Site investigations at the Camp Creek dam-site Wynyard.

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Abstract

Detailed seismic surveys across this dam-site indicate that the probable depth to definite bedrock is 4 - 8 m and that some of the overlying material may be weathered bedrock. Test pits have located permeable gravel and sandy beds and further investigations should be undertaken to define their depth and lateral extent. Near surface (up to about 2 m depth) brown silty clay will probably be used in construction if the dam is built. Occasional samples of this material show dispersive properties. Deeper materials are more often, but still only occasionally dispersive. These sediments appear to have a low clay mineral content from X-ray diffraction studies. Further investigations are recommended for testing the suitability of the construction materials.

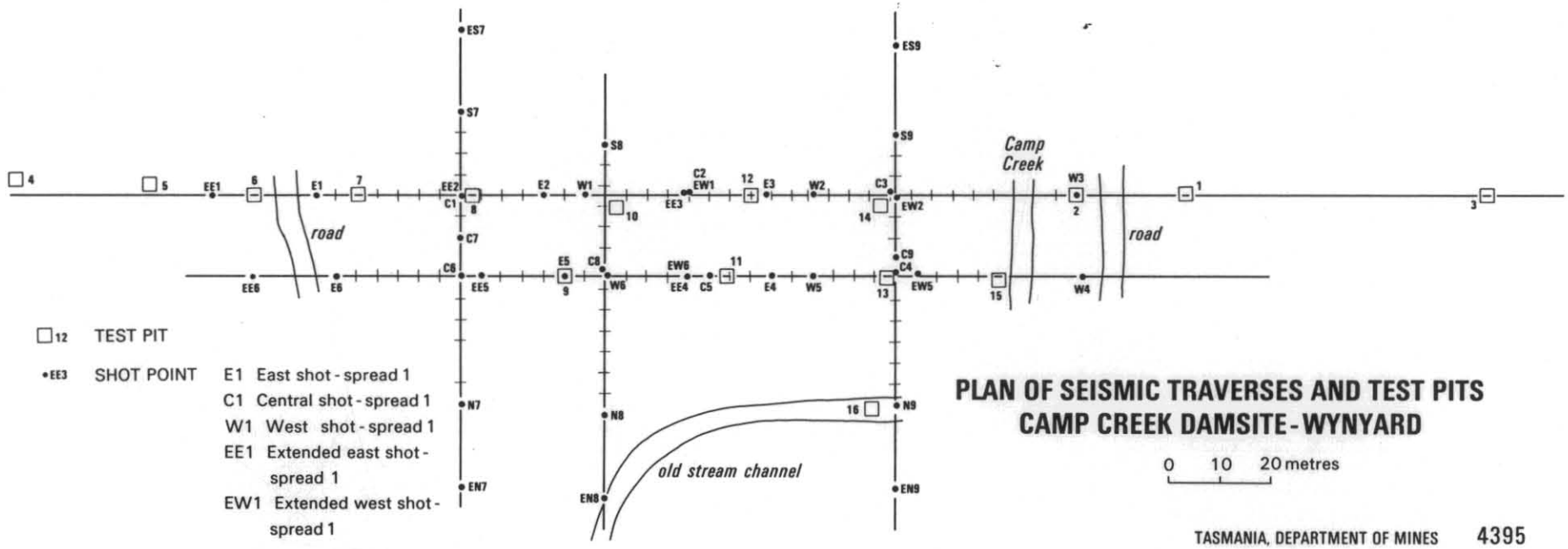
A more detailed seismic survey than that conducted previously (Matthews 1977) was undertaken across the proposed dam-site on Camp Creek, about 3 km south of Wynyard [CQ922580]. Sixteen test pits were dug with a backhoe to examine the nature of the materials at shallow depth under the area. Samples from some of the 16 test pits, together with samples from two test pits in the storage area, have been tested for dispersive properties.

As noted in the previous report, the dam site and storage area are underlain by Wynyard Tillite of Permian age; this rock comprises interbedded tillite (conglomeratic beds) and rhythmites (fine grained grey siltstone beds). The Permian rocks are overlain by a varying thickness of Quaternary sediments, weathered rock, talus and soil.

