1979/36. Drilling at a proposed damsite on R. Vos' property, Legana.

W.L. Matthews

Abstract

Diamond drilling has shown that basalt underlies the site of a proposed dam near Legana. The basalt is coarse-grained and unweathered at shallow depth on the abutments and finer grained and more deeply weathered in the central part of the dam. Water pressure tests suggest that leakage through the bedrock will probably be fairly small. If the unconsolidated clayey material near the dam is not removed, this should give added protection against a large leakage.

INTRODUCTION

Three diamond drill holes have been drilled on the site of a proposed ornamental dam 4 km north-west of Legana [EQ007226]. These holes were drilled to examine the nature of the material underlying the damsite and to allow rock permeability measurements to be made. If high leakages were encountered, there could be some danger of landslip areas downslope being affected.

DESCRIPTION OF DRILL HOLES

The logs of the three holes are given in Appendix 1 and their positions are shown on Figure 1. Hole 1 was drilled at 60° to the horizontal so that near vertical joints, if they occur, would be intersected. The other two holes were vertical.

Hole 1 entered coarse-grained fresh basalt at shallow depth and remained in similar material to the final depth of 15 m. The basalt was mid-grey in colour and olivine crystals could only be seen occasionally in hand specimens. Broken joints were not common. Thin seams of zeolite and calcite fill the unbroken joints.

Hole 2 resulted in poor core recovery due to the weathered nature of the rock in this location, together with closer spaced jointing. In recovered sections, iron oxide staining, clay and weathered basalt occur around the joints. Some zeolite and calcite veins are present. The basalt is finer grained and much darker in colour than that in Hole 1 and contains abundant visible olivine.

Hole 3, like Hole 1, entered unweathered rock at shallow depth. The basalt is coarse-grained with a narrow seam of very coarse-grained material. Jointing is sparse except for one narrow section at a depth of about 5 m. Joints are occasionally filled with zeolite and calcite.

WATER PRESSURE TESTING

Various sections of the holes were sealed off and were tested for leakage properties by forcing water into them under pressure. The zones tested, the leakage and calculated permeabilities are shown in Appendix 2.

Hole 1 shows fairly low leakage rates for the intervals tested and the permeability decreases with depth. The top section tested is in the moderate to low permeability range.

Hole 2 gave very high permeability results for most of the tests but this is largely due to the difficulty in obtaining a seal with the packer

