TR12-134-139

34. THE HYDROGEOLOGY OF THE LAKE TIBERIAS REGION, MIDLANDS, TASMANIA

by D. E. Leaman

INTRODUCTION

As part of an investigation for dam sites on the Jordan River for the Rivers and Water Supply Commission it was considered necessary to examine the origin, nature and control of the head-waters of the river. This amounted to a study of Lake Tiberias, the alternative damming or draining of which has been proposed.

GEOGRAPHY

Lake Tiberias is situated in the Lower Midlands some eight miles S of Oatlands. The area is readily accessible by road and rail and is situated at an elevation of about 1,400 feet.

The lake has a surface area of approximately 3½ square miles and a catchment, including the lake, of 9-10 square miles. The maximum depth of the lake is unknown but much of it is less than 6 feet. There is no unbroken water surface since sedges occupy 90% to 95% of the 'lake' surface. In reality it is a large swamp.

There is one outlet from the lake, this being occupied by the Jordan River. No water actually flows in this outlet for much of the year, the level of the lake normally being lower than the over-flow height. At the time of the present investigation, following a rainfall of 5 inches in the catchment, the level of the lake was 2 to 3 feet lower than the base of a dug trench in the outlet. The Jordan River has cut a youthful valley into the hills W of the lake.

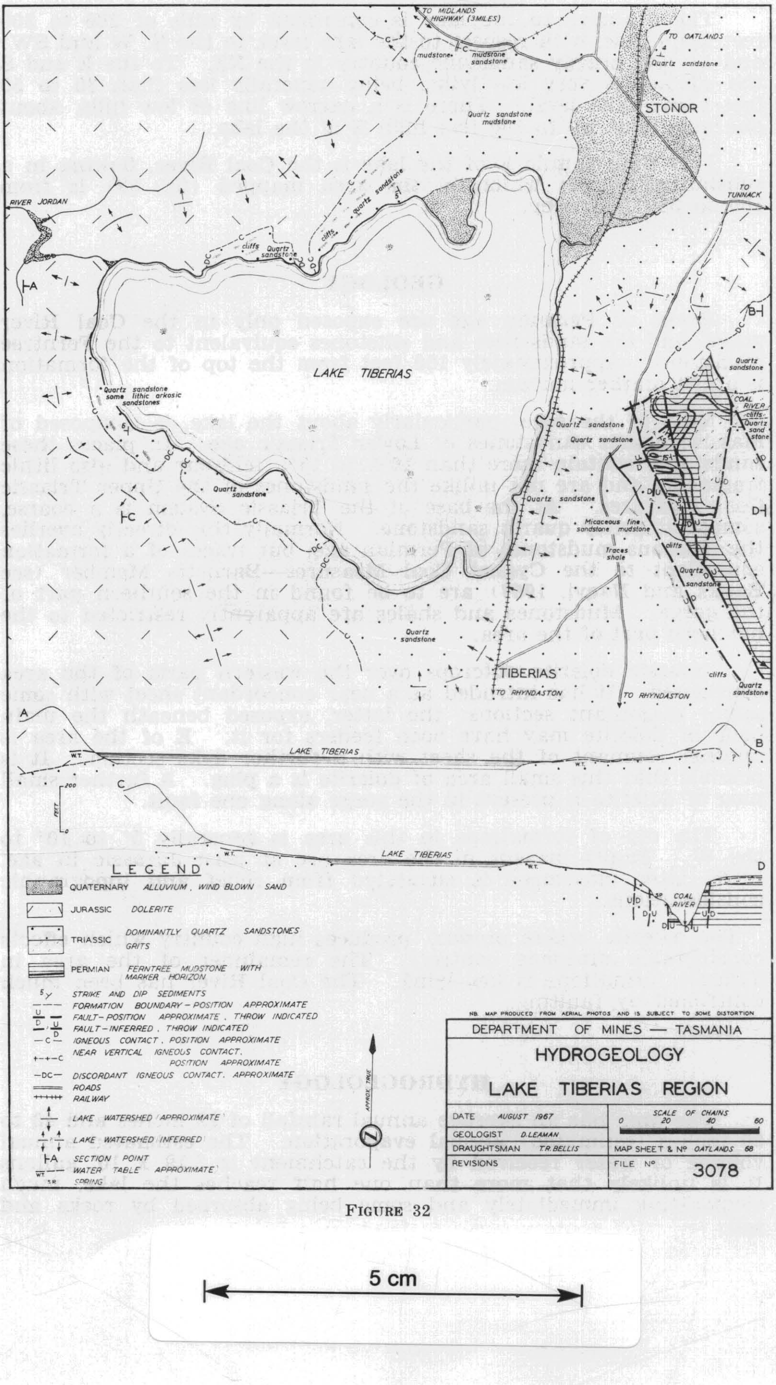
TO MIDLANDS HIGHWAY (3MILES)
TO OATLANDS
STONOR
TO TUNNACK
RIVER JORDAN
LAKE TIBERIAS
TIBERIAS
TO RHYNDASTON
TO RHYNDASTON
COAL RIVER
Quartz sandstone
mudstone
Quartz sandstone some lithic arkosic sandstones
Micaceous fine sandstone mudstone
Traces shale
cliffs
LAKE TIBERIAS
W.T.
FEET
200
0
LEGEND
QUATERNARY ALLUVIUM, WIND BLOWN SAND
JURASSIC DOLERITE
TRIASSIC DOMINANTLY QUARTZ SANDSTONES GRITS
PERMIAN FERNTREE MUDSTONE WITH MARKER HORIZON
STRIKE AND DIP SEDIMENTS
FORMATION BOUNDARY - POSITION APPROXIMATE
FAULT - POSITION APPROXIMATE, THROW INDICATED
FAULT - INFERRED, THROW INDICATED
IGNEOUS CONTACT, POSITION APPROXIMATE
NEAR VERTICAL IGNEOUS CONTACT, POSITION APPROXIMATE
DISCORDANT IGNEOUS CONTACT, APPROXIMATE
ROADS
RAILWAY
LAKE WATERSHED (APPROXIMATE)
LAKE WATERSHED INFERRED
SECTION POINT
WATER TABLE APPROXIMATE
SPRING
APPROX. TRUE
NB. MAP PRODUCED FROM AERIAL PHOTOS AND IS SUBJECT TO SOME DISTORTION
DEPARTMENT OF MINES — TASMANIA
HYDROGEOLOGY
LAKE TIBERIAS REGION
DATE AUGUST 1967
SCALE OF CHAINS
0 20 40 60
GEOLOGIST D.LEAMAN
DRAUGHTSMAN T.R.BELLIS
MAP SHEET & Nº OATLANDS 68
REVISIONS
FILE Nº 3078

