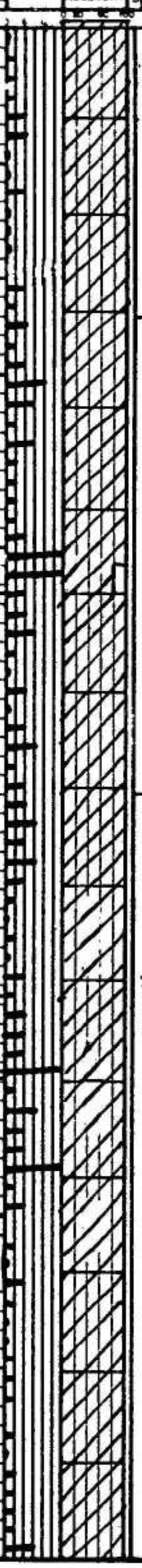
GEOLOGICAL LOG OF DRILL HOLE

PROJECT COREE DAMSITE, COTTER RIVER, ACT
LOCATION HIGH ON LEFT BANK, ON DAM AXIS.
SLOPE CH. -10 OF BA (SMA PLAN NO.3701)
ANGLE FROM HORIZONTAL 60° DIRECTION 231° mag.
COORDINATES W 33785 / S 8220 STROMLO GRID RL 2057

HOLE NO. **DC2**
SHEET 3 OF 5

ROCK TYPE	DESCRIPTION	RL / DEPTH	DEPTH + SIZE OF CORE	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL
ACID VOLCANIC ROCK Feldspars white. Occasional xenoliths	Fresh, slight weathering along some joints <1in. Grey.	1919 60	160 NMLC	Fractures – joints, some veins. Joints – fresh or iron-stained, some weathered Veins – leached, 0·005–0·10 in, 1/ft 160-70. A few thin quartz veins. Layering – one example at 172, 30°	
	Fresh, grey.		167		
		1910 63	170		
	Fresh to moderately weathered. Grey + grey-brown. Weathering along joints or between two joints		173 178	Fractures – joints or veins. Joints – some fresh, many stained, some also weathered, esp. complete weathering at: 176'6 0·1 in. moderate angle. 187–189' 0·2in. very high angle, responsible for core loss. 188'6 0·3 in. mod. angle. Veins – leached, about 0·01 in., 1/ft., half broken. 8 quartz veins occur.	
	Fresh, grey.	1901 66	180		
	Moderately weathered compl. weath along some joints.		187		
	Fresh, slight weathering along joints, up to 12 in. but more often 1–1½ in.	1893 69	189'7 190		
		1884 72	200	Fractures – joints or veins except: 214'7–215 weathering 219–220 drilling fractures at 0 angle. Joints – stained, some weathered, some thin film white clay. Veins – leached, 1·4/ft, 1/3 of them broken. Many low angle. About 0·01 inch. Quartz veins, about 0·01 inch, 0·7/ft.	DRY
	Slightly weathered, grey.	1876 75	210'6		
	Completely weathered, clayey, at moderate angle		214'7 214'11		
		1867 79	220 222		
ACID VOLCANIC ROCK Feldspars pink + white *	Fresh, slightly weathered along joints up to 4 in.		223		
ACID VOLCANIC ROCK Feldspars pink + white. Xenoliths 1/ft.		1858 82	230		
		1850 86	240		

FRACTURE LOG / LIFT & % CORE RECOVERY / CASING



WATER PRESSURE TEST

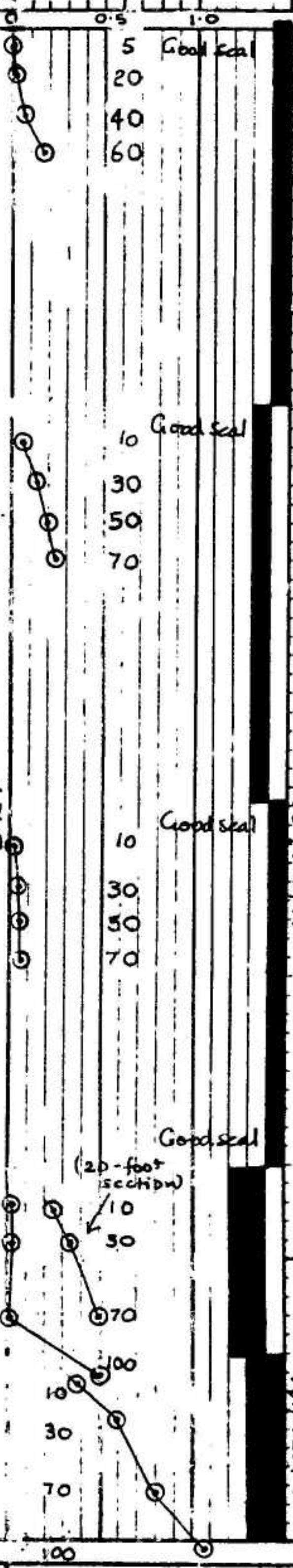


PHOTO REF NO.
NO PHOTOGRAPHS M/736/19
M/717/1
M/717/2
M/717/3
M/717/4
M/717/5
M/717/6
M/717/7
M/717/8
M/717/9
M/717/10
M/736/9A
M/736/10A
NO PHOTOGRAPHS

DRILL TYPE MINDRILL E55
FEED HYDRAULIC
CORE BARREL TYPE NMLC
SPLIT INNER TUBE
DRILLER M. DZIWULSKI
COMMENCED 24-2-68
COMPLETED 26-3-68
LOGGED BY D.A. BUCHHORN
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

See sheet 1.

* occasional xenoliths.

WATER PRESSURE TESTS
PACKER TYPE MECHANICAL
SUPPLY LINE N-ROD, 70'
STREAMFLOW COUPLINGS.
VERTICAL SCALE – 100 PSI/in.
Figures given are gauge pressures
Test sections are indicated graphically, [illegible]

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE BMR FILM
No. + FRAME No.
COLOUR —

M(Pf)99

I 55/A16/471-5

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT COREE DAMSITE, COTTER RIVER, ACT.
LOCATION HIGH ON LEFT BANK, ON DAM AXIS.
SLOPE CH. -10 OF BA
ANGLE FROM HORIZONTAL 60°
DIRECTION 231° mag
COORDINATES W 33785/ S 8220 STROMLO GRID
R.L. 2057

HOLE NO. **DC2**
SHEET 4 OF 5

ROCK TYPE

ACID VOLCANIC ROCK
Feldspars pink + white.
Xenoliths 1/ft

ACID VOLCANIC ROCK
Feldspars pink.
Xenoliths 1/ft.

ACID VOLCANIC ROCK
Feldspars pink.

?

ACID VOLCANIC ROCK
Feldspars white.
Some xenoliths.

DESCRIPTION

Fresh - slightly weathered along joints, up to 1 in. Grey.

Fresh or slightly weathered, grey.

Fresh, grey.

Slightly weathered.

Fresh, grey

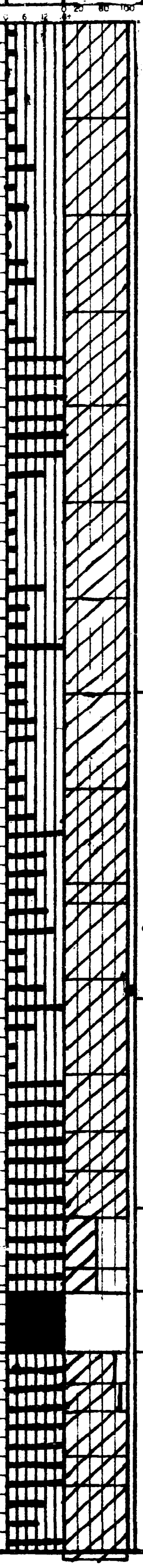
Fresh, grey. Sheared.

Fault zone, probably clay and possibly some rock chips, as a small amount of core at 306'3 and 309'7 is grey clay and rock chips; bit sank through this material.

Fresh, speckled grey.

RL / DEPTH	DEPTH & SIZE OF CORE
1850	240
86	NMLC
	244'8
1841 / 89	250
	255
1832 / 93	260
	265
1824 / 97	270
	271
	273
1815 / 100	280
1806 / 104	290
1798 / 107	300
	302
	306'3
	308 ?
1789 / 111	309'7
	310
1781 / 114	320

FRACTURE LOG / LIFT & % CORE RECOVERY / CASING



STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES

Fractures - joints or veins, even where somewhat fractured.

Joints - stained. Joints parallel to core 257'6-260'6 and 261'6-263.

Veins - quartz veins up to 0.1 in., about 0.15/ft. Leached calcite veins do not seem to be frequent, but may be the cause of the highly fractured rock. Cannot be distinguished from joints.

Fractures - joints or veins.

Joints - stained but not so much as before, especially in the lower part. Some are fresh or lined with white clay. One is moderately weathered.

Veins - Some quartz. Many leached & broken veins.

Fractures - very numerous but largely joints or veins.

Joints - clean, or white clay, or thin coating black (chlorite?). 300'6-302 app. joint ‖ core, but core disturbed below 302.

Veins - leached calcite.

Fractures - numerous, abt. 0.1 in diam. chips.

Veins - very numerous, quartz. < 0.01 in.

FAULT angle unknown

Fractures - very numerous to 311. Largely joints or veins.

Joints - mostly clean, some with thin coating clay or black material.

Veins - numerous calcite veins, cannot see if leached ones also occur.

WATER LEVEL

DRY

302
24.3
26.3

WET

WATER PRESSURE TEST Loss in gallons per minute per foot

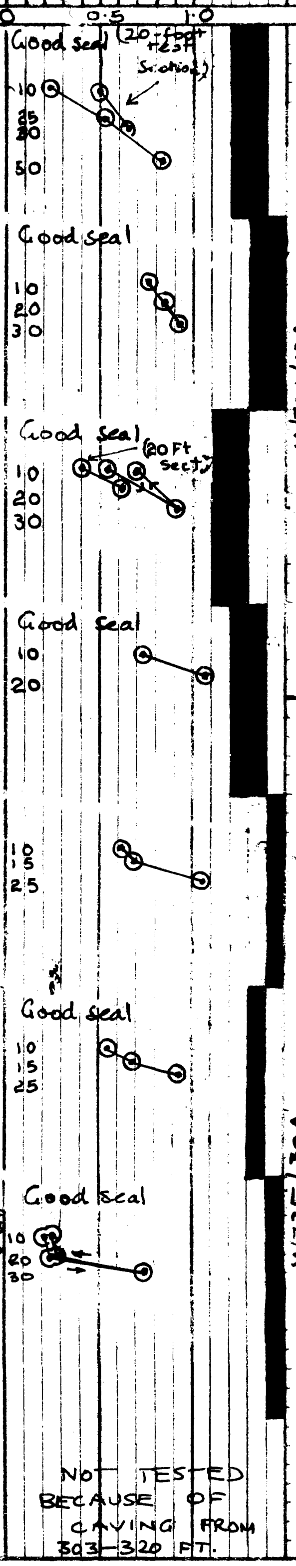


PHOTO REF. NO.

