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DEPARTMENT OF SUPPLY AND SHIPPING.

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS.

REPORT No. 1948/54
Geol. Ser. No. 20.

GEOLOGICAL REPORT ON DAM SITES 4 MILES NORTH-EAST OF TENNANT CREEK. NORTHERN TERRITORY.

by

L.C. Noakes
Geologist

CANBERRA, A.C.T. September, 1948.

TABLE OF CONTENTS.

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GEOLOGICAL REPORT ON DAM SITES 4 MILES NORTH-EAST OF TENNANT CREEK, NORTHERN TERRITORY.

By L.C. Noakes.

Report No. 1948/54
(Geol. Ser. No. 20)

I. SUMMARY.

1. An investigation has been made of possible dam sites on a small stream north-east of Tennant Creek township in the Northern Territory.

2. The sites are located in moderately-dissected spinifex country, about 4 miles from the township.

3. The catchment area above the sites is small and amounts to about 2 square miles.

4. The general geology consists of steeply-folded slates intruded by small bodies of quartz porphyry.

5. The investigation covered two possible sites for a rock-fill dam with a concrete core or membrane. On account of the small catchment and storage areas the possibilities of leakage were critically examined.

6. Dam Site 1 lies in slate which strikes at right-angles to the course of the stream and dips downstream at 60 degrees. Section E-F at Site 2 lies half in porphyry, half in slate. An alternative is suggested at Site 2 where, by changing the direction of the proposed wall, the foundations may lie entirely in porphyry. Costeans will be required if any of these sites are to be further investigated.

7. Geological factors suggest the order of preference would be:-

   (a) The alternative site at Site 2.

   (b) Section E-F at Dam Site 2.

   (c) Dam Site 1.

8. The storage area lies in slate, with small porphyry intrusives, and leakage should not be abnormal.

9. Stream gravels provide a possible source of aggregate but further investigation is intended. Outcrops of granite would probably be the best alternative source of aggregate.

10. Sand from the stream bed at the possible dam sites may be suitable for use in concrete, but further investigation is in hand.

11. Slate and porphyry from the vicinity of the dam sites will provide material for rock-fill.

II. INTRODUCTION.

The Department of Works and Housing is investigating the possibility of providing additional water supplies to the township of Tennant Creek in the Northern Territory and in March, 1947, requested the Bureau of Mineral Resources, Geology and Geophysics, to carry out a geological examination of possible dam sites in the Tennant Creek area.

A preliminary inspection of two possible dam sites was made on the 5th June, 1947, in conjunction with Messrs. Waite and Gilfillian, Engineers of the Department of Works and Housing, and a detailed plane table survey of both sites was carried out by L.C. Noakes and D.M. Traves on the 6th and 7th of July.

Unfortunately, the preparation of the report on the dam sites has been long delayed by a protracted illness and the writer tenders his apologies to the officers of the Department of Works and Housing who may have been inconvienced by the delay.

III. LOCATION, ACCESS AND MAPPING.

The two possible dam sites lie on a comparatively small stream which rises about 2 miles north of Tennant Creek and flows to the north and north-east. The sites lie approximately north-north-east of Tennant Creek township at a distance of 4 to 4½ miles by road. The Stuart Highway is followed north from Tennant Creek for 3 miles to the north side of a gap in the Honeymoon Range, whence a good track, fire-ploughed in part, leads eastward for 1 to 1½ miles to the stream on which the sites are located. The track from the Stuart Highway to the dam sites traverses gently undulating spinifex country, with a predominantly stony surface, (see Fig. 5), and could be readily improved to accommodate heavy transport.

The limits of the catchment area and a small area in the vicinity of the possible dam sites have been topographically surveyed, and copies of these plans, showing the position of survey pegs, were provided by the Department of Works and Housing. The two sites selected lie only 500 feet apart on the main stream and were conveniently covered by one plane table sheet on a scale of 50 feet to the inch.

However, the original plane table sheet was lost during the writer's absence and, to accompany this report, a sketch plan had to be compiled from the survey plans, field books, photos and from two geological sections which had been taken from the original field sheet. This sketch plan is reasonably accurate but can be corrected when further geological work becomes necessary on the sites. The sketch plan can be related to the survey plans by reference to the numbered pegs.

