

1979/20. Seismic survey at a proposed dam site at the Guide River, Hampshire.

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Abstract

A seismic survey of the Guide River dam site indicates deeply weathered basalt in the abutment areas. Permeability tests are suggested in test pits and diamond drill holes. Test pits are also suggested to determine the extent of Precambrian rocks at shallow depth in the dam site area.

GEOLOGY

Although the area is dominantly underlain by Tertiary basalt in varying stages of weathering, the boundary of the basalt with neighbouring areas of Precambrian rocks has been a little more clearly defined. This information has been plotted on Figure 1. Some further areas of quartz gravel fragments have been noted in the basalt soil surrounding the dam. These appear to occur on roughly the same contour except for one area about the middle of the storage area. New locations of this material and small outcrops of basalt in the stream bed are shown on Figure 1.

SEISMIC SURVEY

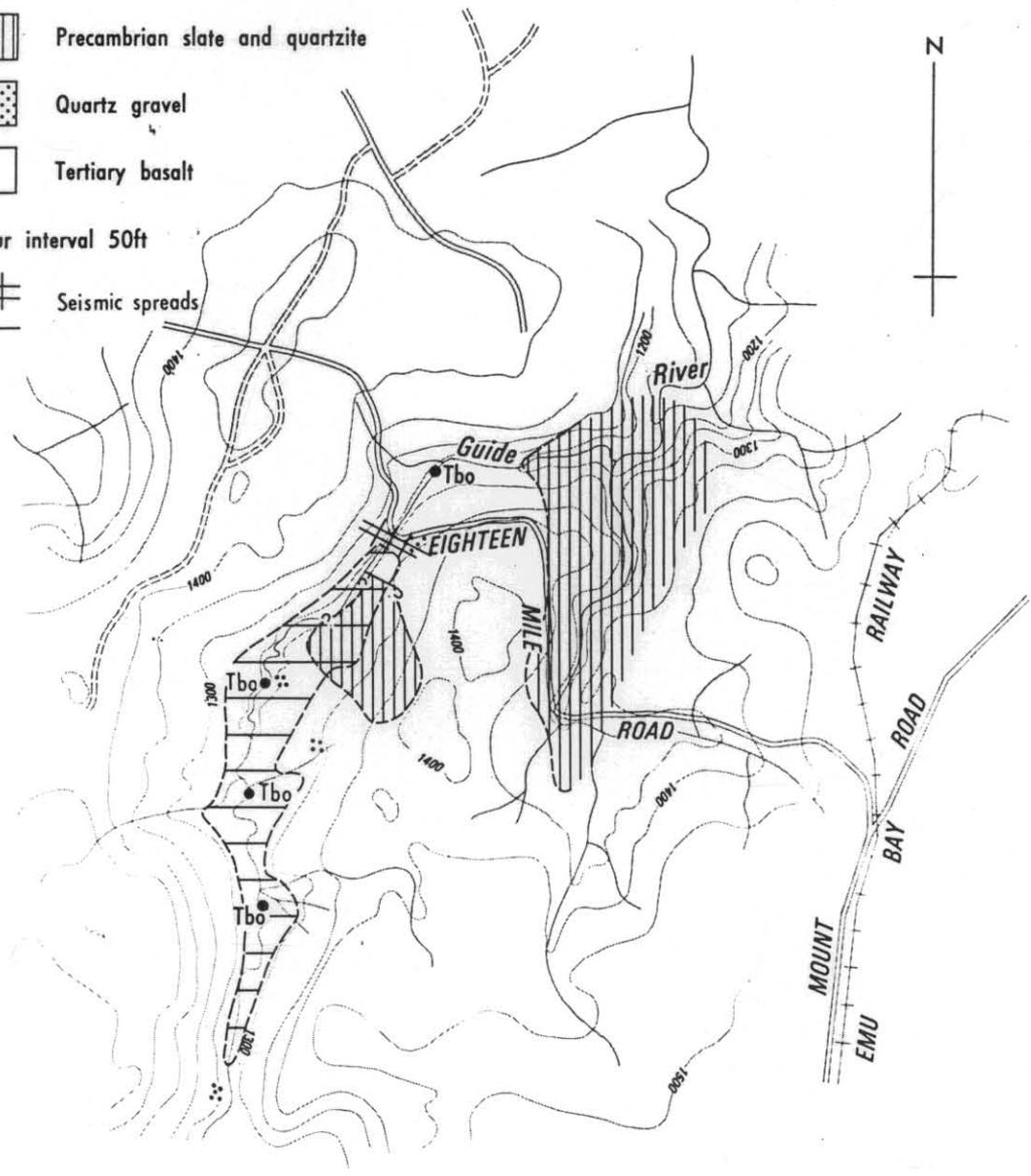
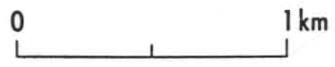
All seismic spreads were fired at both ends and at their centres. The six spreads with a geophone spacing of 4 m had extension shots fired 20-30 m from the first geophone at each end (Figure 2).

