

1983/14. Investigation of a leaking dam at Evandale

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Abstract

A permeable layer in a leaking dam at Evandale is probably too deep to be economically sealed with a cut-off trench. Covering the permeable area with clay where it is exposed in the dam storage is suggested.

INTRODUCTION

Mr D.L. Mackinnon of 'Dalness', Evandale, requested that a dam, which was constructed on his property some years ago and which leaks, be investigated to attempt to determine the reason for the failure.

The dam [EQ245004] has a capacity of several million litres and was constructed in a valley underlain by Tertiary sediments east of the home-stead. The material in the valley is probably partly Quaternary sediments derived from redeposition of Tertiary material, and partly *in situ* Tertiary sediments. The materials exposed near the dam are clay and zones of angular, hard mudstone fragments with varying amounts of clay. The origin of these angular fragments is unknown, but they could be derived from areas where the Tertiary clay has been baked by basalt, hardened by some other process, or they may have been weathered from Permian mudstone exposures. Permian rocks are exposed in the bed of Rose Rivulet, which flows about 500 m east of the dam.

The dam has only been full once, when, not long after construction, there were good rains. Soon after, a leak was noted downstream from the dam wall and the dam has held little water since, possibly partly because of the drier seasons and partly because of the leak.

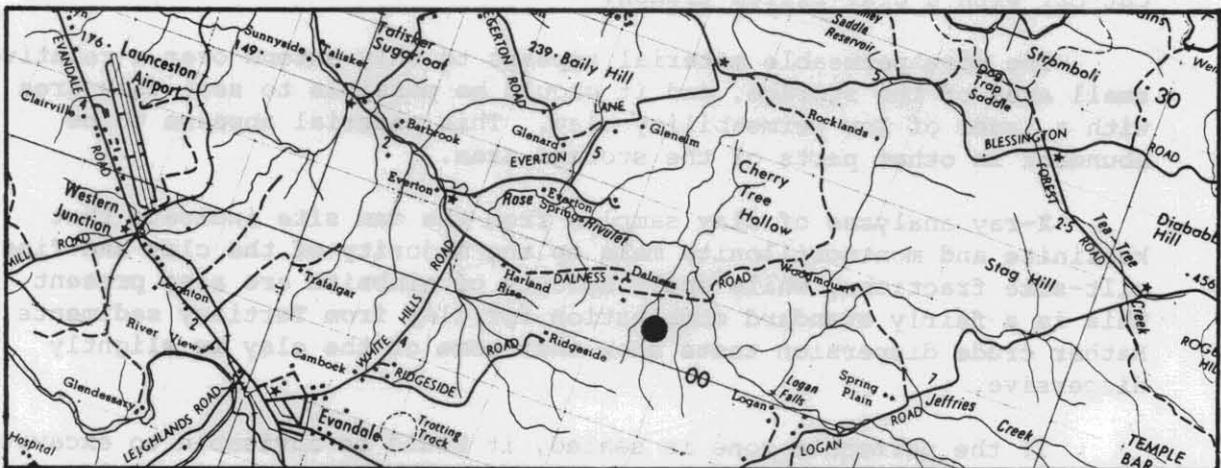


Figure 1. Location of dam and property

REASON FOR LEAKAGE

The water seepage emerges downstream from the dam wall, so it appears that there is a permeable zone extending under the dam wall. This permeable zone would have to be deeper than the cut-off that would have been dug under the dam wall, and would be in contact with the water in the storage area.

Shallow auger drilling was suggested to locate the more permeable zones and, if sufficiently shallow, a deeper cut-off could be dug and filled with compacted clay.

RESULTS OF DRILLING

The logs of the holes drilled are given in Appendix 1 and the approximate locations of these holes are shown on Figure 2. Although each hole encountered water, much of the material encountered has a low permeability, being mainly clay and sandy clay, particularly in the upper portions of the holes. Pebbles in the clay were encountered in each hole; in Holes 1 and 2 these were found towards the bottom, while in Holes 3 and 4 they were struck at shallower depth and continued to the bottom. It was not possible to obtain undisturbed tube samples below about 4.2 m in Hole 4a, and this is almost certainly due to loose, low-cohesion material at this depth.