36-2

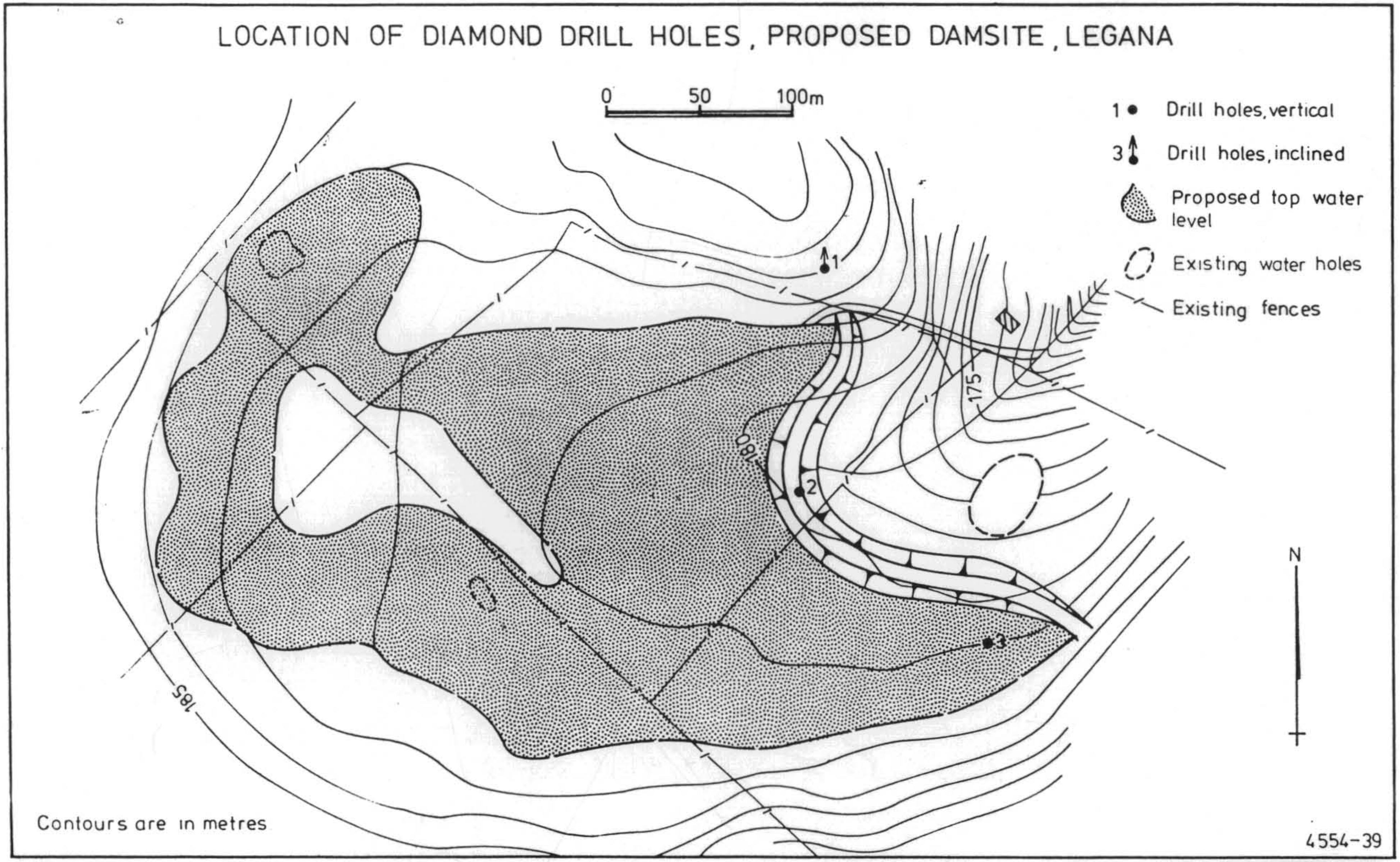

Figure 1.

5 cm

2/6

in the jointed rock and much of the water recorded as being lost flowed around the packer and came to the surface. It is significant that the water loss was smaller as the pressure increased, whereas the reverse is usually the case. At a later time, a further test undertaken over a long section of the hole gave much lower permeabilities.

In Hole 3, apart from one value, all the other permeabilities were low. The high value is questionable, considering that the water loss at higher pressure for the same section was much smaller.

CONCLUSIONS

From the above results, it seems likely that water loss from the dam through the bedrock will be relatively small. Although some high permeability values were obtained, it is likely that most, if not all, are due to testing difficulties rather than open joints. In constructing the dam, it is proposed to extend a clay cutoff to bedrock as there are some gravelly beds in the overlying material that may be fairly permeable. In most of the test pits dug by the consulting engineers, part of the sequence above bedrock was clayey and probably of low permeability. If this material is left in place near the dam, the clayey zones will aid in preventing quick percolation to bedrock and this will be added protection against high seepage rates even if there are zones in the bedrock more permeable than suggested from the above results.

The basalt derived clay in the area should be suitable for dam construction. Attention should be given to ensure that gravelly zones are not incorporated in the core material.

[14 August 1979]

APPENDIX 1

Logs of diamond drill holes

Hole 1 (60° inclination)

Depth (m)	*Recovery (m)*	*Description*
0- 2.40	1.9	Coarse-grained basalt, broken for 400 mm at beginning (boulders?) then solid basalt with two joints cutting core with dips of 20° and 60°. About 10 mm of weathering around the joints. Some 1 mm zeolite veins.
2.40- 3.82	1.44	Coarse fresh basalt with occasional 1 mm wide zeolite veins. Two joints dipping 45° and 60°.
3.82- 5.36?	2.80	Fresh coarse basalt with 4 joints, some zeolite on joint planes - needle like crystals (natrolite?).
5.36- 6.96	0.34	Fresh coarse basalt, one joint at about 40° on top of core.
6.96- 9.84	2.86	Fresh coarse basalt, 2 joints - one at 55° and zeolite covered, the other stained with iron oxide but no weathering. Two calcite filled joints dipping at about 45° and 2 mm wide.
9.84-12.84	2.99	Coarse fresh basalt, 2 joints with no weathering dipping at about 45°, occasional thin (<1 mm wide) zeolite veins.
12.84-15.0	1.79	Coarse basalt, one joint at end dipping at about 20°. Occasional 1 mm wide zeolite veins.