IV. TOPOGRAPHY.

The possible dam sites lie in moderately-dissected, undulating country within a mile of the northern edge of the low hills which constitute the westerly-trending Honeymoon Range. The sites lie towards the head of the stream, which apparently has no formal name, and the catchment area is small - amounting to little more than 2 square miles.

The average annual rainfall in the area is approximately 14 inches. This is strictly seasonal and the streams flow only after the occasional storms which usually occur between December and March. Water holes in the creek beds may persist during the early months of the dry season (the water hole at Dam Site 2 contained over 2 feet of water in June) but in normal years little surface water could be expected after July or August.

The present stream channel, in the vicinity of the dam sites, is confined to a narrow trough, averaging about 20 feet wide and 5 to 15 feet deep, but there is evidence of an older valley into which the present stream channel has been incised. The banks of the present stream channel are steep in most places and particularly along the eastern or right-hand side of the creek. The fall of the stream bed has not been determined accurately, but it appears comparatively steep as the contours on the surveyed plan show a rise of approximately 400 feet to the mile for 4,000 feet above the upper dam site.

V. GENERAL GEOLOGY.

The rocks of the area consist of steeply folded beds of slate intruded by small bodies of sheared quartz porphyry. Specimens of these rocks have been examined in thin section by W.B. Dallwitz, Petrologist to the Bureau, and his notes are reproduced in Appendix I.

The slates belong to a group of metamorphics which form the basement rocks of the Tennant Creek area, and are probably of Lower Proterozoic age. All of the outcrops examined in the vicinity of the dam sites, and throughout the storage area, consist of fine-grained sediments which have been altered, principally by regional metamorphism, into sheared and jointed slates, but on the whole, the grade of metamorphism is not high, and most of the rocks outcropping are slates rather than schists. In many outcrops, the bedding is obscured by cleavage and schistosity, but schistosity was observed to parallel bedding in some outcrops in the vicinity of the dam sites. The essential mineral constituents are quartz, sericite and hematite with minor quantities of black iron ore and leucoxene.

The slates have been steeply folded and dip fairly uniformly to the north at angles which vary from 45 degrees to vertical and average approximately 60 degrees. (See Fig. 3). The outcrops observed suggest that the slates of the storage area lie on the northern flank of a major fold, and the few, authentic, southerly dips observed can probably be referred to minor buckles in the pattern of broad folding. Outcrops in the vicinity of the dam sites show a number of small faults and shears, with shears developing along the bedding planes in many places, but no evidence of major displacements was found.

The sheared igneous rock occurs in small bodies, irregularly intruded into the slate. Some outcrops were at first mistaken for sheared sandstone until definite intrusive contacts were found. (See Fig. 4). The rock consists of phenocrysts of quartz, with subordinate orthoclase, set in a felsitic groundmass. Alteration is apparent in both the phenocrysts, where all of the orthoclase has been partially kaolinized, and in the groundmass which shows extensive alteration to sericite. The rock has been sheared and the planes of schistosity are readily discernable in hand specimens. Shearing has not been intense, as the quartz phenocrysts, although stained, are not shattered although the weaker, orthoclase phenocrysts have, almost invariably, been crushed.

Most of the outcrops of porphyry are very small and so intimately associated with the slates that differentiation is not possible on a scale of 50 feet to the inch. These small outcrops conform to the bedding of the slates in most places and appear as small lenses or sills intruded along bedding planes. (See Fig. 4). A larger intrusive body, approximately 120 feet wide, forms a bar across the stream at Site 2. This body is probably a sill, although its boundaries, particularly on the northern side, are somewhat irregular and, in depth, it will probably dip to the north with the metamorphics.

VI. ENGINEERING GEOLOGY.

Two possible sites for a dam were inspected in the field, Site 1 and Site 2 on Plate I. It is understood that the type of dam considered most suitable is a rock-fill dam with a concrete core or membrane, and, for this reason, a preliminary investigation of rock materials was made in the vicinity of the sites.

The possibilities of leakage from the dam and from the storage area are of more than usual importance on account of the small catchment area of approximately 2 square miles.