CORE BOX
M/736/10A
M/735/30A

CORE BARREL
NO PHOTOGRAPHS
M/736/6A
M/736/20A
M/736/21A
M/736/22A
M/736/23A
M/734/8
M/734/11
M/734/12
13
14
NO PHOTO
15
16
17
18
M/734/19

DRILL TYPE MINDRILL F55
FEED HYDRAULIC
CORE BARREL TYPE NMLC
SPLIT INNER TUBE
DRILLER M. DZIWULSKI
COMMENCED 24-2-68
COMPLETED 26-3-68
LOGGED BY D.A. BUCHHORN
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

See sheet 1

WATER PRESSURE TESTS
PACKER TYPE MECHANICAL
SUPPLY LINE N-ROD, STREAMFLOW COUPLINGS.
VERTICAL SCALE: 100 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 —

M(Pf)99

I 55/A16/471-6

BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT CORRE DAMSITE, COTTER RIVER, ACT.
LOCATION HIGH ON LEFT BANK, ON DAM AXIS
SLOPE CH -10 DF BA.
ANGLE FROM HORIZONTAL 60°
DIRECTION 231° mag
COORDINATES W 33785/S8220 STROMLO GRID
R.L. 2057

HOLE NO **DC2**
SHEET 5 OF 5

ROCK TYPE	DESCRIPTION	RL ⊥ DEPTH	DEPTH & SIZE OF CORE	FRACTURE LOG	FT & % CORE RECOVERY	CASING	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot	PHOTO REF NO CORE BOX	CORE
		118	320								
ACID VOLCANIC ROCK Feldspars white. Some xenoliths	Fresh, speckled grey.	114 1177	NMLC 324'5		▨		See sheet 4.	WET	NOT TESTED See sheet 4.	M/135/30A	M/134/20
	END	116	OF				HOLE				

DRILL TYPE MINDRILL F55
FEED HYDRAULIC
CORE BARREL TYPE NMLC
SPLIT INNER TUBE
DRILLER M. DZIWULSKI
COMMENCED 24-2-68
COMPLETED 26-3-68
LOGGED BY D.A BUCHHORN
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

See sheet 1.

WATER PRESSURE TESTS
PACKER TYPE MECHANICAL
SUPPLY LINE N-ROD, STREAMFLOW COUPLINGS
VERTICAL SCALE 100PSI/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 —

M(Pf)99

I 55/A 16/471-7

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

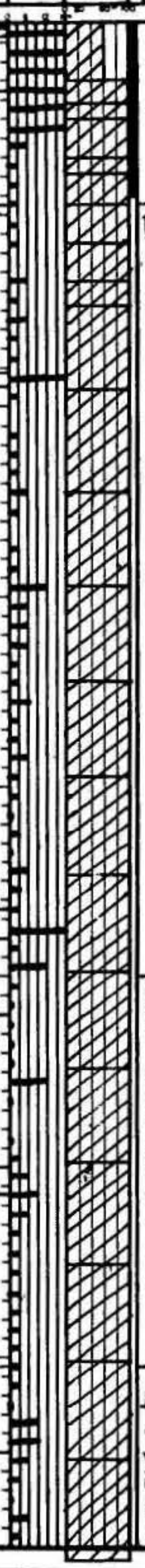
PROJECT: COREE DAMSITE, COTTER RIVER, ACT.
LOCATION: RIGHT BANK SADDLE. SLOPE CH. 250 OF KJ (SMA DRAWING NO. 3701)
ANGLE FROM HORIZONTAL: 60°
DIRECTION: 301° mag.
COORDINATES: W33540/S10205 STROMLO GRID
R.L.: 2082

HOLE NO: DC3

SHEET 1 OF 2

ROCK TYPE	DESCRIPTION
SOIL	grey-brown
ACID VOLCANIC ROCK Feldspars pink. No xenoliths	Completely weathered highly weathered, brown. Moderately weathered, brown. Highly weathered Highly weathered
ACID VOLCANIC ROCK Lithic fragments Feldspars pink. Some xenoliths.	Completely weathered width 0.7 in. mod. angle
As above, no xenoliths.	Slightly weathered, grey-brown.

RL / DEPTH	DEPTH & SIZE OF CORE
2082	0'0
0	0'9
	3'6
	NMLC
	9'6
2073 / 9	10
	18'3
2065 / 17	19
2056 / 26	30
2047 / 35	40
	46'6
	48
2039 / 43	50
	52
2030 / 52	60
	61'6
2022 / 60	70'6
	75
2013 / 69	80



STRUCTURES: JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES

Fractures – due to breaking of weathered core.

Fractures – mainly joints, some veins.
Joints – ironstained & black. Some are highly weathered with development of clay in some cases.
Veins – leached, very thin, not very numerous. Many look like recemented joints. Most are broken by drilling.

Fractures – joints or veins.
Joints – ironstained & black.
Veins – leached & iron-stained, moderate number. Mostly thin & resemble recemented joints, but one is 0.2 in. wide.

Fractures – Joints or veins.
Joints – ironstained, brown or black. At 73'6 0.2 in clay at high angle
Veins – leached, < 0.1 in, not very numerous. Some broken. 70-76 Parallel to core, broken from 73'6 – 75.

WATER LEVEL: DRY; 67 2-4; WET

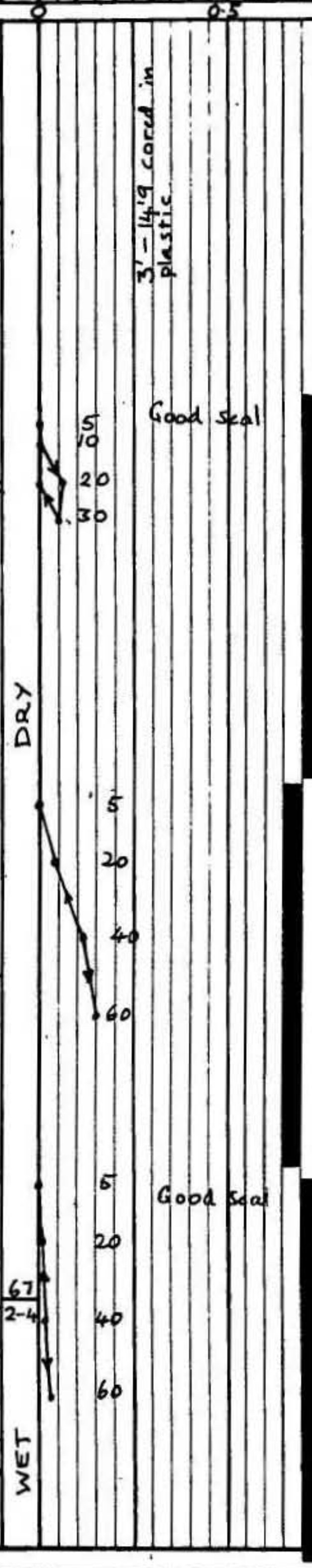


PHOTO REF NO – CORE BOX / CORE BARREL: NO PHOTOGRAPHS; M/735/33 and 34; M/735/4; M/735/5; M/735/6; M/735/7; M/735/8; M/735/9; M/735/10; M/735/11; M/735/12; M/735/13; M/735/14; M/735/34; M/735/15; M/735/16

DRILL TYPE: BOYLES BBS2
FEED: HYDRAULIC
CORE BARREL TYPE: NMLC SPLIT INNER TUBE & ~~PLASTIC INNER TUBE~~
DRILLER: M.R. PARCELL
COMMENCED: 10-3-68
COMPLETED: 19-3-68
LOGGED BY: D.A. BUCHHORN
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

Calcite veins leached leaving very thin planar cavity.

Degrees of weathering defined in text.

Full water return.

Joints are at all angles where not otherwise described.

WATER PRESSURE TESTS
PACKER TYPE: MECHANICAL
SUPPLY LINE: N-ROD, STREAMFLOW 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: BMR FILM NO. & FRAME NO.
COLOUR: —

M(Pf)99

I 55/A16/471-8

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

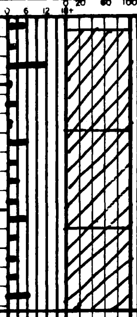
GEOLOGICAL LOG OF DRILL HOLE

PROJECT COREE DAMSITE, COTTER RIVER, ACT.
LOCATION RIGHT BANK SADDLE
SLOPE CH. 250 OF KJ (SMA DRAWING NO. 3701)
ANGLE FROM HORIZONTAL 60°
DIRECTION 301° mag
COORDINATES W 33540/ S 10205 STROMLO GRID
R.L. 2082

HOLE NO. DC3

SHEET 2 OF 2

ROCK TYPE	DESCRIPTION	RL / DEPTH	DEPTH / SIZE OF CORE	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot	PHOTO REF NO. CORE BOX	PHOTO REF NO. CORE BARREL
		2013	80			0 … 0.5		
ACID VOLCANIC ROCK Feldspars pink. No xenoliths.	Slightly weathered, grey-brown. 80'2 compl. weathered, width 0.2in., high angle. 83' h.w. 0.2in	69	NMLC 83'6	Fractures - mostly joints or veins, except at 80'2 and 83'. Joints - iron-stained, black or red-brown. Veins - leached, <0.1in, mostly broken. 91 - 92'6 parallel to core, mostly broken.	WET	Good seal 10 50 70	M/735/34	M/735/17 M/735/18 M/735/19
	Fresh to slightly weath. Grey. Slight weathering mainly near joints.	2004	90					
	Fresh, grey.	78 1996	95'2					
	END OF	82		HOLE		90		



DRILL TYPE BOYLES BBS2
FEED HYDRAULIC
CORE BARREL TYPE NMLC
SPLIT INNER TUBE & PLASTIC INNER TUBE
DRILLER MR. PARCELL
COMMENCED 10-3-68
COMPLETED 19-3-68
LOGGED BY D.A. BUCHHORN
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

See sheet 1.

WATER PRESSURE TESTS
PACKER TYPE MECHANICAL
SUPPLY LINE N-ROD, STREAMFLOW 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 BMR FILM NO. & FRAME NO.
COLOUR —

M(Pf)99

I 55/A16/471-9.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT COREE DAMSITE, COTTER RIVER

LOCATION HIGH ON LEFT BANK, ON DAM AXIS. OFFSET 1 FT. S. OF SLOPE CH. 12 OF BA (SMA PLAN NO. 3701)

ANGLE FROM HORIZONTAL 40°

DIRECTION 085° mag.

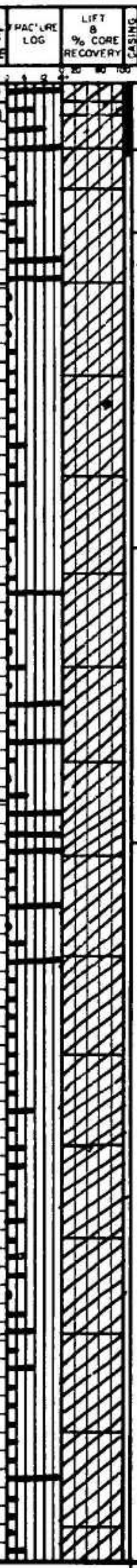
COORDINATES W 33795 S8225 STROMLO GRID

R.L. 2046

HOLE NO. DC4

SHEET 1 OF 2

ROCK TYPE	DESCRIPTION	R.L. / DEPTH	DEPTH & SIZE OF CORE
ACID VOLCANIC ROCK Feldspars pink. Very few Xenoliths.	Completely weathered, brown	2046 0	1'0
	Moderately weathered, brown.		NX Casing NMLC 3'7
	Fresh, grey		7'3
	Moderately weathered compl. weath. along joints, clay up to 0.1 in. Not slippery.	2040 9	8 10'8
	Fresh + slightly weathered. Grey.		15
	Moderately weathered		16
	Fresh, slightly weathered up to 4 inches along joints. Grey.	2033 18 2027 27	20 27 30 38'9
	Fresh to moderately weathered. Grey to brown.	2020 36	41
	Slightly weathered, grey-brown.	2014 42 2007 46	50 60
	Highly weathered, 1in., a little clay	2001 49	67'9 70
		1995 52	80



STRUCTURES
JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES

Drilling breaks as a result of weathering.

Fractures – joints mainly, some veins. | Joints – weathered, a few are ironstained.

Fractures – joints or veins mainly, some are drilling breaks. | Veins – leached + weathered, < 0.05 in, mostly high angle, average 3/ft., few are broken.

Fractures are joints or veins, but many are broken quartz veins. Joints – fresh or slightly weathered, slightly ironstained. Veins – very thin leached veins (as above). Quartz veins 0.4 in, low angle, at 27'6, 33, 35'3.

Fractures – joints, veins, breaking of weathered zones. Joints – ironstained, some coated with grey material, some have dendrites. At 40 ft, high angle one with 0.2 in. soft clay and rock. At 47 ft, very irregular high angle one with 0.2 in. soft clay and rock. Veins – leached ones as above. Parallel ones 60-62, 75-76, partly broken. Quartz vein, 0.3 in, low angle, at 42'6. Brecciated zones occur throughout, recemented by firm masses of chlorite (relatively soft) maximum thickness 0.2 in. One thin zone (0.4 in.) occurs at angle of 10° at 84 ft. Other zones cannot be measured. Chlorite also occurs as thin veins, very low angle.