Holes were drilled in the storage area to depths of between 1.8-3.7 m. On the western side, the holes were drilled to examine if clay extended to these depths and whether it would be suitable for use as a seal for the base of the dam. Clay and silty clay were encountered in each hole to the depth drilled. A hole was drilled to 1.8 m on the eastern side of the storage area and loose clayey material with mudstone fragments was encountered for the whole section.

POSSIBLE REMEDIAL MEASURES

The probable cause of the leakage is the presence at the surface on the eastern side of the storage area of a zone of material consisting of mudstone fragments with varying amounts of clay, sand and silt-size material. This material extends under the dam and is sufficiently permeable to allow excessive leakage. As this material extends to a depth of greater than 7.3 m, it is probably too deep to be economically cut-off with a clay-filled trench.

The more permeable material appears to only extend over a relatively small area of the storage, and it should be possible to seal this area with a layer of low permeability clay. This material appears to be abundant in other parts of the storage area.

X-ray analyses of clay samples from the dam site indicate that kaolinite and montmorillonite make up the majority of the clay and fine silt-size fractions, while small amounts of gibbsite are also present. This is a fairly standard combination for clay from Tertiary sediments. Rather crude dispersion tests show that some of the clay is slightly dispersive.

If the permeable zone is sealed, it would be advisable to excavate some of the existing material to form an even surface. This would make placement of an adequate thickness of covering material over the whole area more certain. A layer up to 0.6 m thick or greater should be considered. This would need to be well compacted and at the correct moisture content when placed to make the operation more likely of success. Extra care should be taken with compaction because of the slight dispersive nature of some of the clay. Clay would also need to be placed on the wall of the storage area where the mudstone pebbles occur. Some levelling and compacting of other areas of the storage area, particularly near the dam wall, would also be worthwhile.

[21 April 1983]