Refraction seismic surveys indicate layers of materials which transmit vibrations at various rates. With a knowledge of the surface geology an interpretation of the materials that are likely to underlie the area can be made. Under most spreads there is a surface layer with a seismic velocity of 400-550 m/s. This layer is likely to represent soil and unsaturated clayey material and is probably derived from *in situ* weathering of basalt. Below this surface layer is material with a higher seismic velocity which usually ranges from about 1900-3700 m/s. Some higher velocities (5000-7300 m/s) are questionable and are the result of firing downslope with a progressively thinner surface layer away from the shot. A very high apparent velocity is indicated in these circumstances for the lower layer and even when averaged with the upslope apparent velocity, as required for interpretation purposes, a very high velocity results. Velocities of 1900 to 3700 m/s may represent basalt with varying degrees of weathering. The upper ranges may represent largely unweathered but jointed basalt. The higher velocities under various spreads of 5000-7300 m/s, if true velocities, could be due to unweathered and largely unjointed basalt. The higher velocities and usually deeper positions for these materials, have in most cases been obtained from information from the extended shots for the shorter spreads or from the shots on each end of the spread for the longer spreads. Refractors in usually shallower positions are indicated from information derived from the other shots e.g. the centre shots. These have usually, but not always, lower velocities than those obtained from the more widely spaced shots. The profiles are sometimes very irregular in shape suggesting lateral variations in the degree of weathering of the basalt. Seismic profiles are shown in Figure 3.

GEOLOGY AROUND PROPOSED DAM SITE GUIDE RIVER

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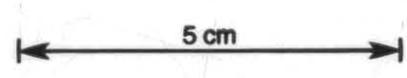
-  Tbo Basalt outcrops in river
-  Proposed storage area (approximate)
-  Precambrian slate and quartzite
-  Quartz gravel
-  Tertiary basalt
- Contour interval 50ft
-  Seismic spreads



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Figure 1



Spread 9, south of the proposed dam site is probably underlain by Precambrian rocks over its whole length. The west end being near the river in a swampy area, has a high indicated surface velocity material making the average for the two ends also higher than normal. This has probably resulted in the calculation for the first refractor being deeper than it should be, particularly on the eastern end and the information from the centre shot is probably more reliable in this case. If as expected, Precambrian sediments underlie this spread, they would also be weathered or jointed to some extent as velocities of up to 3500 m/s could be expected for unweathered Precambrian sediments.

CONCLUSIONS

As expected from surface geological examinations, the seismic survey has indicated considerable depths of weathering in the basalt. If the higher velocities indicated under spreads 4, 5 and 6 are true velocities then unweathered basalt will occur at about the depths indicated. However it is suspected that these are only apparent velocities and the basalt may be at least partly weathered to deeper levels. This is supported by the fact that these velocities are not indicated under spreads 1 and 2 which are of wider geophone spacing: such velocities, if they persist over wide areas should show on these longer spreads. The longer spreads average the velocity over the whole spread masking sharp variations caused by rapid lateral changes in weathering. The shorter spreads may have picked up some of these lateral changes in weathering and exhibit higher or lower velocities over short distances. These may be represented by some of the possible refractors at the usually shallower depths as shown on the profiles.

The depth of weathering may be such that it is uneconomic to instal a cut-off to relatively unweathered rock all the way across the dam. It is therefore necessary to examine closely the permeability of the weathered basalt that occurs above bedrock as water loss may be significant through these zones. Also the permeability of the less weathered rock would need to be examined as both the weathered sections and the unweathered parts of the basalt can be fairly permeable, as evidenced by the number of successful water bores installed in these materials. This is the most important factor which should be determined in any subsurface investigations as the permeability of the material under the abutments appears to be the factor most likely to determine whether the site is suitable. In addition to possible leakage through the basalt, the presence or absence of quartz gravel beds should be determined as these have potential to allow high seepage rates. Other investigations, as outlined in the previous report (Matthews, 1979) should be made once it has been established that only minor leakage is possible under the dam or around the abutments.