WATER LEVEL

DRY

23'6
22-4
23-1
27'2
15-5

WET

PHOTO REF NO. (CORE BOX, CORE BARREL)

NONE
M/734/4
M/734/5
M/734/6
M/734/7
M/734/8
M/755/16
PHOTOGRAPHS
NO
M/755/17
M/757/17
M/757/18
M/757/19
M/75
10

DRILL TYPE MINDRILL E1000
FEED HYDRAULIC
CORE BARREL TYPE NMLC
SPLIT INNER TUBE
DRILLER P. GRECH
COMMENCED 4-4-68
COMPLETED 21-4-68
LOGGED BY D.A. BUCHHORN
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.

Calcite veins leached leaving very thin planar cavity.

Degrees of weathering defined in text.

Full water return throughout.

Joints are at all angles where not otherwise mentioned.

See also sheet 2.

WATER PRESSURE TEST
PACKER TYPE MECHANICAL
SUPPLY LINE N-ROD, STREAMFLOW 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 BMR FILM NO. + FRAME NO
COLOUR —

M(Pf)99

I 55/A16/471-10

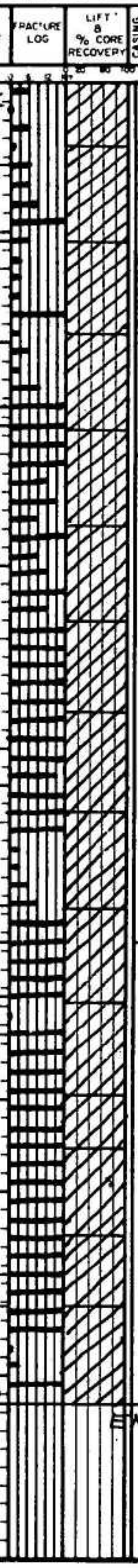
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

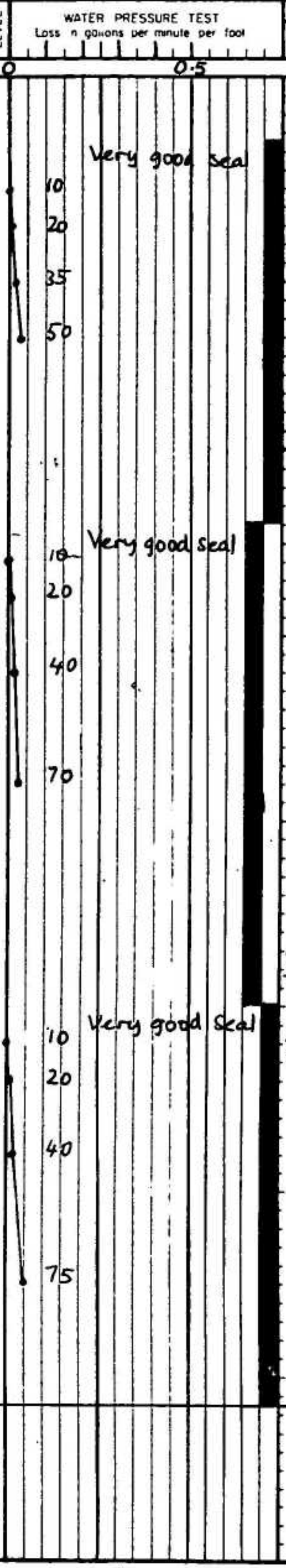
GEOLOGICAL LOG OF DRILL HOLE

PROJECT CORÉE DAMSITE, COTTER RIVER.
LOCATION HIGH ON LEFT BANK, ON DAM AXIS. OFFSET 1 FT. S. OF SLOPE CH.12 OF BA (SMA PLAN NO 3701)
ANGLE FROM HORIZONTAL 40° DIRECTION 085° mag.
COORDINATES W33795/S8225 STROMLO GRID R.L. 2046

HOLE NO. DC4
SHEET 2 OF 2

ROCK TYPE	DESCRIPTION	RL / DEPTH	DEPTH & SIZE OF CORE	STRUCTURES JOINTS VEINS SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	PHOTO REF NO CORE BOX	PHOTO REF NO CORE BARREL
			80				
ACID VOLCANIC ROCK Feldspars pink. Very few xenoliths.	Slightly weathered, grey-brown.	52	NMLC 84'6	Fractures - mostly due to drilling, especially where weathered. Joints - slightly iron-stained yellow brown or black. Veins - leached, < 0·01in. about 6/ft but very numerous 84-98'6. Very few broken. Quartz veins 0·2 in. at 93'3, very low angle. Chlorite - low angle veins and angular infillings in several places; numerous 93-95'6.		M/755/17	M/757/20
	Moderately weathered, grey-brown..		88				M/757/21
	Highly and completely weathered, clayey	1988 55	88'5				M/755/2
	Slightly to moderately weathered, grey-brown		94				
ACID VOLCANIC ROCK Feldspars ? Phenocrysts coarsergrained	Moderately weathered, grey-brown.		97'5				M/755/4
	Completely weathered, clayey, 7ins.	1982 58	98'6				NO PHOTO
ACID VOLCANIC ROCK Feldspars ? Very few xenoliths.			106	Fractures - joints, veins, drilling, (especially where weathered). Joints - many low-angle ones. A few weathered, most are clean, some slightly iron-stained. Veins - extremely thin, very numerous, leached calcite veins, many are broken.			M/755/6
	Completely weath. 0·3in	1975 61	110 116		WET		M/755/7
	Completely weath. 0·6in.		118				M/755/8
	Completely weath. 0·3in.	1969 65	120				M/755/9
	Highly weathered, 2in, Yellow-brown. About 0·7" slippery clay, highangle.		124'6 126'6				M/755/10
	Highly to completely weathered, clayey, brown.	1963	129'6	Fractures - due to breakage of weathered rock. Joints - low angle, clean or ironstained. Veins - very thin leached veins, numerous. Thin seams clay, numerous, throughout.		M/755/18	M/755/11
	Moderately weathered	68	131'6 135				M/759/12
	Almost pure clay, white & yellow, 5 in.	1956	140				M/755/13
	Completely weathered, clayey. Pure slippery clay seams probably < 1in.	72	144'6 146'9				M/755/14
	Highly weathered, brown.	1950	150				M/755/15
	Very clayey, yellow-brown, 3 ins.	75 1949 76	151'10	END OF HOLE			





DRILL TYPE MINDRILL E1000
FEED HYDRAULIC
CORE BARREL TYPE NMLC
SPLIT INNER TUBE
DRILLER P. GRECH
COMMENCED 4-4-68
COMPLETED 21-4-68
LOGGED BY D.A. BUCHHORN
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

See sheet 1.

Measurements of the angles of 130 joints in this hole gave maxima of 25°, 47°, 90°. 75% of measurements lay between 13° and 62°.

WATER PRESSURE TESTS
PACKER TYPE MECHANICAL
SUPPLY LINE N-ROD, STREAMFLOW 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 BMR FILM
NO & FRAME NO.
COLOUR —

M(Pf)99

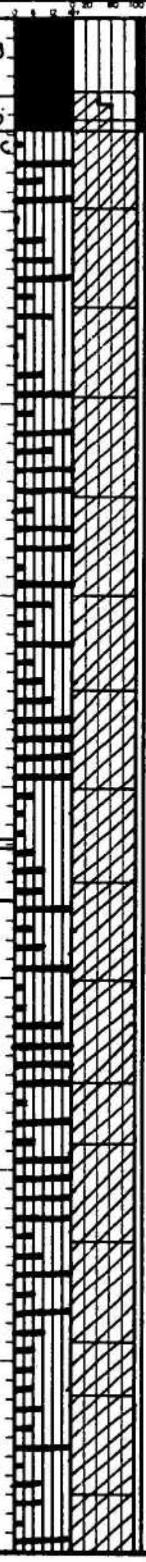
I 55/A16/471-11

BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT CORee DAMSITE, COTTER RIVER.
LOCATION RIVERBED
ANGLE FROM HORIZONTAL 45°
DIRECTION 216° mag.
COORDINATES W 34090 / S8340
R.L. 1800

HOLE NO. **DC5**
SHEET 1 OF 2



ROCK TYPE	DESCRIPTION	RL ⊥ DEPTH	DEPTH ∖ SIZE OF CORE	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot (0 – 0.5)	PHOTO REF NO CORE BOX	PHOTO REF NO CORE BARREL
ALLUVIUM	Sand and gravel (of Ordovician sediments, ie. quartzite, etc.)	1800 0	NX casing 4	Core lost is alluvium. Hole appears to follow rock/alluvium boundary 4-5'10.				NO PHOTO
ACID VOLCANIC ROCK. Feldspar pink Xenoliths about 2/ft.	Moderately weathered, brown. Alluvium also occurs.		5'10					
	Fresh, grey.		NMLC	Fractures - joints. Joints - ironstained Veins - few		5 10 Very good seal		M/756/3
		1793 7	10	Fractures - joints Joints - clean. 11-15, many high-angle ones, 14-15, parallel joint. Veins - few, leached.				M/756/4 M/756/5
		1786 9	20	Fractures - joints or veins, some drilling fractures 50-80. Very highly fractured 36'9-38'6. Joints - clean. Veins - thin, mostly leached, some unleached calcite and quartz. All angles, parallel ones 57'6-58'6 and 71'6-72'6. About 4/ft, but there are about 24/ft 26'6-27'6 (very low angle), also closely spaced 36'9-38'6 but spacing uncertain. Most veins are broken.			M/755/23	M/756/6 M/756/7
		1779 15	30			5 10 15 Very good seal		M/756/8
COARSE-GRAINED XENOLITH OF ACID VOLCANIC ROCK Feldspar white	Fresh, green.	1772 22	40 42'9		WET			M/756/9 M/756/10
ACID VOLCANIC ROCK. Feldspar pink Few xenoliths.	Fresh, grey. At 43'5 a calcareous sandstone(?). Thickness 0.10 inch, angle 50°.		43'2 46					M/756/11
No xenoliths.		1765 29	50			5 10 15 Very good seal		M/756/12 M/756/13
		1758 36	60				M/755/21	M/756/14 M/756/15
		1751 43	70			5 15 25 Very good seal. Hole making water from below 77'6 at rate of 0.4gpm. 23'5 test section.		M/756/16 M/756/19 M/756/20
		1743 50	80					

DRILL TYPE MINDRILL E1000
FEED HYDRAULIC
CORE BARREL TYPE NMLC
SPLIT INNER TUBE
DRILLER P. GRECH
COMMENCED 2-5-68
COMPLETED 8-5-68
LOGGED BY D.A. BUCHHORN
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

Calcite veins frequently leached leaving very thin planar cavity.

Degrees of weathering defined in text.

Full water return throughout. Below 77'6 hole made water. (See waterpressure test column.)

Joints are at all angles where not otherwise mentioned.

