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DAM SITE E. UPPER COTTER RIVER.

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DEPARTMENT OF SUPPLY AND SHIPPING

BUREAU OF MINERAL RESOURCES

DAM SITE E, UPPER COTTER RIVER

REPORT NO. 1946/26

I. SUMMARY

1. A fifth possible dam site has been examined on the Upper Cotter River. The site has been designated Site E, and lies near the confluence of Kangaroo Creek with the Cotter River.

2. The geology and structures previously mapped in the Bushranger's - Collins Creeks area can be traced south to the Kangaroo Creek area where the Tidbinbilla quartzite and underlying metamorphic rocks of the Kangaroo Creek formation have been faulted down against the Franklin formation by the Cotter Fault.

3. Consideration of regional geological factors indicates that Site E is not as suitable as Site B for the constructions of a dam, but Site E should be satisfactory for a comparatively low retaining wall.

4. The rocks at Site E should provide firm foundations, but exposures are poor and exploratory excavations will be needed to determine the detailed distribution of rock types.

5. Alluvial flats along the Cotter River above Kangaroo Creek should provide ample supplies of both aggregate and sand for concrete.

6. A preliminary estimate of storage capacity indicates that a 60 foot wall at Site E would impound approximately 844,000,000 gallons of water.

II. INTRODUCTION.

A. GENERAL.

In March 1946 the Department of Works and Housing requested that a geological examination be made of the Upper Cotter Valley in the vicinity of Kangaroo Creek to determine whether a dam could be constructed near the junction of Kangaroo Creek with the Cotter River.

A geological examination of the area was subsequently made by Messrs. Noakes and Dimmick. The party was transported by pack horse from Tidbinbilla, and operated for four days, 11th to 14th April, from a camp established at the mouth of Kangaroo Creek.

This report deals primarily with a possible dam site, near the mouth of Kangaroo Creek, and includes only a brief addition to the general geology of the Upper Cotter Valley, which was described at some length in the report on dam sites referred to above.

Additional geological information has been incorporated on a regional plan of portion of the Upper Cotter Valley (Plate 1), and a more detailed account of the geology of the area will be presented when the examination of the Cotter Valley is complete.

B. LOCATION AND ACCESS.

The possible dam site at Kangaroo Creek is referred to as dam Site E, and the position of this site relative to the four sites (A-D) previously examined is shown on Plate 1.

Kangaroo Creek rises on the Cotter-Paddy's river divide about 3 miles north-east of Mount McHeahnie. It flows westward for about 5 miles to join the Cotter River some 8 miles downstream from the old Cotter Homestead. The possible site at the Kangaroo Creek junction lies approximately 16 miles from the source of the Cotter River, and some 19 miles from its confluence with the Murrimbidgee River.

There is at present no access by road into the Upper Cotter Valley, and the Kangaroo Creek junction is best reached on horseback. Rough tracks lead in from the valley of the Tidbinbilla River, from Gibralter Creek and from Booroomba Homestead. The tracks from these three localities join at the head of Kangaroo Creek. In each case the distance is approximately 10 miles, and takes 4 to 5 hours with pack horses, but the track from Booroomba Homestead provides the easiest riding. Another track leads into the old Cotter Homestead from Orroral Homestead on the Gudgenby fall, and a rugged motor vehicle could possibly reach the Upper Cotter Valley along this track.

Kangaroo Creek junction could also be reached by horse from the Mount Franklin road, which follows the Cotter-Goodradigbee divide from Mount Franklin to the vicinity of Mount Bimberi. There are no established tracks leading from this road into the Upper Cotter Valley, but horses could probably travel down most of the major spurs leading from the road down to the Cotter River.

It is understood that a preliminary survey for a road from Gibralter Creek to the Kangaroo Creek-Cotter River junction has already been made. This road would traverse granite for most of the way, and should be comparatively easy to construct.