A. Foundations

(1) Dam Site 1 (See Plate I and Figures 1-3).

A dam at Site 1, to impound the maximum depth of water (up to the 95 foot contour shown on Plate I), would be approximately 40 feet high, and the maximum length of the wall would be about 315 feet. The long axis of the dam would lie parallel to the strike of the slates which dip downstream at approximately 60 degrees. (See Sections A-B and C-D Plate I).

In the section exposed in the east bank of the stream at Site 1, the slates contain several massive bands which consist of partly silicified slate and lenses of porphyry. Typical exposures are shown in Figure 3, with finely bedded slate on the right, and a massive band in the left centre. The essential difference between the two rock types can be seen in Figure 4, which shows slate with fracture cleavage on the left and massive, partly silicified slate and porphyry on the right, separated by a small strike fault. Many of the contacts between beds of different competence are marked by strike faults.

However, the massive bands are relatively narrow - up to 20 feet wide - and may prove to be irregular along the strike. These rocks can provide suitable foundations for a rock-fill dam as far as strength is concerned. It may be possible to imbed the concrete membrane in one of the massive bands, although, due to the narrowness of the band and its dip to the north, the concrete core would have to follow a slight curve, convex downstream, to keep within the same band.

However, some leakage problems would be likely because the foundations of the dam would be relatively shallow. Although the slates should form a tight formation at depth, bedding and fracture planes, particularly the strike faults, are likely to conduct water for some distance immediately below the surface. Risk of leakage would arise from the possibility that water under head, would travel down fractures or down the dip of the slates and pass beneath the concrete membrane.

It would be wise to anticipate such leakage by grouting below the concrete membrane, particularly in the vicinity of the stream bed, where the hydro-static head of the water would be greatest.

Minor leakage might occur at the western end of the dam, along bedding and fracture planes which traverse the narrow ridge forming the western abutments.

If further investigations on Site 1 are intended, costeans, at rightangles to the proposed wall, should be sunk to bed-rock on the slopes on both sides of the stream. (See Plate I). These exposures should indicate whether or not the massive bands, found in the creek, persist along the strike of the slates.

(2) Dam Site 2. (Figures 5-8).

The position of Dam Site 2 is approximately 500 feet upstream from Site 1. The best position for the dam cannot be decided without costeaning, but a retaining wall constructed along Section E-F, on Plate I, to impound water up to the 95 foot contour, as at Site 1, would be approximately 370 feet long and about 40 feet above stream-level. The concrete membrane would lie in quartz porphyry in the western half of the dam site, but in slate in the eastern half. No difficulties are expected in procuring adequate foundation for the dam, or for the central core.

The quartz-porphyry, although sheared and altered, is still quite a strong rock, particularly in the outcrops in the creek bed, where partial silicification has caused a hard bar to form across the stream channel. Two faults or shears were mapped in the porphyry, and these may have to be grouted. The porphyry contains some inclusions of partly digested slate, but these are fairly hard and show no open contacts.

The rock is strongly jointed and the direction of dip of the principal joint planes are given below:-

STRIKE AND DIP OF PRINCIPAL JOINT PLANES.

Strike	40°	45°	90°	160°
Dip	V	55°SE	25°-30°N	V

The apparent dip of joint planes has been shown in Sections E-F and G-H, although spacing of the planes is only diagramatical. The joint pattern in the porphyry is shown to advantage in Figures 7 and 8. No leakage problems are expected in the porphyry although some grouting might be required along faults and flatly dipping joints. The relative tightness of this prophyry bar is indicated by the fact that it contained the only water-hole found in the creek in early June.

The slates in the eastern half of Section E-F strike approximately 95 degrees, and dip north at about 60 degrees, so that foundations constructed along the line of Section E-F would cross the bedding at an angle of 20 degrees with the dip in a downstream direction. This situation is similar to that pertaining at Site 1, and although the hydro-static head of water in this portion of the dam would not be great, some precautions should be taken if leakages were to be reduced to a minimum. The suggested positions of costeans to allow inspection of the slates in this section, are shown on Plate I.

Leakage from the western end of Site 2 should be negligible, particularly if the porphyry continues to the west.