WATER PRESSURE TESTS
PACKER TYPE MECHANICAL
SUPPLY LINE N-ROD, STREAMFLOW 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 BMR FILM
NO. & FRAME NO.
COLOUR —

M(Pf)99

I 55/A16/471-12

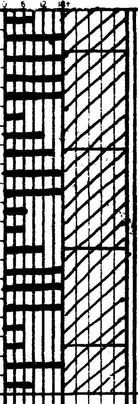
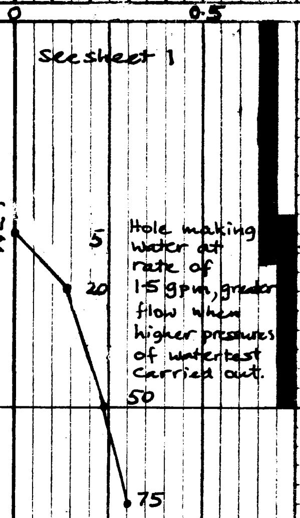
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT COREE DAMSITE, COTTER RIVER
LOCATION RIVERBED
ANGLE FROM HORIZONTAL 45° DIRECTION 216° mag.
COORDINATES W34090/ S8340 R.L. 1800

HOLE NO **DC5**
SHEET 2 OF 2

ROCK TYPE	DESCRIPTION	RL / DEPTH	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 NO CORE BOX	PHOTO REF NO CORE BARREL
		1743	80	0 6 12 18+	0 20 60 100				0 0.5		
ACID VOLCANIC ROCK Feldspar pink. No xenoliths.	Fresh, grey.	50 1736/58 1729/65	NMLC 90 100				Fractures - mostly joints, some veins and drilling fractures. Joints - clean Veins - < 0·10 inch, mostly leached, some calcite and quartz veins unleached. About 2/ft and half are broken.	WET	See sheet 1 Hole making water at rate of 1·5 gpm, greater flow when higher pressures of water test carried out.	M/755/21	M/168/20 M/736/21 M/717/20 M/717/19 /18
	END		OF				HOLE				

DRILL TYPE MINDRILL E1000
FEED HYDRAULIC
CORE BARREL TYPE NMLC
SPLIT INNER TUBE
DRILLER P. GRECH
COMMENCED 2-5-68
COMPLETED 8-5-68
LOGGED BY D.A. BUCHHORN
VERTICAL SCALE 10 FT/IN.

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

See sheet 1.

WATER PRESSURE TESTS
PACKER TYPE MECHANICAL
SUPPLY LINE N-ROD, STREAMFLOW COUPLINGS
VERTICAL SCAL 50PSI/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 —

M(Pf)99

I55/A16/471-13

PLATE 1

COREE DAMSITE, COTTER R.

REGIONAL GEOLOGY; POSSIBLE SOURCES OF CONSTRUCTION MATERIALS

See also Plate 2.

Grid based on Mount Stromlo, A.C.T. Co-ordinates in feet.

track road

geological boundary; exact, approx., not located.

fault; exact, approximate, not located. a, normal, b, reverse. Triangle on downthrow side.

strike & dip of bedding; strike of vertical foliation

Location of possible construction material; small arrow points to next number. Deposits described in text.

Map compiled from Malcolm (1954); Noakes (1946); Noakes (1948); additional mapping by D.A. Buchhorn, J. Mendum and G.A.M. Henderson, 1967.

SILURIAN-DEVONIAN
gs Shannon's Flat Granodiorite; granodiorite.
io " " " iron ore
gb Bendora Granite; foliated adamellite + granodiorite
gd McDonald Granite; porphyritic granite
gc Cow Flat Granite; porphyritic granite.

SILURIAN
UPPER
Sup porphyry.
Suv Uriarra volcanics, Vanity Member; acid volcanics
tuff " " " " ; fine tuff
Sus " " , Swamp Ck. Mbr. acid volcanics
Sut " " , Tarpaulin Mbr. fine tuff
Suw " " , Walker Mbr. acid volcanics
MIDDLE
Smp Paddy's R. Volcanics; foliated acid volcanics
sh " " shale
ls " " limestone
LOWER
Slt Tidbinbilla Quartzite; quartzite

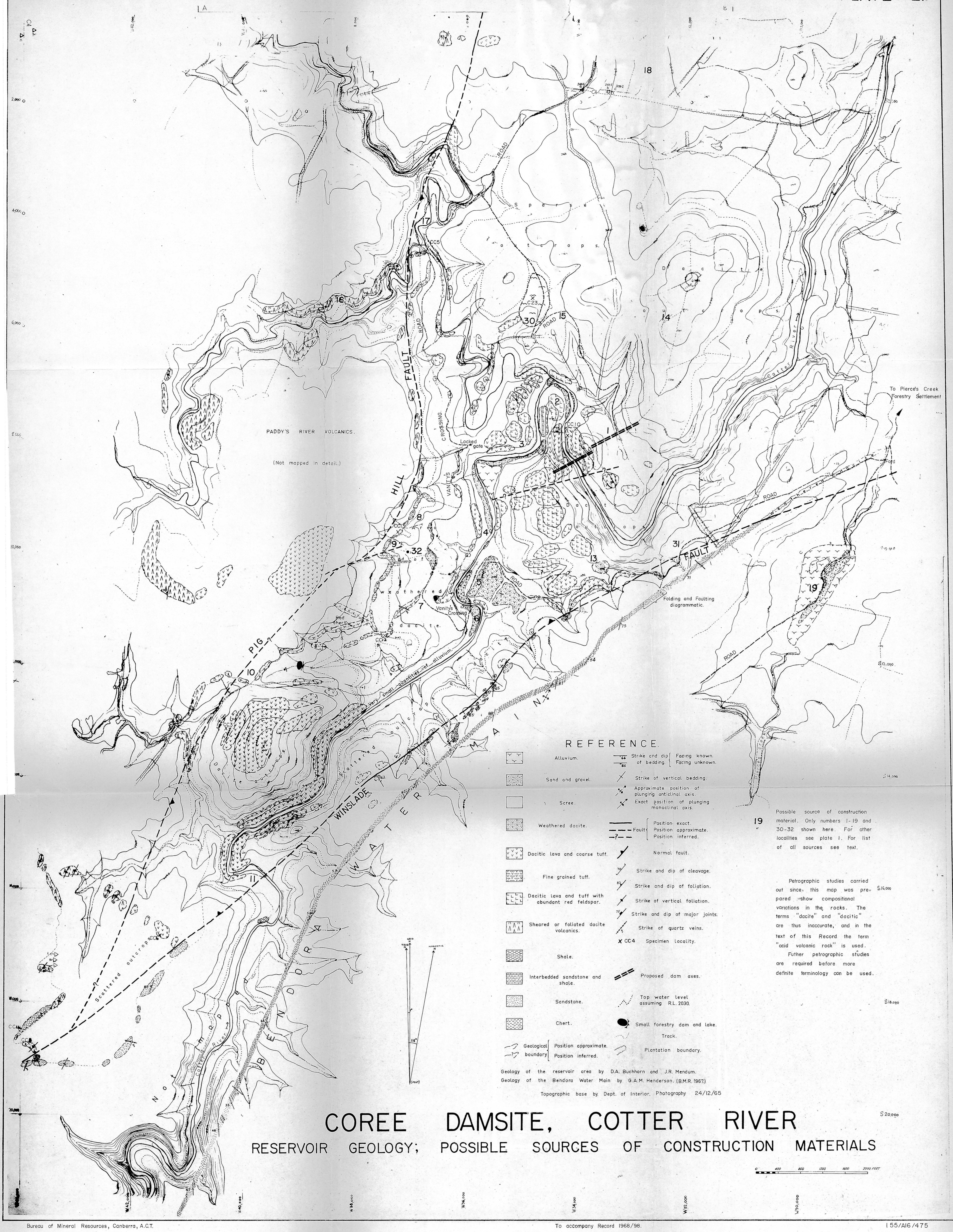
ORDOVICIAN
UPPER
Ou (unnamed) ; sandstone, quartzite, shale, "chert"
O (unnamed) ; sandstone, quartzite, phyllite

To accompany Record 1968/98

Bureau of Mineral Resources, July 1968.

155/A16/496

PLATE 2.



19 Possible source of construction material. Only numbers 1-19 and 30-32 shown here. For other localities see plate 1. For list of all sources see text.

Petrographic studies carried out since, this map was prepared show compositional variations in the rocks. The terms "dacite" and "dacitic" are thus inaccurate, and in the text of this Record the term "acid volcanic rock" is used.

Futher petrographic studies are required before more definite terminology can be used.

Geology of the reservoir area by D.A. Buchhorn and J.R. Mendum.
Geology of the Bendora Water Main by G.A.M. Henderson. (B.M.R. 1967.)

Topographic base by Dept. of Interior. Photography 24/12/65

COREE DAMSITE, COTTER RIVER

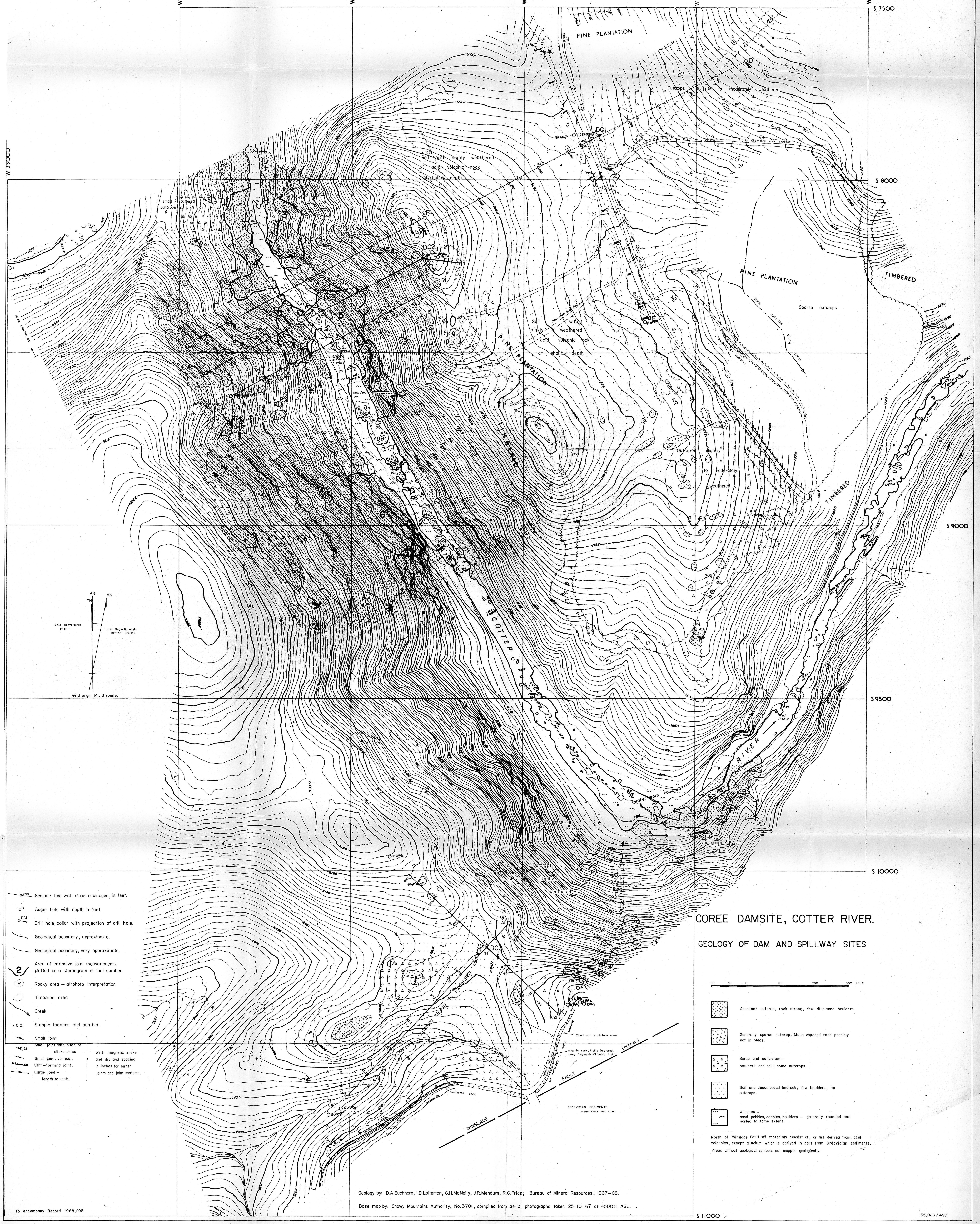
RESERVOIR GEOLOGY; POSSIBLE SOURCES OF CONSTRUCTION MATERIALS

Bureau of Mineral Resources, Canberra, A.C.T.

To accompany Record 1968/98.

I55/AI6/475

PLATE 3.



COREE DAMSITE, COTTER RIVER.

GEOLOGY OF DAM AND SPILLWAY SITES

100 50 0 100 200 300 FEET.