C. MAPPING.

Geological features were plotted directly on to air photographs in the field, and a base map of portion of the Upper Cotter Valley above Collins Creek was later compiled from aerial photographs. This was done by radial line plot to allow for variationsin scale of the photographs. The strips so obtained from the photographic "runs" and the plan of portion of the Cotter Valley prepared for a previous report were then reduced to a uniform scale of 2 inches to a mile and assembled to form Plate 1. The positions of key points such as Mounts Tidbinbilla, McHeahnie, Gingera and Franklin were taken from survey plans of the Upper Cotter areas, and these constituted the control points for the assembly of the strips. Geological boundaries established in the field were extended by studying the air photographs, and a preliminary geological plan of the area produced.

A plane table survey was made of dam Site E, and a plan and section of this site appear in Plate 2.

III. PHYSIOGRAPHY.

The course of the Upper Cotter River has been determined partly by the strike of the metamorphic rocks and partly by the trend of the Cotter fault (see Plate 1). The topography of the Upper Cotter Valley changes markedly in the vicinity of Kangaroo Creek. Downstream from this

Creek the Cotter flows through a succession of gorges with few river flats, but upstream from Kangaroo Creek the valley floor widens considerably and river flats are continuous for a distance of approximately 1½ miles. Farther upstream the Cotter Valley becomes wider and the slopes less rugged.

This change in topography can probably be explained on a basis of stratigraphy and structure. Above Kangaroo Creek the Cotter River lies almost entirely in granite, and the less rugged topography of the upper reaches of the river, in the vicinity of the Old Cotter Homestead, probably reflects the relative case with which the massive granite has been eroded. The river flats immediately above Kangaroo Creek were apparently formed under the influence of temporary base levels of erosion established by gorges in metamorphic rocks below Kangaroo Creek. During these intervals the river above Kangaroo Creek widened its bed, which lay mainly in granite and along the Cotter fault, and subsequently built up extensive alluvial flats. Several tributary streams flowing to the Cotter from the ranges to the east and west disgorge on to these flats through large alluvial fans, indicating that over considerable periods the Cotter River in this vicinity was too sluggish to remove the coarser material delivered by its tributaries in flood.

IV. GENERAL GEOLOGY

A. INTRODUCTION.

The geology of portion of the Upper Cotter Valley has been described in some detail in a previous report by L.C. Noakes (No. 1946/12), and the following brief account of the geology of the Kangaroo Creek area is intended as an addition to the previous work.

The formations and structures previously examined between Bushranger's and Collin's Creeks extend southward along the Cotter Valley and are little different in the Kangaroo Creek area. The dominant structural feature is the Cotter fault which has been traced southward from Collin's Creek to a point about 2 miles south of Kangaroo Creek. The fault appears to be less prominent to the south and may become insignificant in the granite country at the head of the Cotter River.

B. METAMORPHIC ROCKS.

The Franklin formation and intrusive granite continue along the upthrow or western side of the fault. The structure of this formation in the Kangaroo Creek area varies little from that described farther north - northerly strike with dips averaging about 60 degrees to the west - but some lithological changes are apparent. In the Kangaroo Creek area the formation contains a greater number of sandy and possible tuffaceous phases, and is represented by phyllite, quartzite and schistose sandy tuffs. South of Mount Franklin a large body of granite - the Gingera granite - intrudes the formation with a contact aureole of quartzite and granitized rock and well-jointed contact quartzite occurs along the Cotter-Goodradigbee divide for several miles south of Mount Franklin.

On the downthrow or eastern side of the Cotter fault, the Tidbinbilla quartzite becomes thinner to the south, and the underlying Tharwa granite and an older formation of metamorphic rock are exposed. These older metamorphic rocks, which unconformably underlie the Tidbinbilla quartzite have been tentatively called the Kangaroo Creek formation. This formation contains rock types ranging from quartzites sandstones and tuffs to finely banded shales. Some sandstones have been sheared, and shales have been converted into slaty rock in places. Cleavage systems have been induced in beds of shale and slate, and the relationship of cleavage to bedding in several places indicates that the formation has been thrown into a series of pitching folds. The degree of contact metamorphism varies, but in general, it is surprisingly low considering the proximity of the Tharwa granite. About ½ mile up the Cotter River from the mouth of the Kangaroo Creek the formation is intruded by a tongue of granite, and to this can be attributed the silicification of the rocks at dam site E. The relationship of the Kangaroo Creek formation to the Franklin formation is not clear. The two formations have much in common lithologically, but the grade of regional metamorphism appears higher in the rocks of the Franklin formation. It seems probable that the two formations belonged to the same group or series before faulting took place.