FIGURE 32

The drainage to the lake is controlled by hills of 200 to 300 feet amplitude, with respect to the lake level, in the N, W and SW; and by low, craggy sandstone country in the NE. To the E and S the surface is very low lying, being generally less than 30 to 50 feet above lake level. There is a narrow line of low hills, about one mile long, up to 100 feet high E of the lake.

Less than a mile E of the lake is the Coal River, flowing in a substantial gorge; which in the area mapped (fig. 32) is from 100 to 350 feet deep.

GEOLOGY

Rocks of Permian age are exposed only in the Coal River gorge, and are mudstones and siltstones equivalent to the Ferntree Mudstone. Approximately 100 feet from the top of the formation is a grit marker horizon.

Most of the area, particularly about the lake, is composed of massive quartz sandstones of Lower Triassic age. In places these sandstones contain more than 10% to 15% feldspar and also lithic fragments and are not unlike the sandstones of the Upper Triassic Coal Measures. At the base of the Triassic System is a coarse, somewhat gritty quartz sandstone. Normally this directly overlies the siliceous mudstones of Permian age, but traces of a formation equivalent to the Cygnet Coal Measures—Barnetts Member (see Banks and Naqvi, 1967) are to be found in the southern part of the gorge. Mudstones and shales are apparently restricted to the northern part of the area.

Jurassic dolerite outcrops over the western parts of the area considered. It has intruded as a near concordant sheet with some minor discordant sections; the latter, exposed beneath the main body of dolerite may have been feeders for it. E of the area is another remnant of the sheet with a further dyke section. It is possible that this small area of dolerite is a plug. A further small plug of dolerite is present in the gorge along one fault.

The dip of formations in this area is generally 5° to 10° to the W. Faults present in the area are at least Jurassic in age. Little later movement is suggested from relief and topographic considerations.

The dolerite, where present, produces high country which effects considerable drainage control. The remainder of the area in Triassic formations is low lying. The Coal River has been much controlled by faulting.

HYDROGEOLOGY

The area has an average annual rainfall of 22 inches and 40 to 50 inches (estimated) annual evaporation. The estimated annual volume of water received by the catchment is 3.19×10^8 gallons It is unlikely that more than one half reaches the lake, much evaporating immediately and some being absorbed by rocks and soil.

However, a number of springs and seepages occur along the gorge to the E and also S of Tiberias. Some of these springs were observed to have flows of up to 300 g.p.h. Assuming an average annual loss of 1,000 g.p.h. from the groundwater storage, and ultimately the lake, there would be a loss of 5.5 x 10^7 gallons annually. If however, we consider the permeability of the Triassic rocks, the area of leakage and the head of water it is found that the loss to the gorge is 2.5 x 10^6 gallons annually. For this calculation a permeability, based on tests at Risdon Brook, of 100 g.p.y./ft^2/ft/ft head; an average head of 150 feet, average path length of 3,000 feet and length of block 10,000 feet was used. The average thickness of the wedge of leakage was taken to be 50 feet. Since the value for the permeability cannot reasonably be raised by a factor of 5 it is considered that surface water was confusing the springs at the time measurements were taken.