▨	Abundant outcrop, rock strong, few displaced boulders.
▨	Generally sparse outcrop. Much exposed rock possibly not in place.
△	Scree and colluvium — boulders and soil; some outcrops.
⁚	Soil and decomposed bedrock; few boulders, no outcrops.
⌒	Alluvium — sand, pebbles, cobbles, boulders — generally rounded and sorted to some extent.

North of Winslade Fault all materials consist of, or are derived from, acid volcanics, except alluvium which is derived in part from Ordovician sediments.

Areas without geological symbols not mapped geologically.

⊙250	Seismic line with slope chainages, in feet.
⊙17	Auger hole with depth in feet.
DCI	Drill hole collar with projection of drill hole.
—	Geological boundary, approximate.
- -	Geological boundary, very approximate.
2	Area of intensive joint measurements, plotted on a stereogram of that number.
R	Rocky area — airphoto interpretation
	Timbered area
→	Creek
x C 21	Sample location and number.

Small joint
Small joint with pitch of slickensides 28
Small joint, vertical.
Cliff—forming joint.
Large joint — length to scale.

With magnetic strike and dip and spacing in inches for larger joints and joint systems.

Geology by: D.A.Buchhorn, I.D.Loiterton, G.H.McNally, J.R.Mendum, R.C.Price; Bureau of Mineral Resources, 1967–68.

Base map by: Snowy Mountains Authority, No.3701, compiled from aerial photographs taken 25-10-67 at 4500ft. ASL.

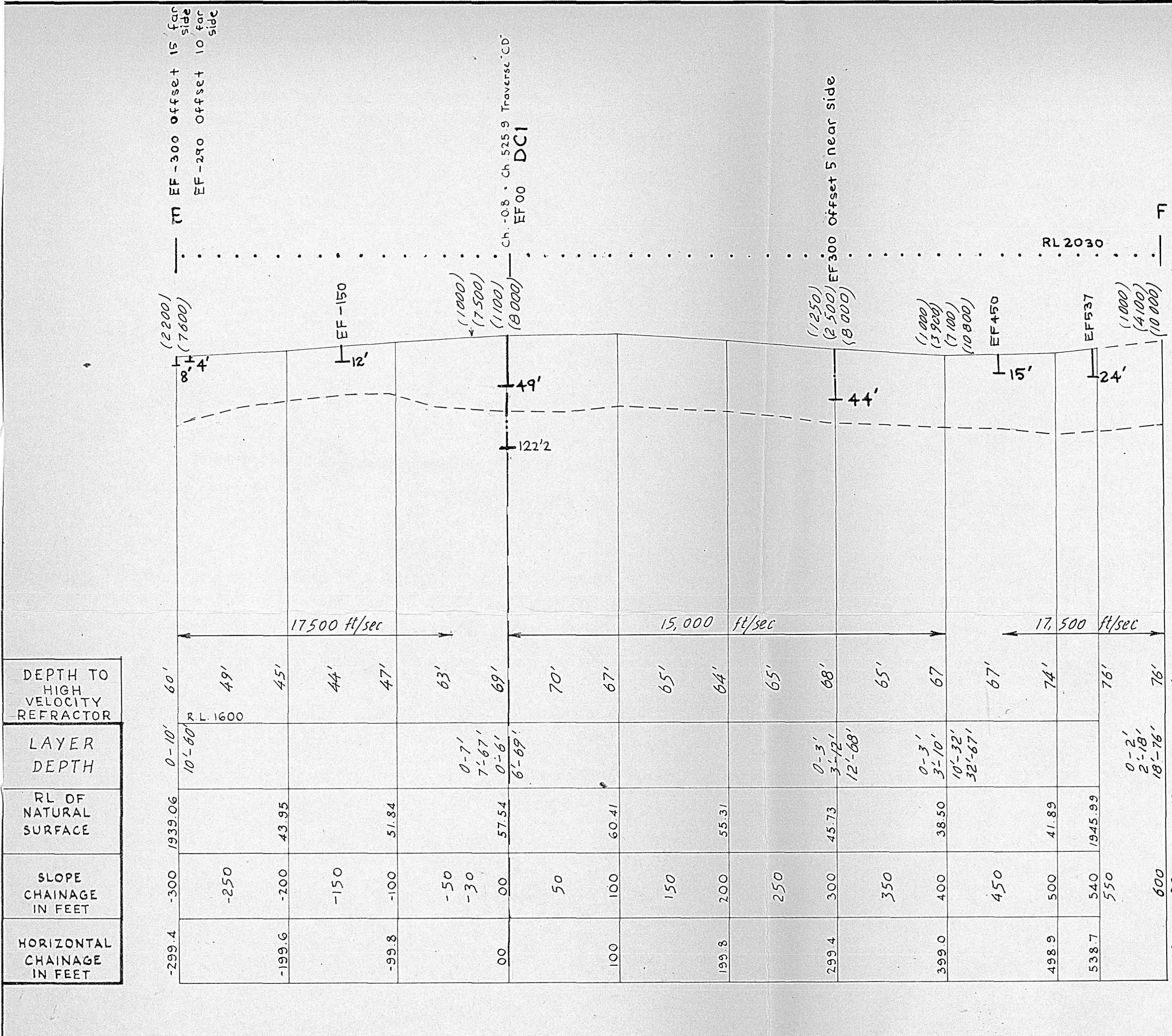
To accompany Record 1968/98

155/A16/497

COREE DAMSITE, COTTER RIVER

SECTIONS SHOWING SEISMIC AUGER AND DIAMOND DRILLING RESULTS

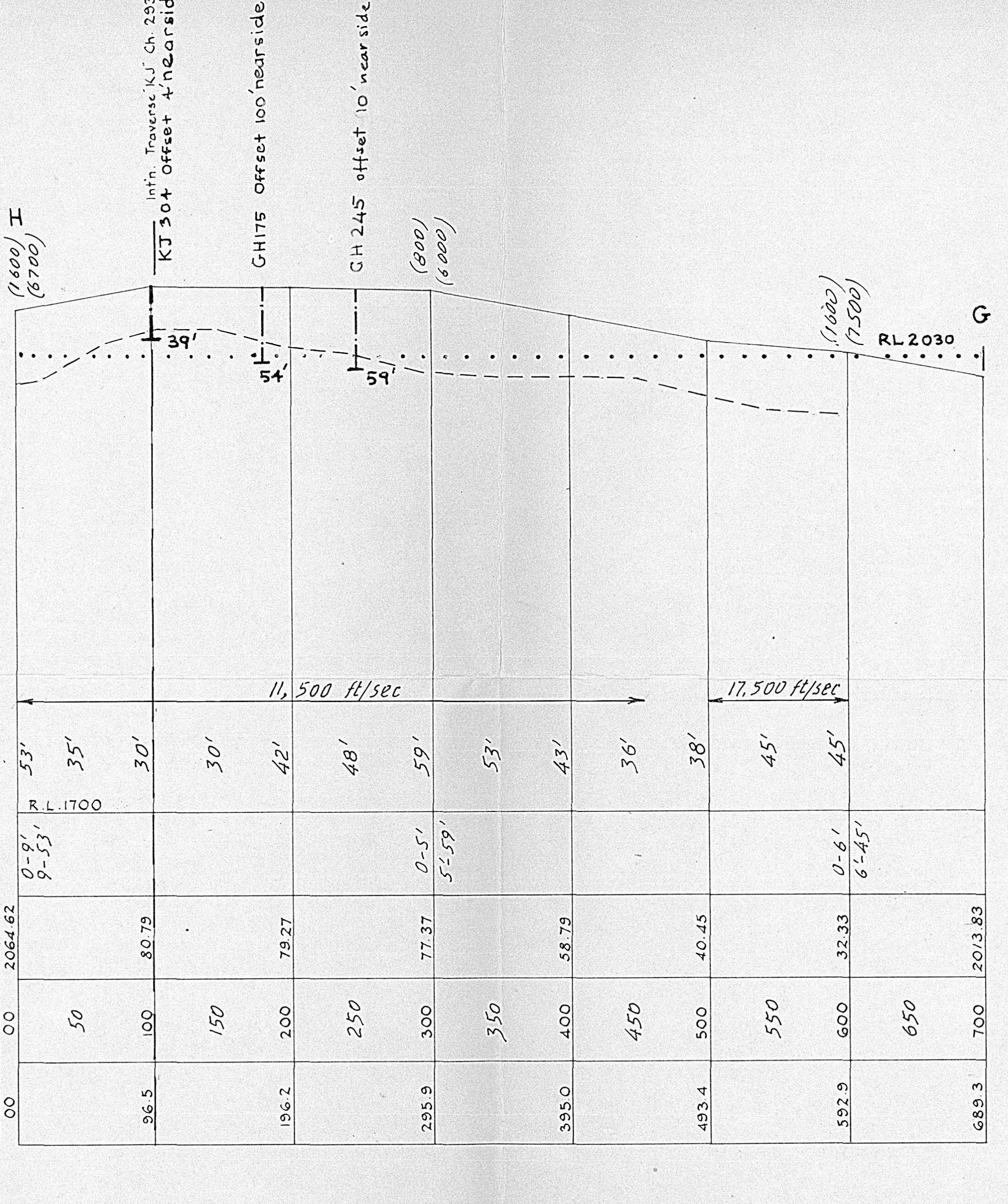
For location of Traverses see Plate 3.



Traverse 'EF'

Left bank saddle

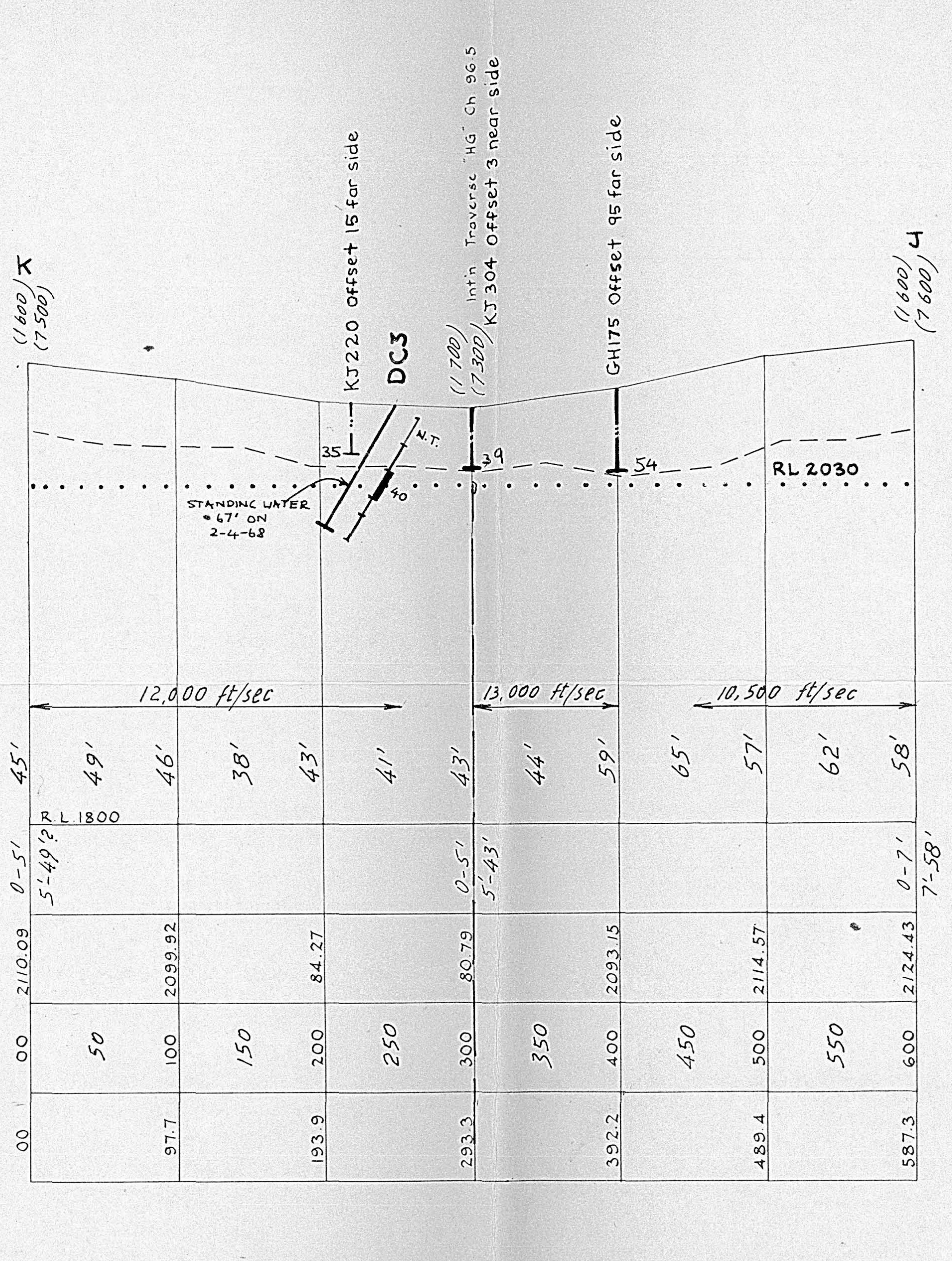
Downstream →



Traverse 'HG'

