

## 22. Examination of Cascade Dam, Derby

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The Rivers and Water Supply Commission are studying the possibility of raising the level of the Cascade (Briseis) Dam by 15 m so that more water will be available for irrigation and mining purposes. A geological examination has been made in response to their request.

A dam in the same area burst in the 1929 floods and was rebuilt in 1935. It is a rock fill dam about 20 m high with a concrete upstream face and two side spillways. It is situated on the Cascade River about 3 km upstream from the township of Derby.

## GEOLOGY

The geology of the dam and storage area is simple in that only Devonian granite (biotite-muscovite granite/adamellite) and the products of weathered granite occur. Some of the granite is even-grained and some is porphyritic.

The granite in general is not deeply weathered and tends to crop out boldly at many places around the dam. This is because the steep nature of the topography causes the weathered material to be stripped off before accumulation can begin. The Cascade River is still in a youthful stage of erosion in this area.

Basalt and underlying Tertiary sediments extend up the Cascade River valley from Derby but wedge out well below the dam. It is not expected that these rocks would occur anywhere near the dam or storage area.

Two main sets of near-vertical joints with strike directions of about 300° and 045° occur around the dam, both sets are widely spaced but the set with 300° strike is the more common. This set is so strong that it has a marked influence on the topography of the area: many of the valleys and ridges extend in this direction. Both sets of joints appear to be tight although they are very persistent and extend over long distances. The joints are often injected by quartz veins (especially the 300° strike set) which suggests a Devonian age for their formation.

Joints seen on the cliffs formed by the spillway excavations on either side of the dam and which strike 300° are probably release tension joints formed after removal of load from the granite by erosion. They are best developed on the side of the dam and are most obvious and open near the surface. If present at depth they are probably closed due to the weight of the overlying rocks. Other joints with various strike directions occur but are neither common nor strongly developed.

Granite crops out over much of the area. Only areas where outcrops are particularly significant have been marked on Figure 20.

## HYDROLOGY

There is some possibility of leakage at the dam through joints. As mentioned, the near vertical sets of joints appear to be tight and probably would not allow much leakage but this could be tested by water pressure tests in drill holes. The existing dam has a direction of about 270° and if a new dam was built between the highest points on the abutments (downstream) this would have a direction of about 260°. Both sets of the near vertical joints are at a fairly sharp angle to these directions tending to make the leakage path longer than if they were at right angles to the dam axis. Leakage could

