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Geological survey of a proposed dam site on Nicholls Rivulet

by D. E. Leaman

INTRODUCTION

It is proposed to build a 50 feet high concrete arch or rock-fill dam in the upper reaches of Nicholls Rivulet, some six miles east of Cygnet in southern Tasmania. Nicholls Rivulet has a small but perennial flow most of the year and is subject to large flows over short periods. The dam site is situated less than two miles from the headwaters of the rivulet and at the site the rivulet has a gradient of approximately 1 in 25. The pond produced by the dam will be very narrow and considerably less than 1,000 feet long. The area surrounding the dam site is of moderately high relief, with streams occupying narrow, youthful valleys. The topography is controlled to a great extent by geological structure, particularly that of dolerite.

GENERAL GEOLOGY

The geology of the area is shown in Figure 1. The sedimentary rocks present are Upper Permian and Lower Triassic in age. Both groups are extensively faulted and intruded by Jurassic dolerite. The faults in the area are pre-dolerite in age and there is no evidence of post-dolerite movement. The dolerite has utilised these zones of weakness and intruded along many of them. The dolerite in the west of the area has the form of large dykes or plugs whereas that in the east has the form of a transgressive sheet dipping southeast.

GEOLOGY OF THE DAM SITE

The dam site is completely in dolerite. The western abutment lies approximately 150 to 200 feet north of a contact along old faults. As a result the Ferntree Mudstone to the south is extensively metamorphosed, very hard and brittle, and much jointed. The joints in the mudstone are random but are generally less than one foot long and one inch apart. The dolerite in the contact zone is very fine grained and also highly jointed. The dominant joints appear to be transverse to the rivulet (approximately E-W). One set has a southerly dip of about 30°. Near the contact the joint density is about 12 per foot, but decreases to 2 per foot in the bed of the rivulet at the dam site.

Some 250 feet upstream from the site there is a small inclusion of Ferntree Mudstone. Similar comments apply to the mudstone and dolerite near the contacts. This inclusion is probably connected beneath the dolerite to the mass of mudstone to the northwest but not to that in the south.

Of note is the contact trending NNW along Nicholls Rivulet. Since dolerite occurs along what was obviously a fault zone to the north and south this was probably an old fault prior to the dolerite intrusion, and as a consequence of the intrusion it has been obliterated in the region of the dam site. There are no major N-S or NNW-trending joints present in the dolerite outcropping in the creek at this point, suggesting that there were no later movements on the fault.

750 feet upstream from the dam site some Ferntree Mudstone outcrops, beneath the dolerite, in the creek. It is unlikely that there is any direct connection to the mudstone in the south.

The dolerite is not deeply weathered at the west abutment, but in places on the route of the spillway and eastern abutment there are zones in which the dolerite has weathered, and kernels or boulders are surrounded by clay. Three holes drilled to 5-6 feet deep, where this condition of weathering is noticeable, failed to locate convincing outcrops.