Right bank saddle

← Downstream

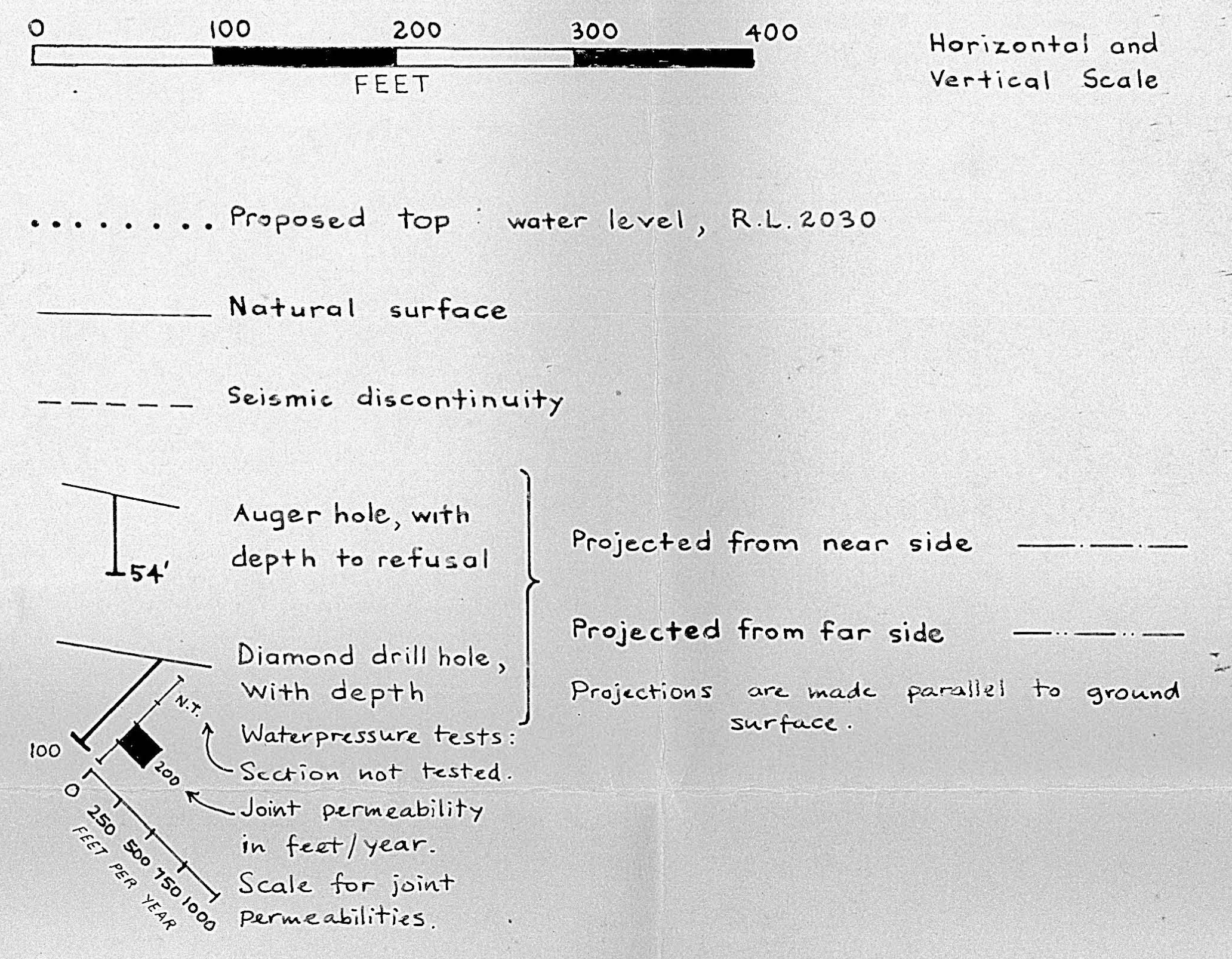


Traverse 'KJ'

Right bank saddle

Looking upstream

LEGEND



. . . . . . Proposed top water level, R.L. 2030

Natural surface

Seismic discontinuity

Auger hole, with depth to refusal

Diamond drill hole, with depth

Waterpressure tests:

Section not tested

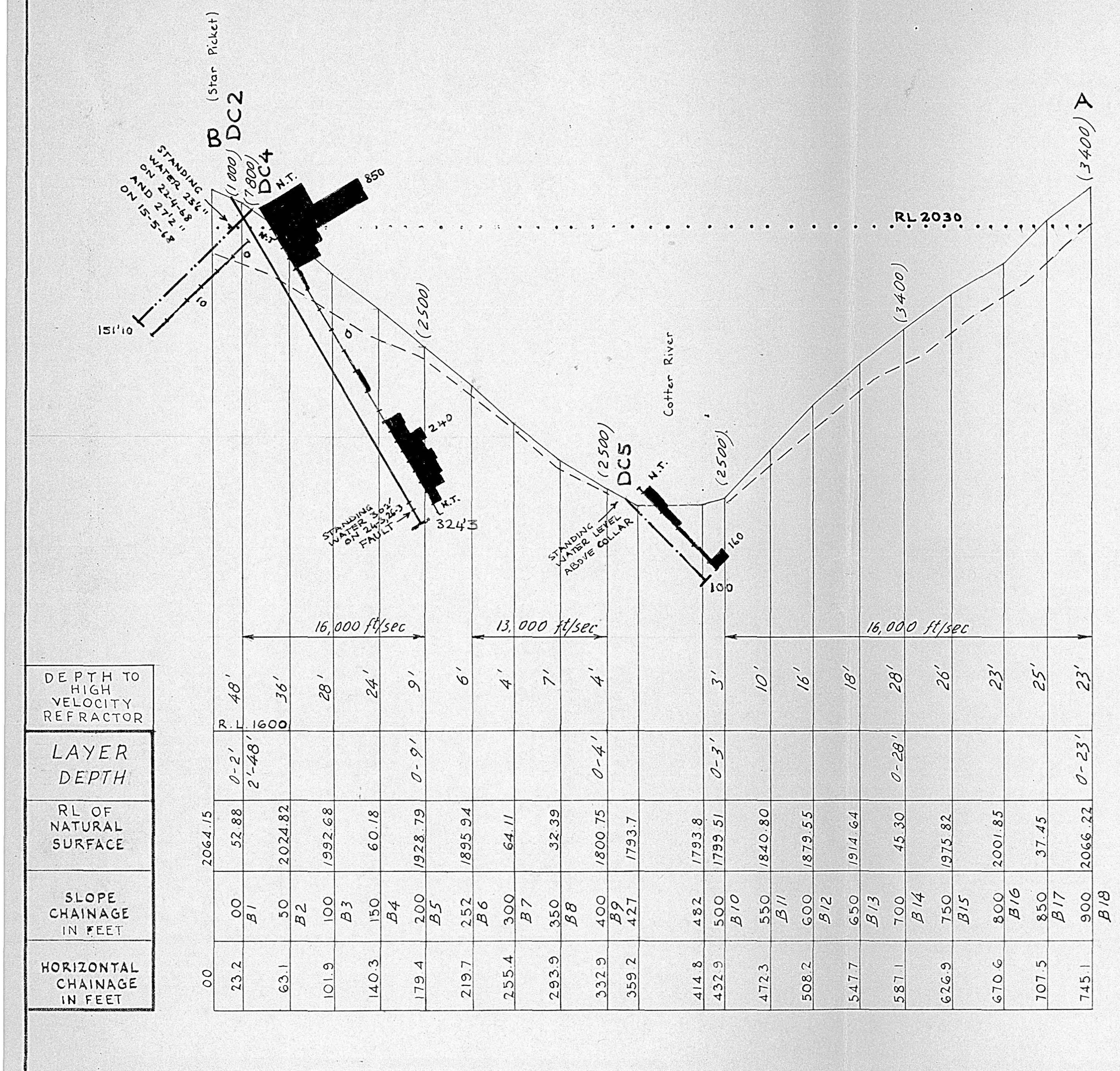
Joint permeability in feet/year.

Scale for joint permeabilities

Projected from near side

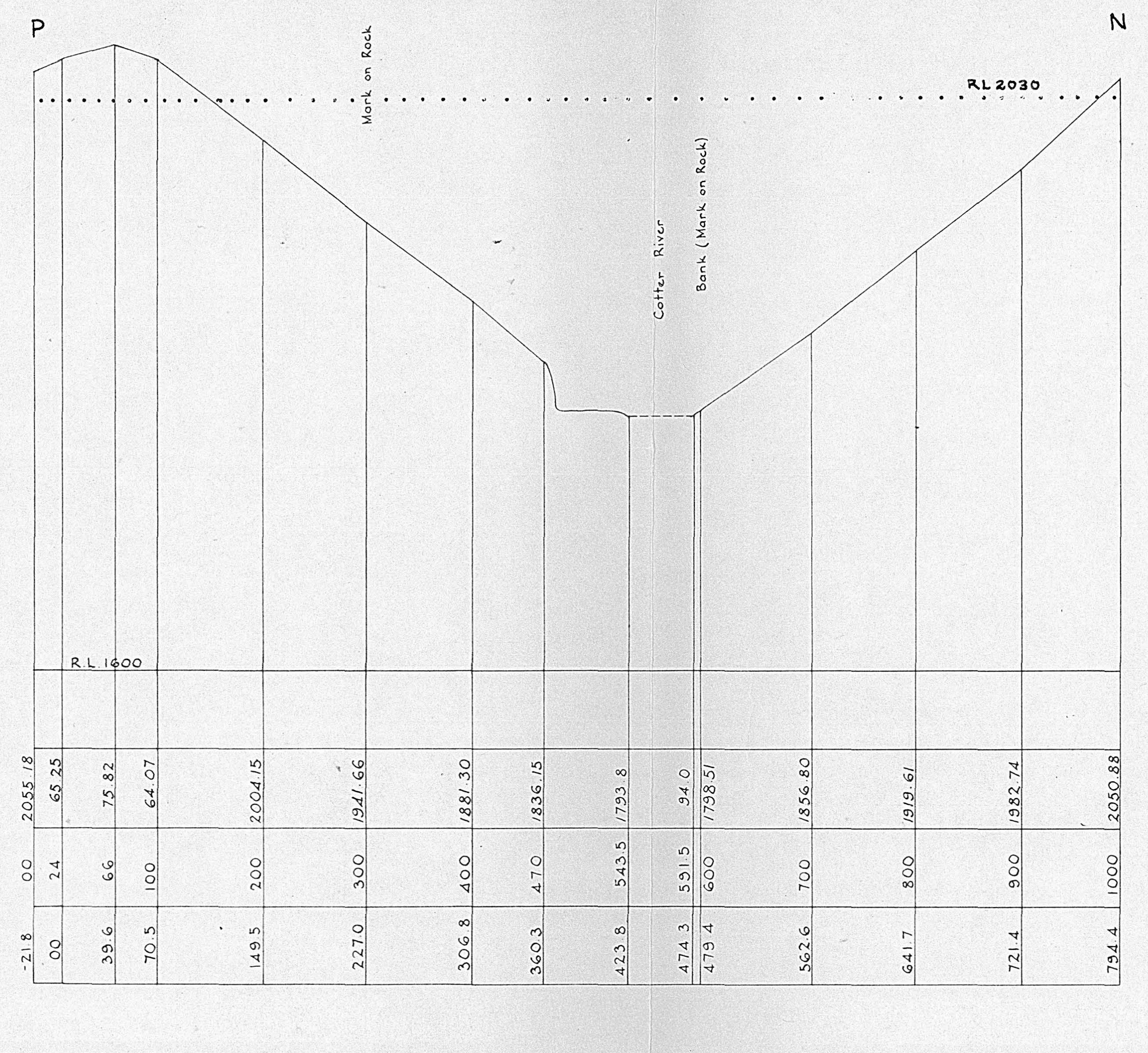
Projected from far side

Projections are made parallel to ground surface.