SEISMIC SURVEY

Nine seismic spreads with a geophone spacing of 4 m were fired over the main part of the dam-site between the two roads (Fig. 1). The lower refractor is probably a little more accurately located than in the previous preliminary seismic survey. A summary of the seismic velocities and layer thickness is given in Table 1.

The upper layer on each spread has a seismic velocity ranging from 280-415 m/s, with a range of 330-400 m/s the most common. This material can be interpreted as soil and unsaturated and perhaps fractured clay. It may also include some deeply weathered *in situ* and unsaturated tillite, as indicated in test pits on the eastern side of the spread layout. Underlying the surface layer is a layer with intermediate seismic velocities ranging from 1075 - 1650 m/s, except for spread 9 where the velocity is 1975 m/s. In spreads 1-8, the lower part of this velocity range is still probably due to unconsolidated and not completely saturated sediments or very weathered unsaturated tillite. The material that is represented by the higher part of this velocity range is probably saturated unconsolidated material (clay, sand or gravel) or weathered tillite. In spread 9, the material with the velocity of 1975 m/s is probably weathered tillite. The third layer, with a velocity range of 1900 m/s to 2850 m/s, is probably tillite with varying degrees of weathering or differing lithologies. The lower velocity material could be rhythmites and the higher velocity material could represent more competent conglomeratic zones.



PLAN OF SEISMIC TRAVERSES AND TEST PITS
CAMP CREEK DAMSITE - WYNYARD

0 10 20 metres

TASMANIA, DEPARTMENT OF MINES 4395

5 cm

Figure 1.

6/e

Spread 8, a cross spread, did not show similar velocities to the other spreads. However, velocities can vary according to the direction of the spread. A higher velocity of 2800 m/s was indicated on the southern end of this spread using an extended shot. It was not repeated with the extended shot from the other end. The depth of the 2800 m/s material on the southern end of the spread is probably about 15 m below the surface. One or two other spreads have fourth refractors indicated on extended shots in one direction only. Depths of these refractors have not been determined as depth calculations are not as accurate when the velocity is only indicated in one direction. In each case, the overlying layer (third layer) has a velocity higher than that expected for unconsolidated material and represents basement or slightly weathered basement rock.

TEST PITS

The location of the test pits are shown on Figure 1. The logs of the various materials encountered are given in Appendix 1. Underlying most of the area is a thin soil horizon (about 0.3 m thick) over a brown silty clay usually about 1.5 - 2 m thick. Below this layer is either definite weathered tillite or probable tillite (holes 1, 3, 4, 5, 6, 7?, 8?) or grey and brown mottled silty clay (holes 9 - followed by definite tillite 10, 11) or clay and gravel beds (holes 2, 12, 13, 14, 15, 16). Large amounts of water entered the last group of holes from the gravel and sandy zones and the bottom of holes collapsed rapidly. Holes 11, 12, 15 and 16 contained partly rotted vegetation, made up of leaves and pieces of wood, towards the base. From the condition of this vegetation, it is apparent that these sediments are of recent age. Most of the holes were dug to a depth of 3 - 3.5 m unless digging conditions prevented it.

INTERPRETATION

From this survey and from the previous preliminary seismic survey, there are no apparent deep channels of unconsolidated material. From the seismic work the fairly definite basement rocks occur 4 - 8 m below the surface over most of the dam-site. As outlined above, some of the material with the intermediate velocity may in fact be weathered rock, but this has only been shown at a few locations. The nature of the material with the intermediate velocity over the whole dam-site is important. Where there is permeable sand and gravel, it is likely that a cutoff would be required to bedrock to prevent excess leakage. The stream appears to have meandered across the flatter part of the dam-site area in the past and gravel beds can be expected to be associated with these older positions of the stream bed. At worst, the deepest possible depth of such gravels appears to be about 8 m. There is a strong possibility that they do not extend to this depth but this would require further investigation to prove.

MATERIAL PROPERTIES

If built, the dam will probably be an earth fill dam. Samples were collected to examine some properties of the various materials present at the site. Preliminary dispersion tests have been conducted on samples from the sixteen exploratory test pits and from two test pits dug within the storage area. In other parts of Tasmania, some of the silty clay deposits derived from the weathering of the Permian rocks have dispersive properties.