In the Kangaroo Creek area the Tidbinbilla quartzite occurs in outliers and a study of air photographs indicates that their relationship with the underlying Kangaroo Creek formation has been complicated by normal faulting. In the Kangaroo Creek area the formation has suffered less silicification than in the area to the north because the older metamorphic rocks were interposed between it and the granite, and the dominant rock type is a buff or reddish, partially silicified sandstone. The formation strikes north and south and dips west at angles ranging from 12 to 25 degrees where it has not been disturbed by faulting.

C. IGNEOUS ROCKS.

Four separate areas of granite are shown on Plate 1 - the Tharwa granite, the Cow Flat granite, the Bendora granite and the Gingera granite. These granites are probably all consanguineous and are shown by the same convention on the plan. A formal name has been given to each granite, because bodies occur on both sides of the fault, and their interrelationships have not been clearly established.

The dominant rock type in each area is biotite granite, with little or no other ferro-magnesian mineral.

The Tharwa granite constitutes the main batholith, and occurs on the downthrow side of the Cotter fault. The Cow Flat granite also occurs on the downthrow side and is a stock or apophysis probably connected in depth with the Tharwa granite. The Bendora granite occurs on the upthrow side of the fault, and is a sill or elongated stock of sheared granite. It may be connected in depth with the Gingera granite, a larger body of dominantly unsheared granite intruding the Franklin formation to the south. The Gingera granite will presumably be found to abut the Tharwa granite along the Cotter fault towards the head of the Cotter River.

A tongue of porphyritic biotite granite truncated on the west by the Cotter fault, intrudes the Kangaroo Creek formation along the Cotter River a ½ mile upstream from the mouth of Kangaroo Creek, and this is connected with the main Tharwa granite.

V. ENGINEERING GEOLOGY.

A. DAM SITE E (See Plates 1 and 2).

1. General.

Dam Site E is situated 200 feet downstream from the mouth of Kangaroo Creek, where the valley of the Cotter River becomes relatively constricted.

In regard to regional problems such as seismic activity and leakage of water from the storage area, this site is not as suitably placed as site B, which was discussed in an earlier report. The main Cotter fault lies approximately 850 feet west of Site E, and air photographs suggest that small scale faulting has taken place approximately 1,300 feet south-east of the site. However, the rocks exposed at site E do not appear shattered and should provide a suitable foundation for engineering works.

The possibility of leakage from the storage area warrants some consideration. The rocks exposed in the storage area consist of granite, steeply dipping quartzite, sandstone, shale and slate. These rocks and their internal structures are not likely to cause any significant leakage particularly since the water table normally lies at or close to river level. However, a retainingwall at Site E would impound water over portion of the Cotter fault zone 2,000 feet upstream from Site E, with the possibility that leakage into the fault zone might occur. On the other hand, the problem is different from that previously considered in the case of sites A,B,C, and D. It is understood that a comparitively low retaining wall, approximately 60 feet high, would be constructed at Site E, whereas a wall of more than twice this height was envisaged at the other four sites. At Site E, the amount of water impounded over the main Cotter fault zone by a retaining wall 60 feet high would not exceed a maximum of 40 feet, and in most places would be considerably less than this. In the absence of any evidence to suggest that migration of water along the fault could readily take place, there seems little liklihood that the impounding of up to 40 feet of water over the fault zone could give rise to significant leakage. It cannot, however, be overlooked.

From a consideration of the general geological features and the possibility of leakage from the storage area, it is considered that:-

(1) Site E is not as suitably placed as Site B for the construction of a dam.