In view of the fact that leakage should be kept to a minimum, it would be advisable to investigate the contacts of the porphyry on the eastern side of the stream. If the porphyry behaves as a normal sill, conforming with the strike of the slates, it should be possible to construct the concrete core wholly in porphyry by changing the direction of the dam as shown in Plate I.

The porphyry would provide adequately strong foundations with a minimum of work to reduce leakage. Furthermore, such a porphyry bar, although probably dipping with the sediments, should, to some extent, act as a cut-off wall, and reduce leakage arising from shallow circulation beneath the foundations of the dam. The suggested positions of costeans to trace the porphyry bar in the eastern side of the valley are shown in Plate I.

(3) Comparison of Dam Sites.

Sections across the valley at Sites 1 and 2 indicate that the area of cross section below the 100 foot contour are approximately the same for both sites, although the length of wall would be slightly greater if the dam were built at Site 2. However, Site 2 appears to offer better foundations and less chance of leakage.

Taking all geological features into account, the order of preference would be:

(a) Alternative site in porphyry at Site 2 (subject to the distribution of porphyry in the eastern half of the site);

(b) Section E-F at Dam Site 2; and

(c) Dam Site 1.

B. Spillways.

The location of a spillway for rock-filled dams, constructed at either sites 1 or 2, should present no difficulty. A tributary gully roughly parallel to the main stream, lies immediately west of the dam sites and, with a cutting from the main valley above the dam sites, this gully would handle the over-flow water. The sides and bottom of the spillway and, part of the gully, will need paving to check erosion.

C. Catchment and Storage Areas.

The outcrops in the catchment and storage areas consist of metamorphics of the Tennant Creek group with minor igneous intrusions, and, in general, are similar to the rocks described from the vicinity of the dam sites.

A reconnaissance of the storage area did not reveal any geological features likely to cause serious leakage. However, a geological party from the Bureau of Mineral Resources, Geology and Geophysics, is at Tennant Creek, carrying out detailed mapping in the mining areas. Their work will include the catchment and storage areas for these dams and will provide a check on the geology and structures upstream from the dam sites themselves.

When the storage area in inundated for the first time, there will be an initial loss of water to saturate:-

(a) The soil cover in the storage area; and

(b) The fractures and openings in the rocks immediately beneath the soil.

The soil cover in the storage area is shallow and porous and will not provide a seal over the underlying rocks. The rocks, themselves, are most unlikely to include porous strata which could act as an acquifers, and therefore storage and circulati n of water will be dependent on fractures. Openings along bedding planes, joints, fracture cleavage and faults near the surface, will be filled with water and will remain charged as long as there is water above them, but the actual leakage from the storage will depend on the extent to which the fractures in depth provide a reticulated system of openings through which water can pass.

The rocks which underly the storage area are, for the most part, metamorphosed, fine sediments, in which no evidence of major shear or fault zones has been found. The rock fractures, below the near-surface zone, are likely to be sufficiently tight to greatly restrict the passage of water, and therefore, apart from the initial losses referred to above, leakage from the storage is likely to be small and not unusual.

In this connection, data concerning the Rifle Creek Dam at Mt. Isa, Queensland, obtained by the Department of

Works and Housing, is of interest. This dam provides some parallels with the proposed Tennant Creek Dam in that climatic conditions are approximately the same, with very low water table, and the storage areas in both localities overlie folded Proterozoic slates. Unfortunately, the catchment (37 square miles) and storage areas of the Rifle Creek Dam are far larger than those available at Tennant Creek, and the relationship of annual draw-off to storage capacity at the Rifle Creek Dam is not given. However, there is no suggestion in the information supplied, that there has been any marked leakage from the storage area at Rifle Creek. Data concerning this dam, as supplied to the Department of Works and Housing, is reproduced in Appendix II to this report.

D. Rock Material.

(1) Aggregate.

Rock material in the vicinity of the dam sites consists of quartz-porphyry, slate and creek gravels.

In general, the quartz-porphyry, which forms a bar across the creek at Dam Site 2, will not provide suitable aggregate, mainly because the rock is sheared, but also because the felspars have been crushed and altered. Those parts of the porphyry which have been silicified could be used as aggregate, but this would entail carefull sorting. Apart from this bar, no outcrops of porphyry were discovered which were sufficiently extensive to provide a source of aggregate.