The water loss S of Tiberias from calculations similarly based is expected to be less than 7.5 x 10^5 gallons annually.

It would appear, therefore, that the lake level decreases due to the effects of evaporation and more importantly due to evapotranspiration since there is normally no free water surface. The lake thus exists only when short, or long, term input exceeds outflow in evaporation, leakage effects being subsidiary. In the past this has meant a semi-permanent lake, but with recent dry seasons this condition has altered.

The volume of water in the lake cannot be reliably estimated but probably does not exceed 40 x 10^8 gallons when filled completely.

Having described the area hydrogeologically some of the problems concerning the lake may be examined.

(1) Why is There a Lake?

A lake exists in this area simply because there is a small but suitable depression in which water may collect—if only temporarily. No catchment area other than the area of depression is necessary and the nearness of gorges or other topographic features is irrelevant to its formation. Other apparently suitable areas lie in valleys, which carry active streams, and are therefore drained.

(2) Why Does the Lake Level Fluctuate so Enormously?

In any storage of water which is dependent on a flash catchment in opposition to a high and fairly steady evaporation rate there must be considerable and sudden changes in level. Further, since the total volume of water involved is small this effect can only be accentuated.

(3) Where is the Greatest Water Loss?

The greatest water loss is by evapotranspiration from the reeds which cover the lake. Direct evaporation is of secondary importance and groundwater leakage is much less significant.

(4) What Would be the Effects of Draining the Lake?

(a) On the Jordan River

Since the Jordan River receives water from the lake only after periods of high rainfall and consequent high levels of storage the loss is probably of no significance generally. It may mean, however, that storages on the river from the lake to Jericho may be affected, but marginally only, since other streams of comparable size are included in the drainage system W of the drainage divide near the Jordan River outlet of the lake.

(b) On the Groundwater Regime at Stonor and Tiberias

This is undoubtedly the most serious consideration. At the present time there are a number of bores in the Stonor-Tiberias region, each receiving 300 to 500 g.p.h. from Triassic rocks. The water table is high, the depth of it rarely more than 20 feet. However, this high level is sustained only by the presence of a large swamp or lake nearby which has a stabilising influence on the water table. To permanently remove this stabilising influence would mean a slow increase in the depth of the water table due to the effects of the Coal River gorge. Since there would be no continuous accretion to the groundwater storage, as the lake provides—even when virtually dry—the leakage and transpiration would steadily work to lower the water table to the level of the Coal River.

This would mean that the bores would all go dry, and would all require costly extension. The failure rate for new bores would increase since the likelihood of striking water at the greater depths is less.

The lowering of the water table extensively would make the area a very dry one in summer.

It might be expected that a fairly high water table could be sustained only in the areas presently adjacent to the water shed for the lake in the W, N and NE and in the western part of the present lake. Elsewhere, the lowered water table is inevitable.

(5) Could the Lake be Impounded Further?

It would be possible by blocking the Jordan outlet to impound the lake further. This is limited by the low land in the E and S. Six to 10 feet would be the limit the level could be raised, but even this would have some noteworthy consequences. The railway could be undermined as could the foundations of some buildings about the lake. The raised level of the lake would elevate the water table in surrounding areas, particularly E of the lake, making them marshy and of little value. In addition, there would be little point in raising the level of the lake since direct evaporation would become more important and the water would probably be rapidly lost. Certainly summer storages would still be low.

(6) Why has the Jordan River Cut a Gorge Westward into Dolerite?

The river systems appear to antedate the Pleistocene period and to have meandered extensively. During the Tertiary and particularly during the Pleistocene when rainfall in this area would have been much greater considerable incisions were made in pre-Pleistocene surfaces. With respect to the two rivers involved here such incisions are independent of rock type. Thus the river cut down into the dolerite, but not by headward erosion.

(7) What Age is the Lake?

From the previous discussion it may be seen that the lake must be post-Pleistocene in age; and in fact advantage has really been taken of the depression since the amount of rainfall diminished. The lake has no higher levels or shorelines.

(8) Why has the Coal River Cut a Gorge Nearby?

Again during the Pleistocene river erosion was enhanced by the increased rainfall. This river is now deeply incised in a large flat plain comprising the Tunnack district to the E. The river was in existence before incision as is shown by the meanders present in the course. East of Lake Tiberias the Coal River has followed fault weaknesses. The presence of such a gorge near the lake is purely coincidence.

(9) Is Capture of the Two River Systems Imminent?

Since Lake Tiberias contributes little water to the Jordan River system it could not be said that the Coal River could capture the Jordan system or even its headwaters. In fact it could drain Lake Tiberias by headward erosion along the fault lines. By this means it would acquire one more small tributary.

Reference

BANKS, M. R. and NAQVI, I. H., 1967.—Some Formations near the Permo-Triassic boundary in Tasmania. *Proc. roy Soc. Tasm.*, 101 pp. 17-30.