Samples from a hole dug just south of the seismic spreads near the eastern road and another about 0.3 km south, showed no signs of dispersion properties in samples taken at about 1.5 m and 3 m in each hole. Samples from test pits 2 (0.6 - 2.1 m), 3 (1.8 - 2.7 m), 6 (0.6 - 1.6 m and 2.4 - 3.1 m)

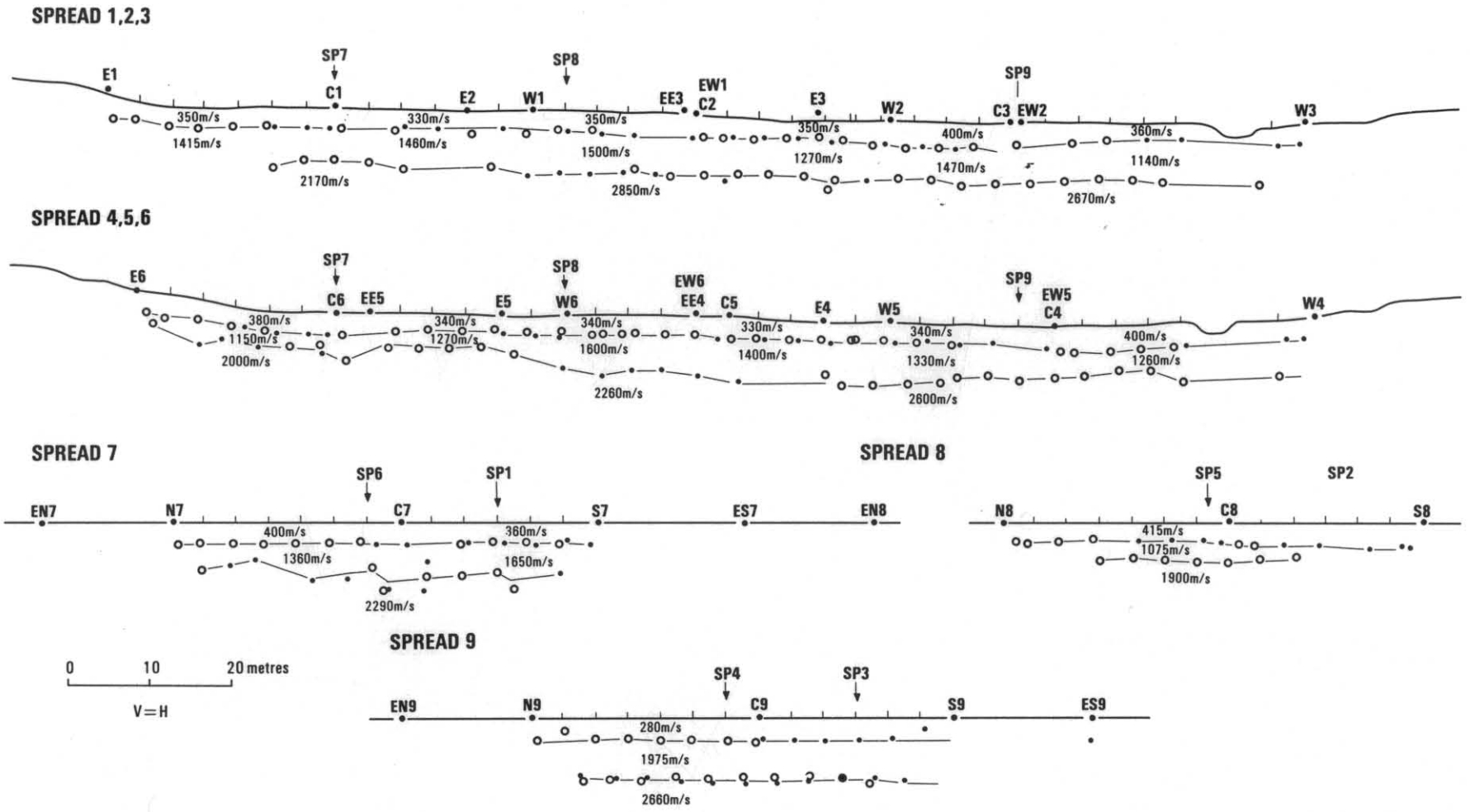


Figure 2. *Seismic Survey, Camp Creek.*

5 cm

Table 1. SUMMARY OF SEISMIC VELOCITIES

	Layer 1		*Layer 2*			*Layer 3*
Spread No.	*Velocity (m/s)*	*Thickness (m)*	*Velocity (m/s)*	*Thickness (m)*	*Velocity (m/s)*	*Depth to upper surface (m)*
1	330-350	2-2.8	1415-1460	4-6	2170	6.6-8.0
2	350	2.4-3.2	1270-1500	4.2-5.2	2850	7.2-8.2
3	360-400	0.8?-3.4	1140-1470	4-5.4	2670	7.2-8.0
4	340-400	1.4?-3.6	1260-1330	2.8-5.4	2600	5.8-8.0
5	330-340	2.4-2.8	1400-1600	2.0-5.8	2260	4.4-7.8
6	340-380	2-2.8	1150-1270	1.8-4	2000	4-6.6
7	360-400	2.6-2.8	1360-1650	2-4.6	2290	4.8-7.6
8	415	1.6-3.4	1075	2-2.6	1900	4.6-5.0
9	280	2.4-2.8	1975	4.4-5	2660	7.4-8

10 (1.2 - 1.5 m) 11 (1.2 - 1.8 m and 2.4 - 3.4 m) 12 (1.2 - 1.8 and 3.1 - 3.5), 13 (1.2 - 1.5 m and 3.1 - 3.5 m) and 14 (1.2 - 1.5 m) show no disperion. Samples from holes 8 (2.1 - 3.1 m), 10 (2.4 - 3.1 m), 14 (3.1 - 3.4) and hole 15 (1.8 - 3.4) show some dispersion. Two samples from hole 9 (1.5 m and 2.4 m) are strongly dispersive.

X-ray diffraction studies of some of the samples from the test pits indicate the presence of some illite and kaolinite in most samples and some montmorillonite(?) in a few. In most samples, quartz produced the largest peaks suggesting that it forms the largest proportion of even the fine grained material within the silty clays. Most of the sediments show only low expansion on wetting.

CONCLUSIONS AND RECOMMENDATIONS