Some investigation should be made to determine the extent of Precambrian rocks at shallow depths in the dam site area. It is unlikely that they occur at shallow depth on the west side of the Guide River but it may extend downstream on the east side. The leakage problems in Precambrian rocks, weathered or unweathered, are unlikely to be as great as in the basalt.

RECOMMENDATIONS

Test pits to at least about 4 m would be useful in examining the weathered surface material and may reach less weathered rock in some places. Twelve or more such pits across the dam site area would give a guide to the nature of the material. Pits could also be used to determine the extent of Precambrian rocks near the dam site.

Deeper examinations would need to be undertaken with diamond drill holes. About six holes to depths of about 15-20 m should be sufficient for preliminary examinations. Most holes could be vertical, although an occasional angled hole may be useful.

Permeability information could be obtainable from pump in, pump out tests, or both, in the pits and boreholes. In the weathered sections of the boreholes, low pressure packer tests may be possible. In the less weathered sections, more reliable packer tests could be undertaken.

REFERENCE

MATTHEWS, W.L. 1979. Geology around a proposed dam site on the Guide River. *Unpubl. Rep. Dep. Mines Tasm.* 1979/4.

[5 July 1979]

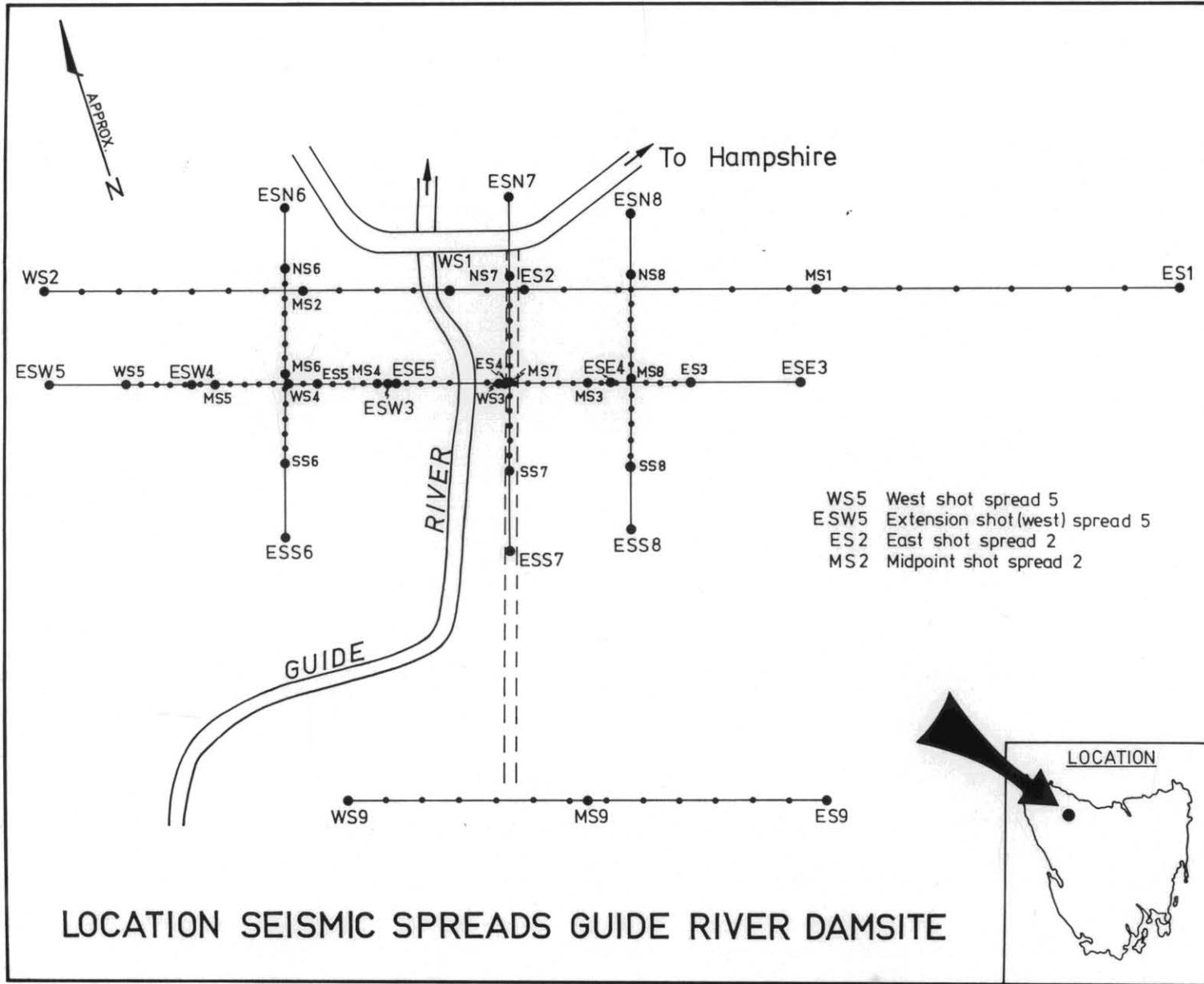


Figure 2.