(2) Site E is probably a satisfactory site for a retaining wall about 60 feet high.

2. Foundations at Site E.

Site E lies in metamorphic rocks of the Kangaroo Creek formation. The rocks exposed at the site include bands of quartzite and alternating beds of silicified sandstone, indurated shale and slate. The quartzite and sandstone show a varying degree of silicification and in thin section consist principally of quartz grains, many of which still show a rounded form and evidence of bedding, with limonite, magnetite and traces of altered biotite and felspar. Specimens from the prominent bed of quartsite 300 feet south-west of Site E (see Plate 2), showed an unusual degree of silicification.

The slates and partly silicified shales are buff, grey or dark grey in colour and usually occur in layers a foot or so in thickness between beds of sandstone or quartzite. The slates and shales are fine-grained and many are well laminated. Under the microscope they show evidence of alterations and some secondary minerals such as epidote have probably been developed.

Actual outcrops at Site E, were too sparse to allow an accurate estimate to be made of the relative proportions of sandstone and slate, but slate and shale do not appear to amount to more than 50 per cent of the formation in the outcrops observed and they occur in thin beds alternating with more competent rock.

Surface weathering is relatively shallow at Site E, partly because the rockshave been hardened to varying degrees by metamorphism and partly because the water table normally lies close to the surface. Over much of the site the rocks are covered by a mantle of soil and scree, but comparatively unweathered rock should be encountered a few feet below the surface.

The rocks at Site E should, therefore, provide sufficiently solid foundations for at least a relatively low retaining wall. However, before work is commenced, an examination of the rocks should be made by preliminary excavations, to ensure that there are no unsatisfactory features such as too deep a zone of weathering or too great a development of slate.

3. Structures.

In the vicinity of Site E the metamorphic rocks strike north-westerly and dip south-westerly at angles which range from 60 degrees to vertical. Bedding planes would, therefore, lie at an angle of approximately 25 degrees to a regaining wall, constructed at right angles to the river, and the dip would be upstream. Under these conditions there should be little risk of leakage along bedding planes, but the detailed distribution of sandstone and slate will need to be determined so that foundations can be placed to bear on the most competent beds.

Two pronounced joint systems were observed in quartzite in the east bank of the river at Site E. One system striked north-west, parallel to the bedding, and dips north-east at 40 degrees, and the other strikes south-west, parallel to the dip of the rocks and dips north-west at 60 degrees. Joints of the second system, striking approximately at right angles to the retaining wall, could give rise to leakage under the foundations, but the joint planes observed were clean tight fractures which are not likely to provide ready channels for leakage. No faults or crush zones were observed in the outcrop at Site E, but exposures were relatively poor, and the foundation rocks will have to be exposed and carefully examined before the chances of leakage along joints and possible faults can be accurately assessed.

B. SOURCES OF AGGREGATE.

Stream gravels from the river flats above Kangaroo Creek junction probably constitute the best source of aggregate above Site E. About a quarter of the gravel consists of granite andthe remainder of contact metamorphic types - principally quartzite, silicified sandstone, hornfels, etc. Only a small proportion of the gravel observed consisted of tabular slaty rock and this could be eliminated if necessary. Gravels in the immediate vicinity of Kangaroo Creek contain a high percentage of slaty material and might, therefore, be avoided.

Alternative or additional supplies of aggregate could be obtained by crushing the Tidbinbilla quartzite, which outcrops on the hillside on the eastern bank of the Cotter above Kangaroo Creek or by crushing the prominent bed of quartzite from the Kangaroo Creek formation, which outcrops 300 feet upstream from Site E (see Plate 2). Specimens of both quartzites have been examined in thin section, and these did not show minerals or structures considered undesirable material, and in most cases will contain a high percentage of silica.

C. SOURCES OF SAND.

There are very few sand beaches along the Cotter River in the vicinity of the Mangaroo Creek, but sand could be obtained by screening the gravels from the alluvial flats. The quality of this sand has not been investigated, but there is little doubt that a sufficient quantity could be obtained from this source. Artificial sand can be obtained by crushing and screening the Tidbinbilla quartzite.