The detailed seismic survey indicates that deep accumulations of unconsolidated material are unlikely to occur in the dam-site area. The maximum thickness indicated is about 8 m, although some of this may be weathered bedrock.

With the location of permeable gravel beds in the alluvium, it is likely that a cutoff will be required to bedrock (or at least weathered bedrock) to prevent excess leakage. If the gravels extend to 8 m, placing a cutoff to this depth may be difficult.

Some of the material in the dam-site area has dispersion properties and this may influence the areas where the dam construction material could be obtained and compaction methods in building the dam.

It is important to know the depth and nature of the unconsolidated material. If it is proposed to investigate the dam-site further, 6 - 10 holes should be drilled with a diamond drill rig (using NMLC core barrels with plastic liners) to 12 - 18 m. These holes could be used to determine

the depth of recent sediments and examine permeabilities of the bedrock. If these holes show that bedrock (including weathered bedrock) is at levels where it is possible to install a cutoff, then a trench should be dug which locates definite bedrock right across the centreline of the proposed dam.

Further tests should be undertaken on the material to be used in the construction to assess its suitability for dam construction. The loading of the dam on the silty clay sediments and the stability of the dam after construction should also be examined under all likely conditions. These studies would best be undertaken by a specialist soil engineer.

REFERENCE

MATTHEWS, W.L. 1977. Examination of a proposed dam-site on Camp Creek, Wynyard. *Unpubl.Rep.Dep.Mines Tasm.* 1977/17.

[10 February 1978]

APPENDIX 1

Logs of test pits.