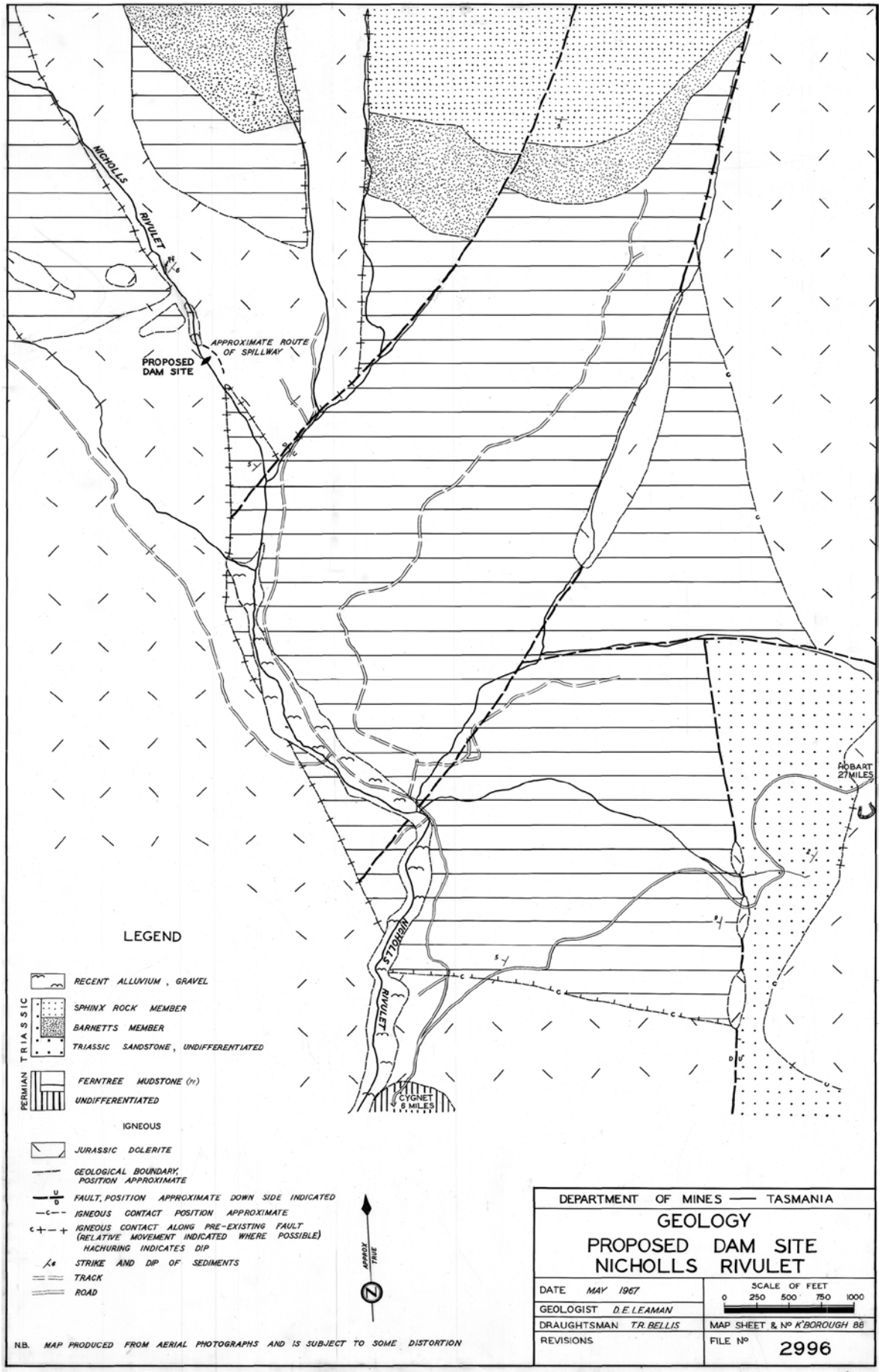
NICHOLLS RIVULET
APPROXIMATE ROUTE OF SPILLWAY
PROPOSED DAM SITE
HOBART 27 MILES
CYGNET 6 MILES
LEGEND
RECENT ALLUVIUM , GRAVEL
TRIASSIC
SPHINX ROCK MEMBER
BARNETTS MEMBER
TRIASSIC SANDSTONE , UNDIFFERENTIATED
PERMIAN
FERNTREE MUDSTONE (fr)
UNDIFFERENTIATED
IGNEOUS
JURASSIC DOLERITE
GEOLOGICAL BOUNDARY, POSITION APPROXIMATE
FAULT, POSITION APPROXIMATE DOWN SIDE INDICATED
IGNEOUS CONTACT POSITION APPROXIMATE
IGNEOUS CONTACT ALONG PRE-EXISTING FAULT (RELATIVE MOVEMENT INDICATED WHERE POSSIBLE) HACHURING INDICATES DIP
STRIKE AND DIP OF SEDIMENTS
TRACK
ROAD
APPROX TRUE
N.B. MAP PRODUCED FROM AERIAL PHOTOGRAPHS AND IS SUBJECT TO SOME DISTORTION
DEPARTMENT OF MINES — TASMANIA
GEOLOGY
PROPOSED DAM SITE
NICHOLLS RIVULET
DATE MAY 1967
GEOLOGIST D.E. LEAMAN
DRAUGHTSMAN T.R. BELLIS
REVISIONS
SCALE OF FEET
0 250 500 750 1000
MAP SHEET & Nº K'BOROUGH 88
FILE Nº 2996

Figure 1

CONCLUSIONS

1. The dam would be built entirely on dolerite. The western abutment would need special consideration with respect to jointing in the dolerite, while the eastern abutment is uncertain due to weathering.
2. Leakage is not expected to be serious, except possibly on parts of the western abutment — again due to jointing.
3. Leakage through the Ferntree Mudstone upstream to that downstream is unlikely since there is probably no N-S connection beneath the dolerite of the dam site. There may be some leakage through the saddle, along the contact, upstream of the dam. The depth of water across the contact will determine the extent of any loss.
4. There is no evidence of a shatter zone along the rivulet.
5. The storage capabilities may be improved by removal of the gravel and boulders in the small flat behind the dam. The thickness of this deposit is unknown but a trench shows it to be deeper than three to four feet.
6. A significant quarrying job is expected along the route of the spillway, which will have a maximum depth of about 15 feet in dolerite. Only in zone A is there expected to be softer rock and odd clay zones.
7. There is no major clay deposit available for use as a clay core.

It may be possible to improve conditions (1) and (2) by moving the dam slightly upstream.

RECOMMENDATIONS

1. Quarry a small amount of the western face to check joints and fully expose the dolerite, particularly with respect to the southerly dipping joints.
2. Wash down to bedrock on the eastern abutment, again to check jointing and weathering.
3. Determine the thickness of gravel in the flat upstream of the dam, either by completing the trench or by blasting.
4. Wash down and test drill the route of the spillway, to fully determine the character of rock to be quarried. Three or four holes are required, one of which should be in zone A. Approximately one hole per 50 feet of spillway is required. As the route, depth and length of the spillway is undecided at present, no further specifications can be given as to tests required.
5. If rock, other than that recovered from the spillway, is required there should be at least two to three holes to check any likely quarry site.

[27 April 1967]