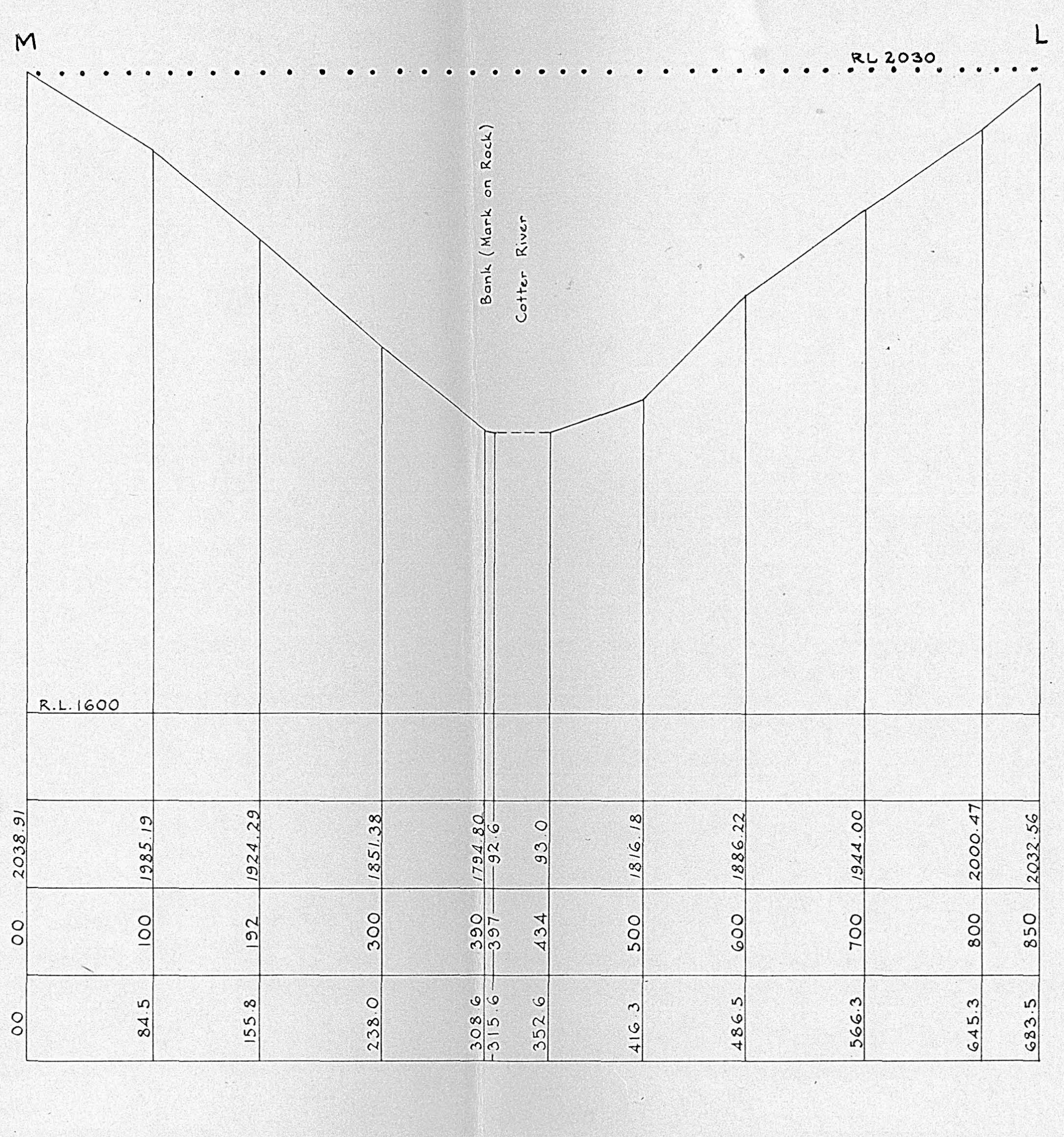
Traverse 'BA'

Looking downstream



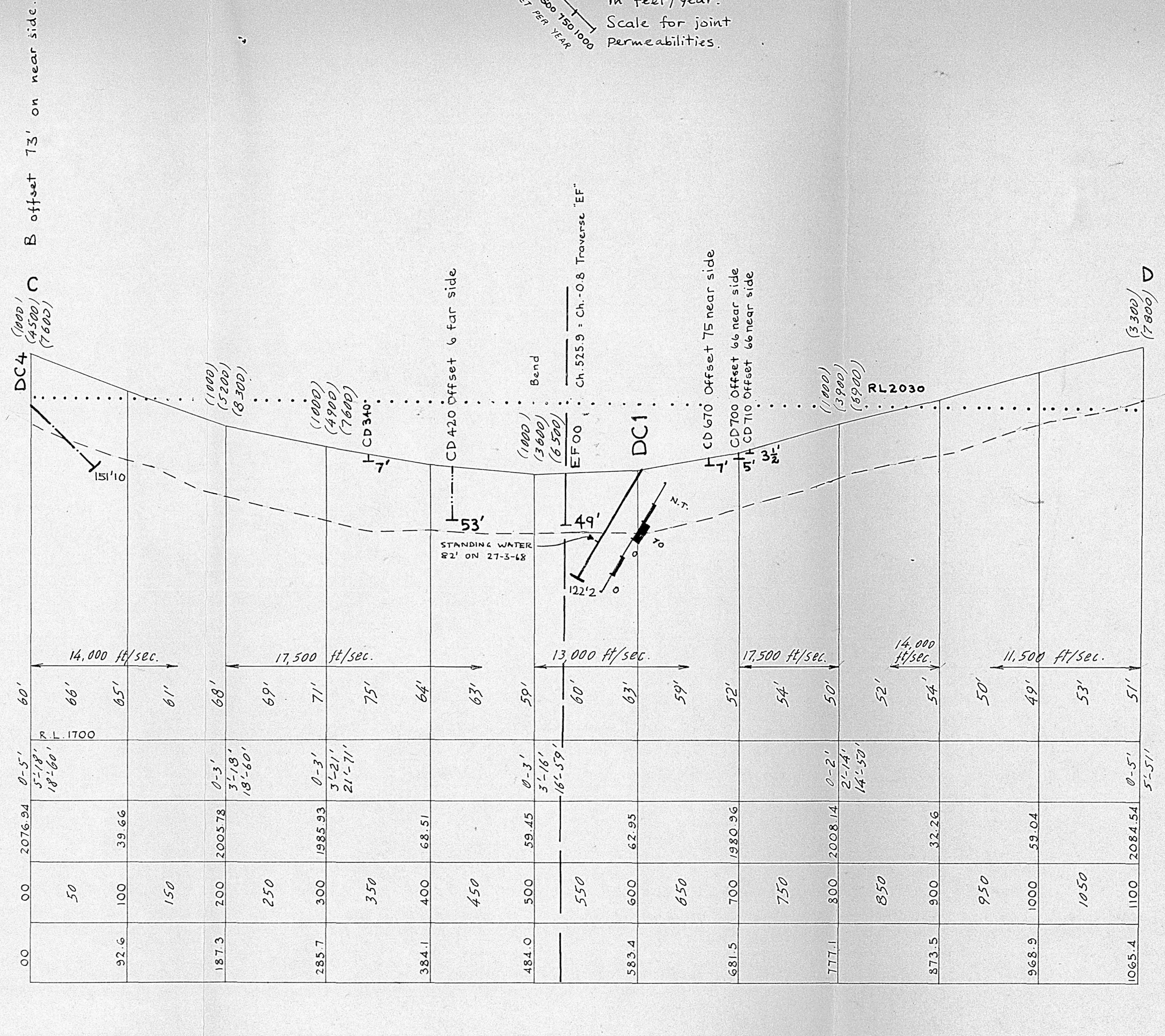
PN - Traverse North of 'BA'

Looking downstream



ML - Traverse South of 'BA'

Looking downstream



Traverse 'CD'

Left bank saddle looking upstream

Datum : Star Picket R.L. 2123.40

Adapted from Commonwealth Dept. of Works drawing CD 67/3868 by Bureau of Mineral Resources, Feb.1968, to accompany Rec. No. 1968/98

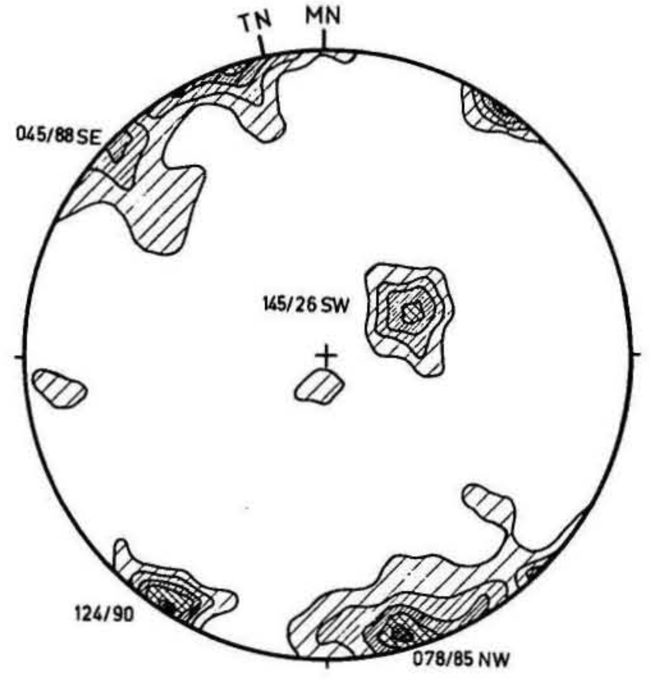
I55/A16/498.

PLATE 5.