D. STORAGE CAPACITY.

A plane table survey of the storage area was not carried out because the river flats were, for the most part, scrub covered and sufficient time was not available. A contour plan of the storage area could probably be compiled by plotting survey data on record in field book E.1300 held by the Department of the Interior.

A preliminary estimate of storage capacity has been made by using air photographs and reduced levels along the river established by surveyors in 1914. This indicates that a retaining wall 60 feet high at Site E would impound approximately 135,000,000 cubic feet or 844,000,000 gallons of water. This preliminary estimate is subject to considerable error and should be confirmed by more accurate methods. It will not be possible to compare storage capacities provided by retaining walls at sites B and E until a contour survey has been made of the storage area at each site.

VI. RECOMMENDATIONS.

The following recommendations are submitted.

(1) If a dam is to be constructed at Site E, a necessary preliminary step would be to establish in detail, by exploratory pits and costeans the distribution of rock types and depth of weathering.

(2) If work is commenced at Site E, geological examinations of the excavations should be made from time to time, and eventually a detailed plan provided to show the geology and structures of the completed excavations.

(3) A geological examination should be made of all proposed quarry sites and gravel pits from which aggregate or sand are to be drawn. A microscopic examination should be made of the sand so obtained to determine the proportion of undesirable minerals present.

(4) A geological survey should be made of any areas through which it is proposed to construct roads or pipe lines.

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The writer wishes to acknowledge the assistance of Mr. T.D. Dimmick, Geologist, in both field and office work. The assistance of Mr. Cole of the Forestry Branch, in arranging transport for the field party is gratefully acknowledged and sincere thanks are tendered to Messrs. Jack, Douglas and Lachlan Maxwell, Forest Rangers, for their help and co-operation.

SUPPLEMENTARY NOTE ON DAM SITE "E", UPPER COTTER RIVER

The geology of dam site "E" is described by Noakes (1946), who gives a plan and section across the site up to 70 feet above river level. With the object of extending the mapping up to at least 150 feet above the river the site was visited on 14/5/59 by N.H. Fisher, L.C. Noakes and the writer, of the Bureau of Mineral Resources and I. Wood of the Department of Works.

Access by landrover was obtained via a newly constructed Forestry road that runs from the hut at Mt. Gingera southwards and eastwards to the Orroral River, and crosses the Cotter River approximately 10 miles upstream from the dam site. From the crossing the vehicle was driven down the Cotter valley to a point about 4 miles upstream from the dam site. The remaining distance was covered on foot.

The additional mapping, shown on the attached drawing, was done by compass, tape and abney level and was restricted to short traverses on either side of the valley along the axis of the proposed dam site. The geology of the site, from surface mapping, is described by Noakes (1946). On the right abutment Tidbinbilla quartzite rests with strong unconformity on the Kangaroo Creek Formation. It forms a massive outcrop at 170 feet above river level. In the section that accompanies this report it is suggested that the unconformity lies a little below the base of the outcrop, and dips in the same direction as the quartzite. However the boundary between the Tidbinbilla quartzite and the underlying Kangaroo Creek Formation is not exposed, and its position and attitude are not known.

The position of the Cotter Fault is not known; it is probably situated west of the 200 foot contour on the left bank, and should be clear of the foundations. The detailed geology of the site, including in particular the lithology of the Kangaroo Creek Formation and the position of the Cotter Fault, can be ascertained only by sub-surface investigation. It is suggested that this be done initially by costeaning and subsequently by diamond drilling.

Access to the site, sufficient for investigation, could best be provided by bulldozing a landrover track down the Cotter Valley from the Orroral Road, near De Salis Creek, to Site E, a distance of 5-6 miles.

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Reference

NOAKES, L.C., 1946 - Dam site E, Upper Cotter River, *Bur. Min. Resour. Aust.* Report 1946/26.