The slates in the neighbourhood of the dam sites do not provide a source of suitable aggregate. In some places, they have been partly silicified, but in general, they consist of sheared, altered rocks with much sericite and strong directional structures.

The river gravel contained in the main stream above and particularly below the dam sites, provide a possible source of aggregate. The gravels consist mainly of slate with some porphyry and quartz with rare boulders of hematite shed from hematite lenses.

This material is preferable to the slate and porphyry in situ, because, by stream selection, most of the gravels consist of partly silicified rock, and are therefore harder, and more tightly bonded than material quarried from normal outcrops.

However, recent work on aggregates by the Cement Section of the Council for Scientific and Industrial Research (Alderman et alia, 1947), throws some doubt on the advisability of using stream gravels from the Tennant Creek area for aggregates in dam construction. Two samples of aggregates from stream gravels in the Tennant Creek area (exact localities not known), were tested in mortar bars over a period of two years. Both of these aggregates showed some signs of reaction with the cement, possibly due to the presence of crypto-crystalline or opaline silica. A little crypto-crystalline silica was identified in one of the samples. If gravels the same as those tested by the Council for Scientific and Industrial Research were used as aggregate, the concrete might slowly deteriorate, although the effects of delayed expansion, due to re-action between cement and aggregate, would probably not become manifest for many years.

Therefore, the use of stream gravels in the vicinity of the dam sites for aggregate in the construction of the concrete membrane could not be recommended without very careful examination. Arrangements will be made to test these stream gravels, but an alternative source of aggregate may be required.

Probably the best alternative would be the granite which outcrops about 5 miles to the west. This granite has not been examined nor have quarry sites been located, but the granite contacts were mapped by the North Australia Regional Survey in the present field season. This information will be available later this year, and will facilitate the search for granite aggregate if this is required.

(2) Sand.

Adequate quantities of sand for concrete can be obtained from the stream channel and from the narrow sand banks which border the stream bed between Sites 1 and 2. (See Plate I). However, any undesirable constituents in the stream gravels, such as crypto-crystalline or opaline silica, will also be represented in the sand and therefore, it is recommended that further examination of the sand should be carried out before the material is used in concrete for the dam.

From a preliminary examination, W.B. Dallwitz reports that the main constituents of the sand are particles of slate and silicified slate stained with hematite, quartz and weathered felspar, felsite or, possibly, crypto-crystalline silica, slate impregnated with magnetite and magnetite. The presence of particles of what may be crypto-crystalline silica, make further investigations essential, and a sample of the sand will be sent to the Cement Section of the Council for Scientific and Industrial Research for further testing.

Alternative sources of sand, suitable for concrete, should be found in stream channels draining granite areas and a locality can probably be found from which supplies of both granite aggregate and sand may be drawn.

(3) Rock-fill.

The rocks outcropping in the neighbourhood of the dam sites can be used as rock-fill for a small dam, although they do not provide ideal material.

The metamorphics and the porphyries are sufficiently impervious and tightly bonded and appear to have sufficient strength for this purpose. Specimens of slate and porphyry were immersed in water for nearly a year and then removed to dry at room temperatures for several months, but no appreciable softening of the rocks could be detected.

Rock excavated from the dam foundations and spillway could be used as rock-fill, but a site for a quarry from which the bulk of the rock-fill can be drawn, will have to be located.

VII. RECOMMENDATIONS.

The following recommendations are submitted:-

1. If further investigations on the Tennant Creek project are intended, it is recommended that first consideration should be given to the alternative site at Site 2, where costeans are required to establish the distribution of porphyry on the eastern side of the valley.

2. Future geological work should include:-

(a) Detailed mapping of any exploratory costeans;

(b) The checking and correction of the geological sketch plan accompanying this report; and

(c) The location of alternative sources of sand and aggregate.

September, 1948.
CANBERRA, A.C.T.

(L.C. Noakes)
Geologist.

REFERENCE.

Alderman et alia, 1947: Studies in Cement-Aggregate Reaction. C.S.I.R. Bull. No. 229.