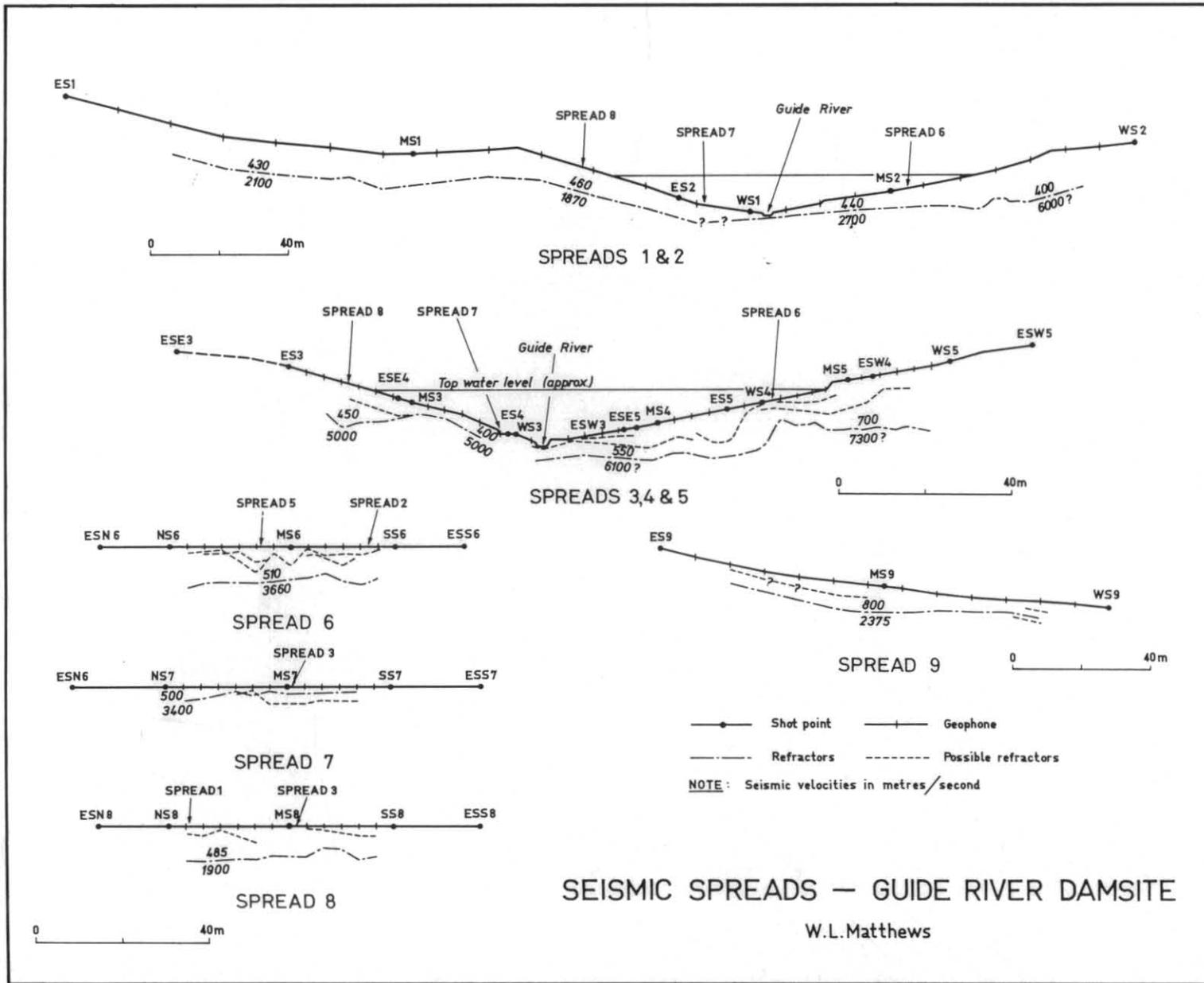


Figure 3.