APPENDIX I

Log of auger holes, 'Dainess', dam site

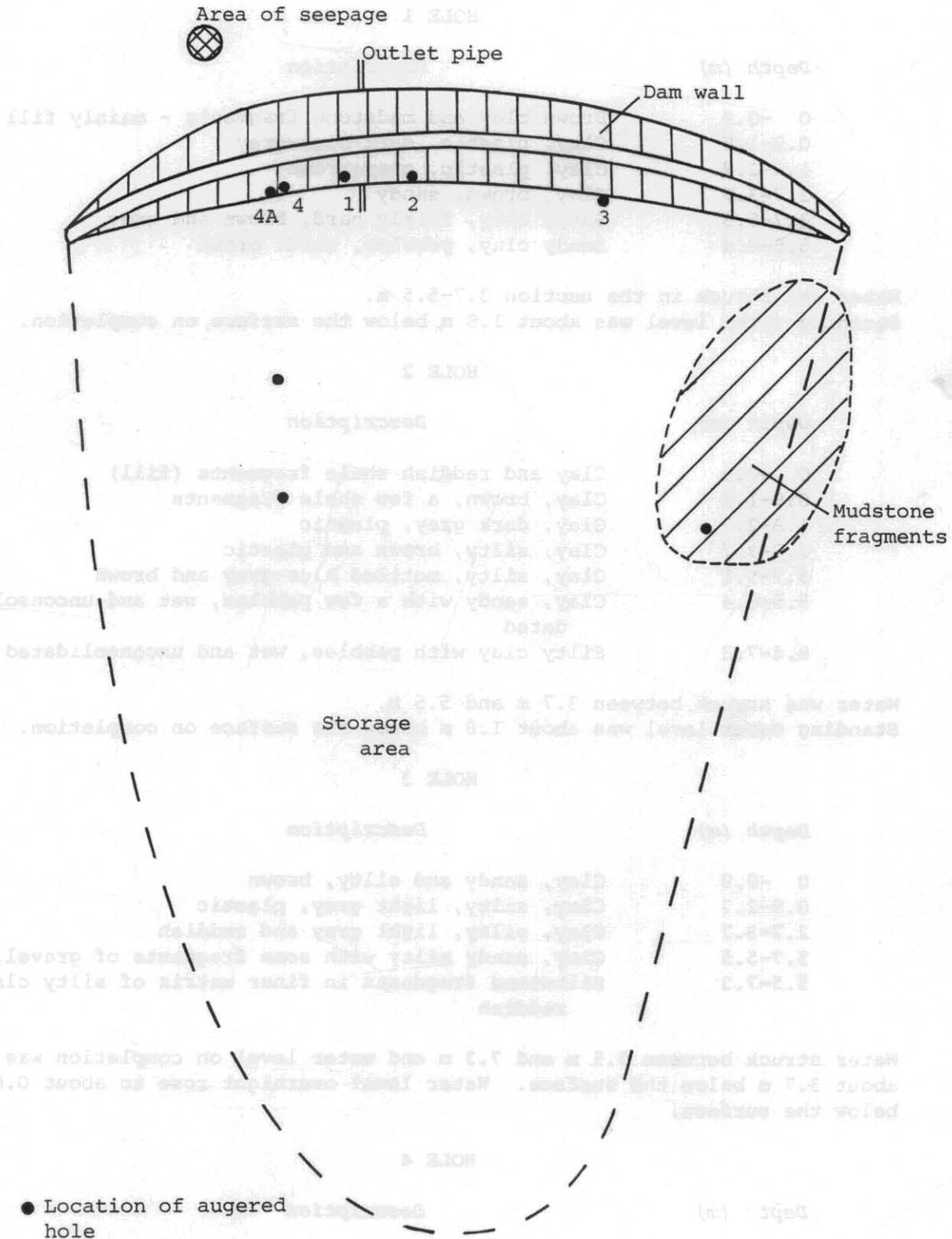


Figure 2. Sketch plan of dam (not to scale).

## APPENDIX 1

## Logs of auger holes, 'Dalness' dam site

## HOLE 1

<i>Depth (m)</i>	<i>Description</i>
0 -0.9	Brown clay and mudstone fragments - mainly fill
0.9-1.8	Clay, plastic, dark blue-grey
1.8-2.7	Clay, plastic, grey-brown
2.7-3.7	Clay, brown, sandy
3.7-5.5	Sandy clay, fairly hard, brown and grey
5.5-6.4	Sandy clay, pebbles, soft, brown

Water was struck in the section 3.7-5.5 m.

Standing water level was about 1.8 m below the surface on completion.

## HOLE 2

<i>Depth (m)</i>	<i>Description</i>
0 -0.9	Clay and reddish shale fragments (fill)
0.9-1.8	Clay, brown, a few shale fragments
1.8-2.7	Clay, dark grey, plastic
2.7-3.7	Clay, silty, brown and plastic
3.7-5.5	Clay, silty, mottled blue-grey and brown
5.5-6.4	Clay, sandy with a few pebbles, wet and unconsolidated
6.4-7.3	Silty clay with pebbles, wet and unconsolidated

Water was struck between 3.7 m and 5.5 m.

Standing water level was about 1.8 m below the surface on completion.

## HOLE 3

<i>Depth (m)</i>	<i>Description</i>
0 -0.9	Clay, sandy and silty, brown
0.9-2.7	Clay, silty, light grey, plastic
2.7-3.7	Clay, silty, light grey and reddish
3.7-5.5	Clay, sandy silty with some fragments of gravel, red
5.5-7.3	Siltstone fragments in finer matrix of silty clay, reddish

Water struck between 5.5 m and 7.3 m and water level on completion was about 3.7 m below the surface. Water level overnight rose to about 0.6 m below the surface.

## HOLE 4

<i>Depth (m)</i>	<i>Description</i>
0 -0.9	Clay, brown with a few mudstone pellets (fill?)
0.9-1.8	Clay, sandy silty, brown
1.8-3.7	Clay, sandy silty, lighter brown
3.7-4.6	Clay, sandy silty, brown and grey mottled
4.6-5.5	Pebbles and clay, grey and brown, fragments up to 30 mm diameter

## Hole 4 (continued)

<i>Depth (m)</i>	<i>Description</i>
5.5-7.3	Little return on augers, rough drilling suggesting gravel fragments

Water level on completion was about 1.8 m below the surface.  
Water struck between 3.7 m and 5.5 m.

A further hole was drilled near Hole 4 to extract undisturbed samples. The hole was augered to about 2.7 m and three samples of about 0.5 m length were taken, after which it was not possible to retain samples in the sampling tube.