APPENDIX I.

PETROLOGICAL NOTES ON ROCKS FROM DAM SITES AT TENNANT CREEK.

by W.B. Dallwitz,
Petrologist

No. 3 - Macroscopically this is a weathered, grayish-white, friable rock, resembling a grit. It has been quite strongly sheared, but the cleavage is rather irregular due to the gritty nature of the specimen. Two systems of joints at angles of 75° to 80° to each other are present. Quartz is the only mineral definitely distinguishable and the base in which it is set is of sericitic and/or kaolinitic nature.

The section for microscopic examination has been cut parallel to the cleavage, and the appearance of the rock when viewed in this direction is very like that of a normal, unsheared igneous rock, in this case a porphyry.

The groundmass is felsitic and very little sericite is distinguishable therein, presumably because the flakes lie parallel to the direction of section. Distributed through the base is a number of areas containing leucoxene flecks and concentrations, sometimes arranged in such a manner as to be suggestive of the shapes of certain former phenocrysts, probably biotite. Some limonitic and, to a much lesser extent, haematitic areas give the same suggestion of crystal outlines.

By far the most abundant porphyritic mineral is euhedral quartz. This mineral shows strong strain-shadows under crossed nicols, but it is not often actually shattered. Many grains are bordered by shreds of sericite whose lengths are perpendicular to the grain-boundary.

Orthoclase is subordinate in quantity, and has, in contradistinction to the quartz, nearly always been crushed during shearing; the few grains that have not been completely shattered show very strong strain-effects. All of the felspar is clouded through partial kaolinisation. No plagioclase occurs in the slide.

What was undoubtedly a former crystal of biotite is now represented by leucoxene and sericite.

Zircon, of which two grains appear in the section, is the only primary accessory mineral.

The rock is a highly acidic, sheared, altered and weathered quartz-orthoclase-porphyry.

No. 4 - Macroscopically this rock differs from No. 3 mainly in being finer grained (it has the texture of an average sandstone) and in having a faint pink tinge; part of it is coloured a uniform purplish red through haematite-staining.

The section has been cut across the cleavage, and its appearance is such that it is difficult to tell whether the rock was originally sedimentary or igneous, but examination of specimen No. 3 from the same rock-mass has proved that it is igneous.

The felsitic groundmass has been extensively sericitised and contains a large number of flecks and aggregations of haematite and leucoxene. In some cases a little black iron ore is associated with these two minerals. A few limonitestains are also present.

The porphyritic grains are much smaller than those in specimen No. 3; probably this feature is partly due to more crushing as a result of strong shearing and partly to the fact that the specimen was collected from nearer the margin of the intrusion than was the former. The quartz and orthoclase show strain-effects and the latter is also kaolinised and sericitised.

The rock is a weathered, sheared and sericitised quartz-orthoclase-porphyry.

No. 2 - In the hand specimen this is a reddish-puce, sheared, weathered, slaty rock which is strongly jointed in two directions; bedding is not distinguishable.

In thin section the essential minerals are found to be quartz, sericite and haematite, while the accessories are black iron ore and leucoxene. The haematite has been converted to limonite in one place, apparently in the vicinity of a joint or crack.

The rock is a haematite-bearing quartz-sericite-schist or slate.

W.B. Dallwitz

JUNE, 1947.
CANBERRA, A.C.T.

(W.B. Dallwitz)
Petrologist.

APPENDIX II.

DATA FROM THE RIFLE CREEK DAM, MT. ISA, PROCURED BY THE DEPARTMENT OF WORKS AND HOUSING, DARWIN, N.T.

RIFLE CREEK DAM — 4th July, 1947.