Hole	*Depth (m)*	*Description*
1	0 - 0.6	Brown clay soil.
	0.6 - 1.4	Brown silty clay.
	1.4 - 2.1	Weathered tillite; surface of *in situ* rock uneven, deeper on the downhill side.
2	0 - 0.6	Brown soil.
	0.6 - 2.1	Brown silty clay.
	2.1 - 2.4	Gravelly clay and silt.
	2.4 - 3.4	Sandy clay with some gravel fragments. Water entered the hole at several places with strong flows at about 2.3 m.
3	0 - 0.9	Reddish silty soil and silty clay, fairly friable.
	0.9 - 1.8	Brownish-red silty clay, fairly friable.
	1.8 - 2.9	Cream to light grey weathered rock (tillite) a few pebbles but largely fine grained material.
4	0 - 0.6	Brown silty soil.
	0.6 - 1.7	Brown fragmental silty clay with some quartz pebbles.
	1.7 - 2.6	Weathered tillite, grey and brown mottled fine grained siltstone with a few pebbles.
5	0 - 0.6	Soil and silty clay.
	0.6 - 2.1	Silty and sandy friable material, light brown with some areas of grey; could be weathered *in situ* tillite.
	2.1 - 2.8	Weathered red, brown and grey tillite, a few pebbles.
6	0 - 0.6	Brown silty clay soil, some pebbles.
	0.6 - 1.5	Brown clay with some silt and a few pebbles, fairly plastic.
	1.5 - 2.1	Red grey and brown mottled sandy clay.
	2.1 - 3.1	Red and grey mottled (sandy at top, silty towards base) clay. Pebbly bed at base. Probably weathered tillite from 2.1 m.
7	0 - 0.8	Silty soil with a few pebbles followed by friable silty clay.
	0.8 - 1.7	More compact fairly plastic silty clay, red and brown mottled.
	1.7 - 3.1	Red and grey pebbly silty clay - tillite?
8	0 - 0.3	Dry grey-brown clayey soil.
	0.3 - 0.8	Brown-grey silty clay becoming more compact with depth.
	0.8 - 2.1	Compact fairly plastic light brown clay.
	2.1 - 3.2	Grey and brown mottled clayey silt, some pebbles towards base. Weathered tillite?

Hole	*Depth (m)*	*Description*
9	0 - 0.3	Grey soil and fractured dry silty clay.
	0.3 - 0.6	Brown silty clay becoming more compact.
	0.6 - 1.8	Brown clay, fairly compact and plastic.
	1.8 - 3.1	Grey silty clay with some pebbles - similar to hole 8 but more plastic, some soft areas. Weathered tillite?
	3.1 - 3.4	Definite hard tillite. Small amount of water coming from this area.
10	0 - 0.6	Silty grey-brown soil becoming more compact with depth.
	0.6 - 2.3	Mainly brown fairly plastic silty clay, still slightly fractured at top but becoming more compact with depth.
	2.3 - 3.77	Grey and brown mottled fairly plastic silty clay. Small seepage entering north end of the hole at about 3.4 m.
11	0 - 0.6	Brown soil and fractured clay, becoming more compact towards base.
	0.6 - 1.8	Brown, fairly plastic clay, a little fractured toward top but compact at bottom.
	1.8 - 3.4	Grey and brown mottled silty clay fairly plastic. No definite tillite. Carbonaceous fragments at base. Some water slowly entering the hole at the base.
12	0 - 0.6	Brown soil and fractured brown clay.
	0.6 - 2.1	Brown fairly compact silty clay, slightly fractured.
	2.1 - 3.1	Mainly brown clay with some grey mottling.
	3.1 - 3.5	Grey sandy gravelly clay (alluvium or weathered tillite bed?) Some carbonaceous material. Water enters hole fairly rapidly about 0.6 m from the base.
13	0 - 0.6	Soil and fractured silty and sandy clay becoming more compact with depth.
	0.6 - 2.1	Silty sandy clay, fairly compact, some fractures.
	2.1 - 3.1	Some grey clay and gravelly clay.
	3.1 - 3.2	Thin gravel bed with water entering hole rapidly.
	3.2 - 3.5	Brown and grey plastic sandy silty clay.
14	0 - 0.9	Brown soil and fractured brown clay.
	0.9 - 1.8	Clay, fairly compact, mainly brown but becoming mottled grey at depth.
	1.8 - 3.1	Grey and brown mottled clay and gravelly clay with some zones rich in gravel fragments.
	3.1 - 3.4	Rounded gravel fragments - alluvium.

Hole	*Depth (m)*	*Description*
15	0 - 0.6	Brown soil and fractured clay.
	0.6 - 1.5	Brown silty clay becoming more compact with depth.
	1.5 - 3.4	Grey-blue clay, sand and gravel beds interbedded. Pieces of wood about 3 m from surface and little altered. Hole collapsed rapidly due to water entering below about 2 m.
16	0 - 0.6	Soil.
	0.6 - 1.2	Fairly compact clay.
	1.2 - 3.4	Sandy clayey gravel and gravel beds. Wood accumulations in the gravel. Water entered hole fairly rapidly and hole collapsed below about 2 m.