CORE DAM SITE COTTER RIVER

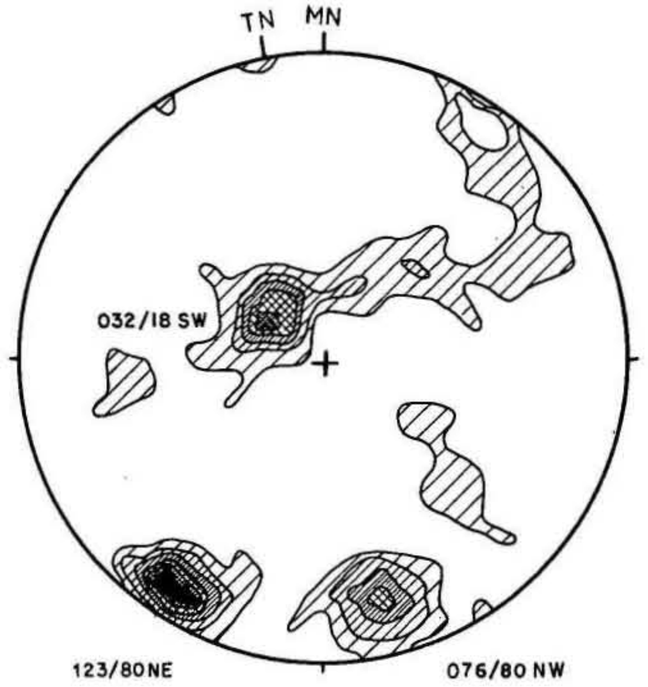
JOINT STEREOGRAMS

1



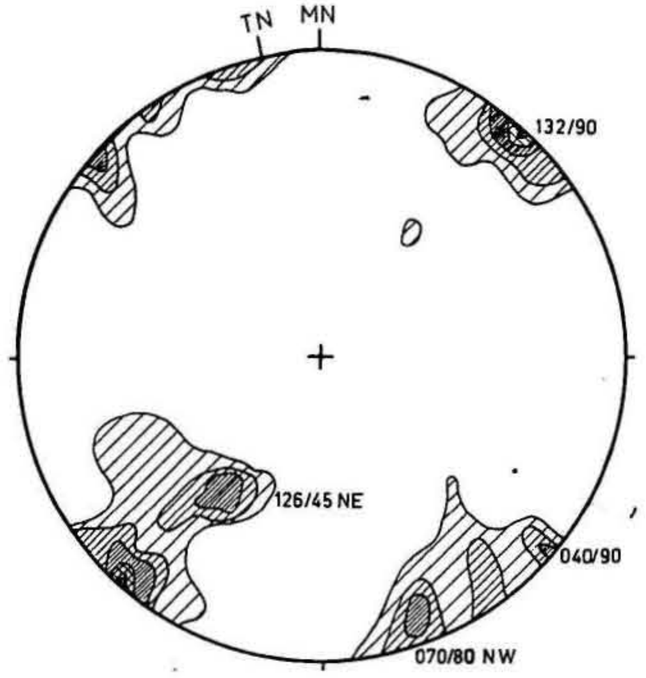
Area 1: 100 poles to joints

2



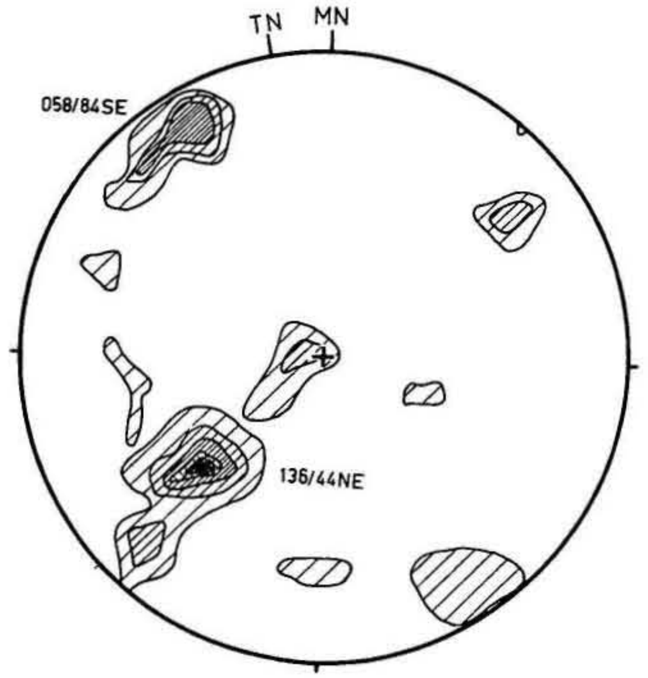
Area 2: 100 poles to joints

3



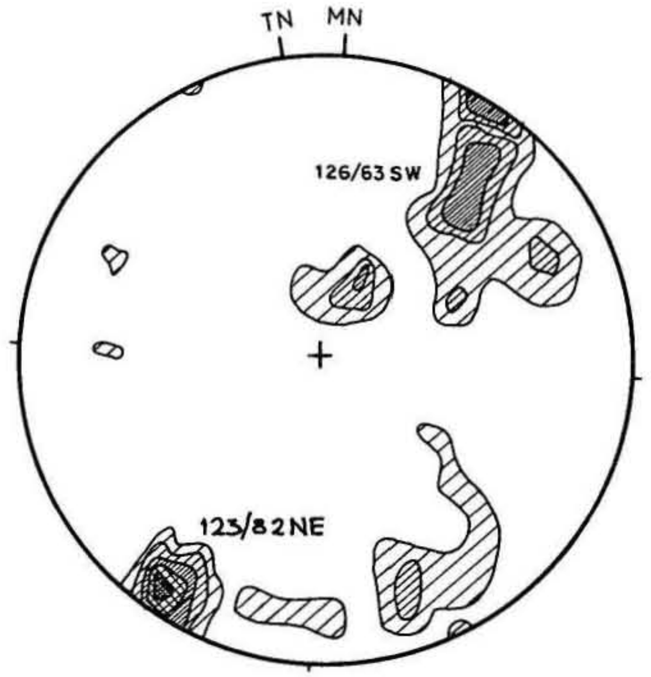
Area 3: 120 poles to joints

4



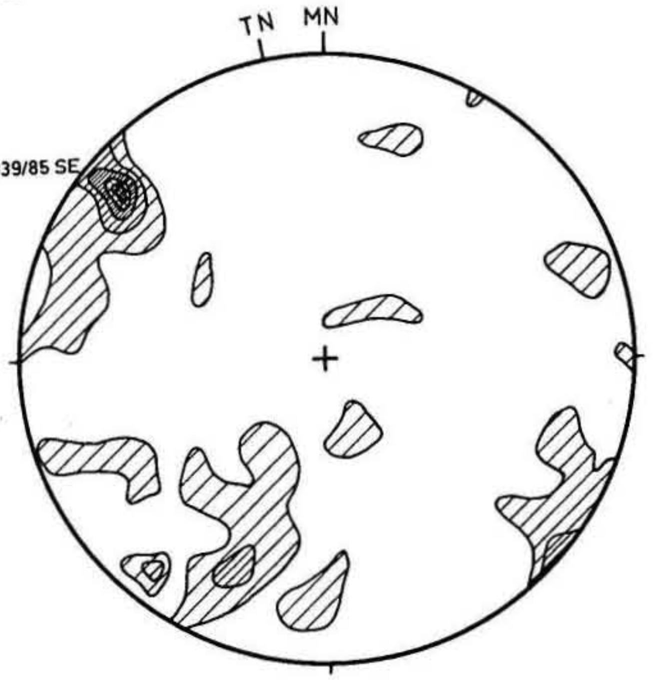
Area 4: 210 poles to joints

5



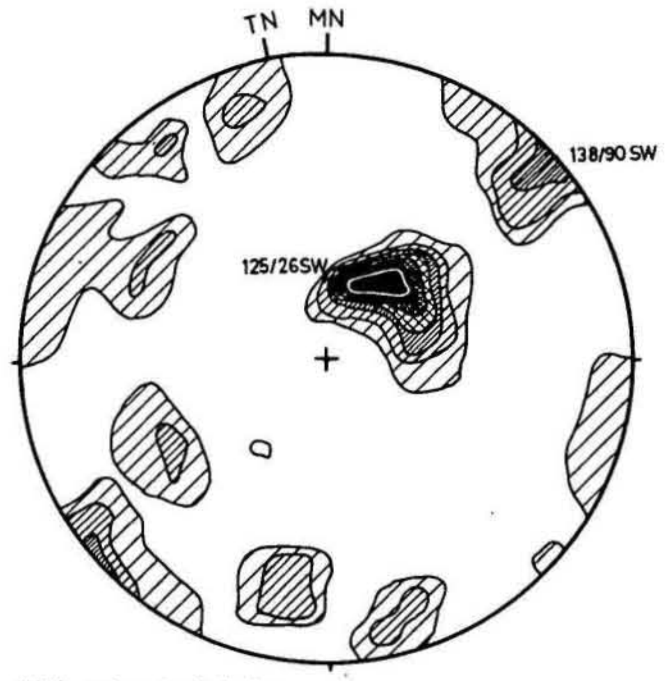
Area 5: 100 poles to joints

6



Area 6: 100 poles to joints

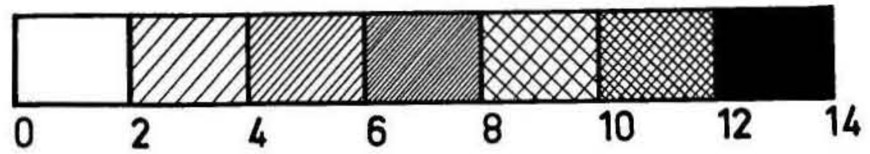
Stereograms of most of the joints of all sizes exposed in each of six areas. The areas (1 to 6 above) are shown in Plate 3.



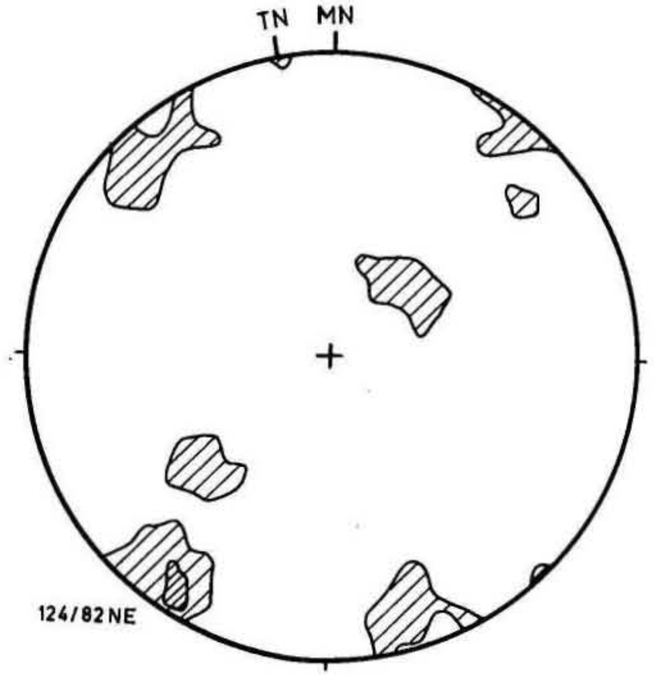
154 poles to joints

Stereogram of measurements of a small proportion, of the joints exposed over the entire area of mapping; larger joints more frequently represented than smaller.

The stereograms are contoured according to point densities, the points being the projections of the poles to joint planes. Points are projected from the lower hemisphere onto the horizontal plane according to an equal-area law; the projection is known as the Schmidt projection.

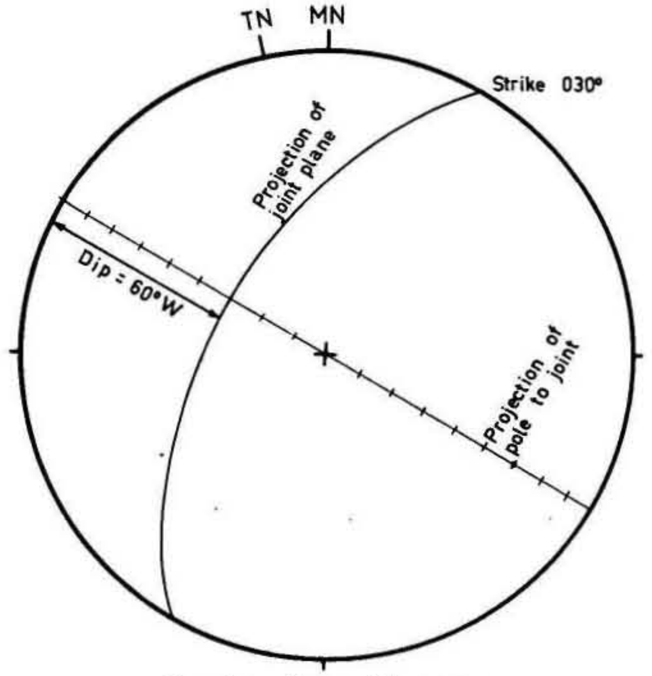


Percentage of points per percentage of area



884 poles to joints

Stereogram of all joint measurements.



Explanatory Diagram:
Stereogram showing the plane 030°/60°W and its pole (the line perpendicular to the plane).
Projections are from the lower hemisphere

Bureau of Mineral Resources, July 1968.

To accompany Record 1968/98

I55/A16/460