(1) TYPE:	Single arch, gravity type, provided with spill basin on downstream side.
(2) ELEVATIONS ETC.:	Spillway crest, 50 feet above ground level at centre-line of dam, and 60 ft. above foundations. Top of wing walls 59.1 ft. above ground level at centre-line of dam and 69.1 ft. above foundations. Maximum water level of dam 1489.00 ft. above sea-level.
(3) CATCHMENT AREA:	37 sq. miles.
(4) ANNUAL PRECIPITATION:	Max.: 37.80 inches in 1895. Mean: 15.96 inches (43 years average). Min.: 4.12 inches in 1905.
(5) AREA OF RESERVOIR WATER PLANE AT MAX. WATER LEVEL:	371 acres.
(6) TOTAL USEFUL CAPACITY OF RESERVOIR:	1,390,000,000 gallons.
(7) VOLUME OF CONCRETE IN DAM:	8,270 cu. yd. approx.
(8) GEOLOGICAL STRUCTURE OF STRATA FORMING THE FOUNDATION:	Quartzite - dipping steeply, with constriction at abutments of dam, rising more than 100 ft. above foundations.
(9) GEOLOGICAL STRUCTURE OF STRATA FORMING THE RESERVOIR BASIN:	Composed mainly of shales lying in the footwall of the quartzite band.
(10) RUN OFF COEFFICIENT:	0.75 (approx.).
(11) EVAPORATION LOSSES:	No record. (8' per annum based on experimental data)
(12) SEEPAGE LOSSES:	No record.
(13) DESIGN DETAILS:	See our Drgs. M-1184, M-1185, M-1186 and M-1187.
(14) LOCATION:	See Geological Plan.

(15) DATE OF COMMENCEMENT OF CONSTRUCTION: July, 1928.

(16) DATE OF COMPLETION OF CONSTRUCTION: March, 1929.

GEOLOGICAL SKETCH PLAN
of
PROPOSED DAM SITE
Four Miles North West of
TENNANT CK.
Note: Original Plane Table Sheet lost.
Sketch Plan from Sections, Field Books, & Photos.
Scale accurate around Section Lines, approximate elsewhere.
SCALE
Ft 0 25 50 100 Ft
LEGEND
Shallow Sandy Soil
Sand
Slate with Small lenses of porphyry
Strike and Dip of Bedding
Strike and Dip of Jointing
Vertical Jointing
Shallow Soil and Scree with small outcrops of Slate and Porphyry.
Sand and Gravel
Porphyry
Faults
Survey Pegs
Reference Nº of Photograph & Direction in which taken
Suggested Costeans
Geology by L.C. Noakes & D.M. Traves
SECTIONS AB, CD
No Vertical Exaggeration
Axis of Section AB
C
D
Sea Level
A
B
Sea Level
SECTIONS EF, GH
No Vertical Exaggeration
G
Axis of Section EF
Water Hole
H
Sea Level
E
F
Sea Level
Sept. 1948
PLATE I
TN
Peg 1300
DAM SITE 1
Peg 850 D
Peg 1500
Flat
Alternative Site
DAM SITE 2
Flat
NT 1 Q
BUREAU OF GEOLOGY, GEOPHYSICS, & MINERAL RESOURCES.

PHOTOGRAPHS.

(By L.C. Noakes).

The position of the photographer and the direction in which the photographs were taken are shown on Plate I.

FIG. 1. Dam Site 1 (Section A-B) from the western end looking East.

FIG. 2. The western bank of the creek at Dam Site 1, taken from the creek bed, looking west.

__FIG. 3.__ The creek bed and eastern bank at Dam Site 1, taken from the western bank looking east. Finely bedded slates, dipping 60° to the north, appear on the right and a massive band on the left centre.

__FIG. 4.__ Contact between bands of different competence in the eastern bank of the creek at Dam Site 1. Slate with fracture cleavage on the left separated by a small strike fault from massive partly silicified slate on the centre and right. Note the lens of porphyry between the strike fault and the head of the hammer.

__FIG. 5.__ Dam Site 2 (Section E-F) from the eastern end looking west.

__FIG. 6.__ Bar of quartz-porphyry in the creek bed at Dam Site 2, from the western bank looking east. The rock-hole in porphyry can be seen at the extreme left.

FIG. 7. Face of jointed quartz-porphyry, 15-20 feet high, on the west side of the rock-hole shown in Fig. 6. The major joints are vertical but prominent joint planes can be seen dipping to the north at 25-30 degrees.

FIG. 8. Outcrop of quartz-porphyry in the creek bed at Dam Site 2 from the eastern bank, looking west. Major joints are vertical or dipping north at 25-30 degrees.