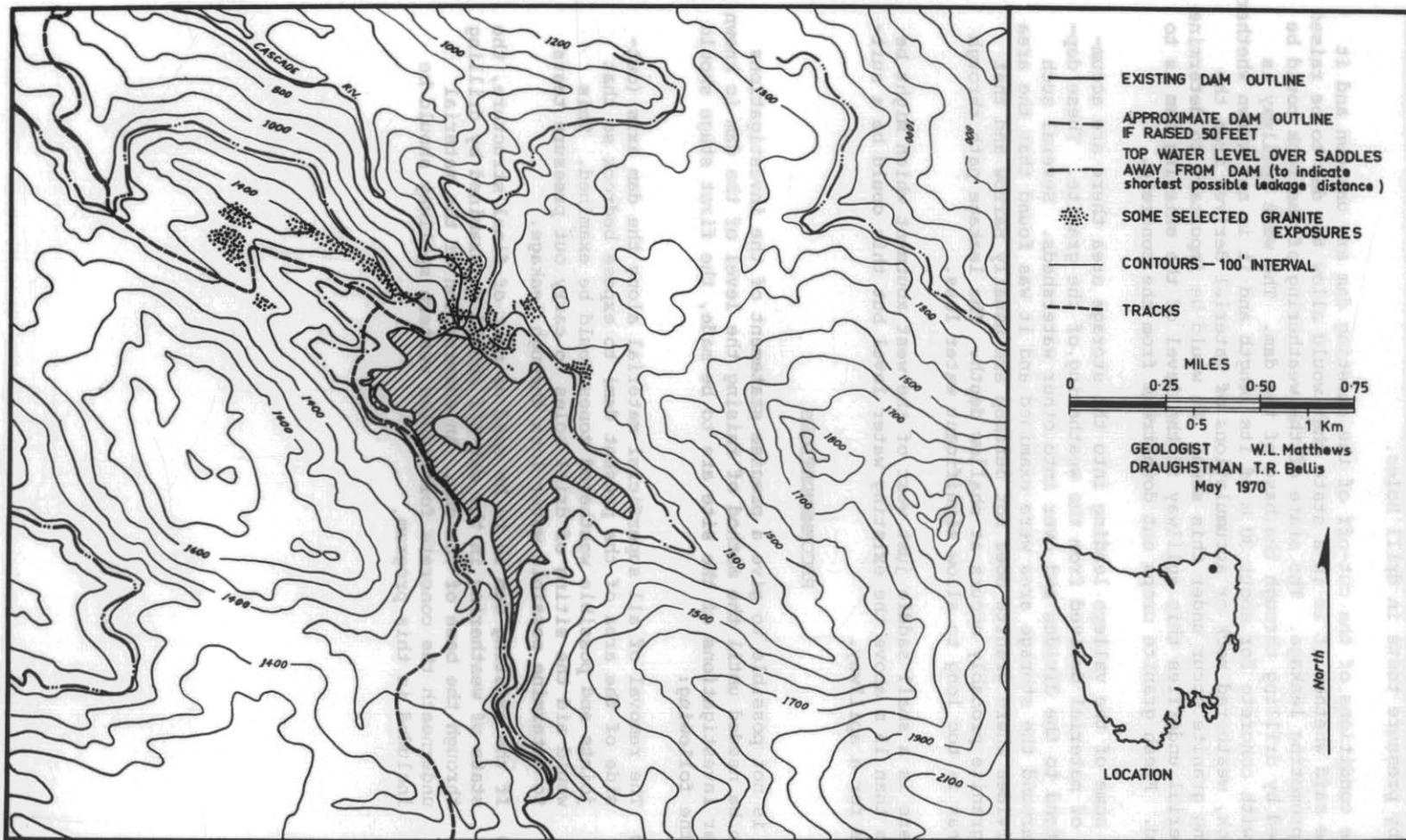


Figure 20. Sketch map of Cascade (Briseis) dam area.

5 cm

occur along the release joints but the extent of this would have to be determined by pressure tests in drill holes.

The conditions of the cut-off of the existing dam are unknown and it cannot be said whether it is in a state that would allow the dam to be raised without promoting leakage. The state of the weathering of the rock could be determined by drilling through the base of the dam. The west spillway is covered with concrete for about 30 m of its length and it is not known whether solid rock, weathered rock or accumulations of material derived from the weathering granite occur under this area. It would be important to determine what material underlies this spillway if the level of the existing dam is to be raised. Fresh granite crops out downstream from the concrete.

In some of the valleys leading into the storage area there are accumulations of material derived from the weathering of the granite. These deposits extend to the divides and over into other watersheds. Several such valleys around the storage area were examined and it was found that the area on the divides where granite does not outcrop are usually narrow and that *in situ* granite probably occurs at shallow depth. The leakage path through these areas is too long to allow significant water loss.

There is a small saddle just west of the west abutment which might be just less than 15 m above the existing water level but this could be a suitable site for a spillway.

#### RECOMMENDATIONS

It is not possible to give a precise statement of the investigations likely to be needed until the method of raising the level of the dam is known. If further investigations of the site are to be made, the first stage should include the following:

- (1) The removal of all superficial material along the dam axis (outside of the area of the present dam) to expose bedrock so that joints and possible weathered zones could be examined. This would aid the siting of drill holes to carry out pressure tests to determine possible water loss through leakage.
- (2) If the existing dam is to be used as part of final structure, the state of weathering in the cut-off should be examined by drilling through the base of the dam. An examination of the material underneath the concrete forming the western spillway should be included in this program.

Figure 50. Sketch map of storage (dam) area.