Throughout the above section, the rock is grey with only occasional possible olivine crystals visible.

Hole 2 (vertical)

Depth (m)	*Recovery (m)*	*Description*
0- 1.29	0.4	Brown clay and laterite fragments and seams.
1.29- 3.04	0.32	Laterite fragments.
3.04- 5.76?	1.28	350 mm of grey clay with weathered zeolite and laterite fragments, 930 mm of coarse unweathered basalt, 5 joints with some iron oxide and weathering around joints. Not all surfaces match suggesting some core loss between joints.

Hole 2 (vertical) (continued)

Depth (m)	*Recovery (m)*	*Description*
5.76- 9.61	0.93	Recovery consists of coarse, largely unweathered fragments, jointed with at least 12 breaks, iron oxide staining on joints, some weathering.
9.61-10.56	0.7	Jointed fresh basalt, brown iron oxide staining on joints. Some clay recovered near end. About 7 joints with dips of from 20 to 70°.
10.56-13.53	0.67	Jointed and broken coarse basalt. Brown iron oxide staining and weathering on joints.
13.53-15.21	1.35	First 400 mm of core very jointed and broken coarse basalt, brown iron oxide and weathering on joints, some calcite on joints. Five joints in next 300 mm of core after which core becomes less jointed.

The basalt throughout is darker than in Hole 1, a little finer and with obvious olivine.

Hole 3 (vertical)

Depth (m)	*Recovery (m)*	*Description*
0- 0.88	-	
0.88-3.80?	1.20	Coarse jointed grey basalt, some iron oxide on joints, some clay recovered.
3.80- 6.28	4.63	Coarse dark, variably jointed basalt, one 60 mm section near middle with 6 joints. Iron oxide staining on most joints, becomes less developed with depth. Little apparent weathering on joints. Final 400 mm of core consists of very coarse crystalline basalt with an intermesh of crystals up to 15 mm long. Some calcite and zeolite veining throughout.
6.28-12.90	6.31	Coarse-grained sparsely jointed basalt. Some flat joints, some low angle. Occasional zeolite seams.
12.90-15.11	2.32	Coarse dark basalt, very sparse jointing, occasional zeolite veins. Near the end is an agate-like nodule 10 mm across with a small core of calcite.

APPENDIX 2

Water pressure testing

Hole 1 Standing water level 1.9 m below surface

Interval (m)	*Applied Pressure* (lb/in^2)	(kPa)	*Water Loss per 5 minutes* (gallons)	(litres)	*Permeability* (ft/year) (approx.)	(lugeons) (approx.)
3.1- 6.1	10	69.9	3	13.6	84.5	7.4
	20	138	5	22.7	93.5	8.2
6.1- 9.1	15	103.4	3	13.6	60	5.2
	30	206.9	5	22.7	54.1	4.8
9.1-12.2	20	138	1.5	6.8	23.4	2.1
	40	275.8	2.5	11.4	20.7	1.8
12.2-15.2	25	172	0.5	2.3	6.4	0.6
	50	345	1	4.6	6.8	0.6

Hole 2 Standing water level 1.9 m below surface

7.5-10.6	8	55	14	63.6	461.4	40.5
	15	103.4	15	68.2	299.2	26.3
	20	138	15	68.2	233.2	20.5
12.2-15.2	20	138	46	209.1	715.6	62.8
	30	206.9	18	81.8	194.4	17.1
	40	275.8	16	72.7	132.4	11.6

The packer was not sealing the hole completely and water was flowing to the surface around the packer. A test was undertaken at a later date and this is given below.

2-15	25	172	4	18.2	15	1.3
	30	206.9	3	13.6	10	0.9
	40	275.8	8	36.4	20	1.8

Hole 3 Standing water level at 2.4 m

3.9- 6.9	5	34.5	-			
	15	103.4	16?	72.7	295.8	26.0
	25	172.4	4	18.2	48.3	4.2
6.8- 9.8	12	82.8	2	9.1	44.2	3.9
	18	124.1	1	4.6	15.8	1.4
	25	172.4	-			
10.4-13.4	20	137.9	1	4.6	14.7	1.3
	30	206.9	1	4.6	10	0.9
	40	275.8	-			
12.1-15.1	20	137.9	1	4.6	14.7	1.3
	30	206.9	1	4.6	10.3	0.9
	40	275.8	1	4.6	8.0	0.7