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# Results of auger drilling at the Deep Creek dam site

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Fourteen auger holes were drilled along the centreline of a proposed dam on Deep Creek near Smithton and six holes were drilled in the storage area. Water pressure tests were carried out in each hole but figures are only approximate due to the crude method used. Samples were collected from some of the holes and tested for possible dispersion of the clay in distilled water and water from Deep Creek.

## Drilling results

It was not possible to case the auger holes as drilling proceeded and there could be some contamination of samples from lower levels by material falling from higher levels in the holes. There was often little or no sample return from the lower levels of the holes and the material that stuck to the augers was examined after their removal.

### *East Abutment (holes 1, 2)*

Material obtained from these holes consisted mainly of clay with some quartz and rock fragments. Quartzite and sandstone fragments were obtained from Hole 1 and some weathered igneous-like fragments from Hole 2. The material from these holes could be weathered *in situ* rock or transported material.

### *Flat between the East Abutment and the hill (holes 3, 4, 5)*

Gravel and clay were struck in these holes. A gravel bed appears to occur fairly consistently at 2–4 m below the surface. Samples indicate that the bed is 0.3–1 m thick.

The material from the top part of each of these holes is almost certainly of Tertiary to Recent age but below about four metres it could be weathered bedrock (i.e. Precambrian). Hole 5 appears to have entered fairly definite bedrock at about six metres.

### *Hill in the middle of the valley (holes 6, 7, 8)*

Sand, clayey sand, sandstone and quartzite fragments were encountered in these holes. This material could either be *in situ* weathered rock (quartzite) or Tertiary to Recent deposits derived from weathering of the quartzite. A small amount of clay is present throughout all of these holes.

### *Flat between the hill and the West Abutment (holes 9, 10, 11, 12)*

Material from these holes consisted of clay, sandy clay and gravel. The material from the upper part of the holes is of Tertiary to Recent age, but the lower sections could be of *in situ* weathered rock. Holes 11 and 12 ended in material which could be bedrock. The section west of Deep Creek is very swampy and it was impossible to drill in this area.

### *Storage area (holes 13, 14, 15, 16, 17, 18)*

Much of the material from these holes is probably of Tertiary to Recent age although most of Hole 14 could be in weathered rock (siltstone) as could the lower parts of holes 13, 15 and 16.

### *West abutment (holes 19, 20)*

Clay, silty clay and gravelly clay were obtained from these holes. This material could either be weathered *in situ* rock or Tertiary–Recent deposits.

## Water pressure testing

The figures obtained from these tests are only approximate. After drilling, each hole was filled with water and the time for a certain volume of water to disappear was measured, whilst the original water level was maintained. Where possible, the section of the hole above the standing water level was sealed with clay to prevent water loss through the soil layer. The results for each hole are shown in Table 1. Some of the holes had very high water losses and if approximate permeabilities are calculated (assuming uniform permeability over the entire hole), permeabilities range up to about 6.1 km/y (20,000 ft/y). If water loss is assumed to occur through the gravel beds (say 1 m thick) the permeabilities range up to about 24.4 km/y (80,000 ft/y).

There were considerable water losses in holes in the flats on either side of the hill in the centre of the valley. It is thought that most of this loss is through gravel beds which occur between about two and four metres below the surface. Although the material underlying the hill in the centre of the valley consists of sand, quartzite and sandstone fragments, there was surprisingly little water loss from holes drilled in this area. A little clay occurred in most sections of these holes. Hole 7 had a high standing water level which suggests fairly impervious material, but in Hole 8 the standing water level was low which could suggest a fairly porous zone (although the water test did not support this). There was little water loss through the material underlying the east and west abutments.

## Tests for clay dispersion

Samples from holes 8, 19 and 20 were placed in distilled water and Deep Creek water for a period of about 48 hours. Clayey gravel from holes 8 and 20, and plastic clay from Hole 19, were tested but unfortunately the samples had dried considerably before the tests were made. Cloudiness had developed in both the distilled water and Deep Creek water which contained samples from Hole 8. Deep Creek water containing a sample from Hole 20 was cloudy but the distilled water was clear and no cloudiness developed in either water type containing samples from Hole 19 after 48 hours.

## Discussion of drilling results

The samples obtained from the auger drilling were so disturbed that it is not possible to state definitely where or if bedrock was encountered. The hill in the middle of the valley could be underlain by broken and weathered quartzite and the other areas that were drilled could be underlain by weathered siltstone in the deeper portions of the holes. On the other hand, it is possible that all the material drilled is Tertiary to Recent deposits which are being dissected by Deep Creek and its tributaries. The former possibility would tie in fairly well with the situation suggested from the seismic survey and interpretation. If the latter proves to be correct, the 1500 m/s (5,000 ft/s) refractor could indicate the position of the water table.

For a dam of the height proposed, it is not of great importance whether the material underlying the dam site is weathered Precambrian rock or Tertiary to Recent deposits. It is important, however, that leakage through the material is low and that it does not have properties which could cause the dam to fail. Several holes indicated that water loss could be great and there are suggestions from the samples tested that some of the clay will disperse when in contact with fairly pure water. The dispersion tests that have been made should not be taken as final and more sophisticated tests should be made (e.g. by the CSIRO Soil Mechanics Section) to determine whether dispersion could be a problem.

The drilling did not determine whether or not dolomite underlies the storage area. In some holes, gravel prevented further drilling and in others, clay occurred to the greatest depths drilled. A surface layer of brown plastic clay about two metres thick underlies most of the storage area and the flats along the centre line.

## Conclusions and recommendations

1. Leakage through near-surface gravel in the flats is a distinct possibility but a cut-off to the base of these gravels should reduce the amount of leakage considerably. Trenching with a back hoe is suggested so that gravel beds can be examined *in situ* and also to prove whether impervious material occurs underneath.
2. Trenching is also suggested on both abutments and on the hill in the middle of the valley. These trenches should be tested for water loss and samples of the material excavated should be tested for possible clay dispersion.

   Trenches in all areas need not be extensive laterally but should be 3–4.5 m deep if possible. Suggested positions are marked on Figure 1.
3. The drilling has not established that dolomite is absent from the dam site and storage area. From regional mapping, it was thought that siltstone would underlie the storage area and that samples brought up by the auger drill would be easily recognisable. The geology suggests that dolomite is unlikely to occur but there is still some doubt. Sink holes have not been seen in any part of the dam site area which suggests that if it does occur, the development of solution cavities and channels has not been great. The surface clay layer, which appears to cover most of the storage area, should give some protection from leakage to possible dolomite beds underneath and also to gravel beds. It is suggested that two percussion holes be drilled in the storage area to establish the underlying rock type. These holes could also be used to examine whether deeper gravel beds occur. If these holes prove inconclusive two more holes could be drilled along the centreline, with one on each side of the hill in the centre of the valley.

The above investigations should prove whether there are any geological factors that would make the dam site unsuitable.

[14 January 1970]

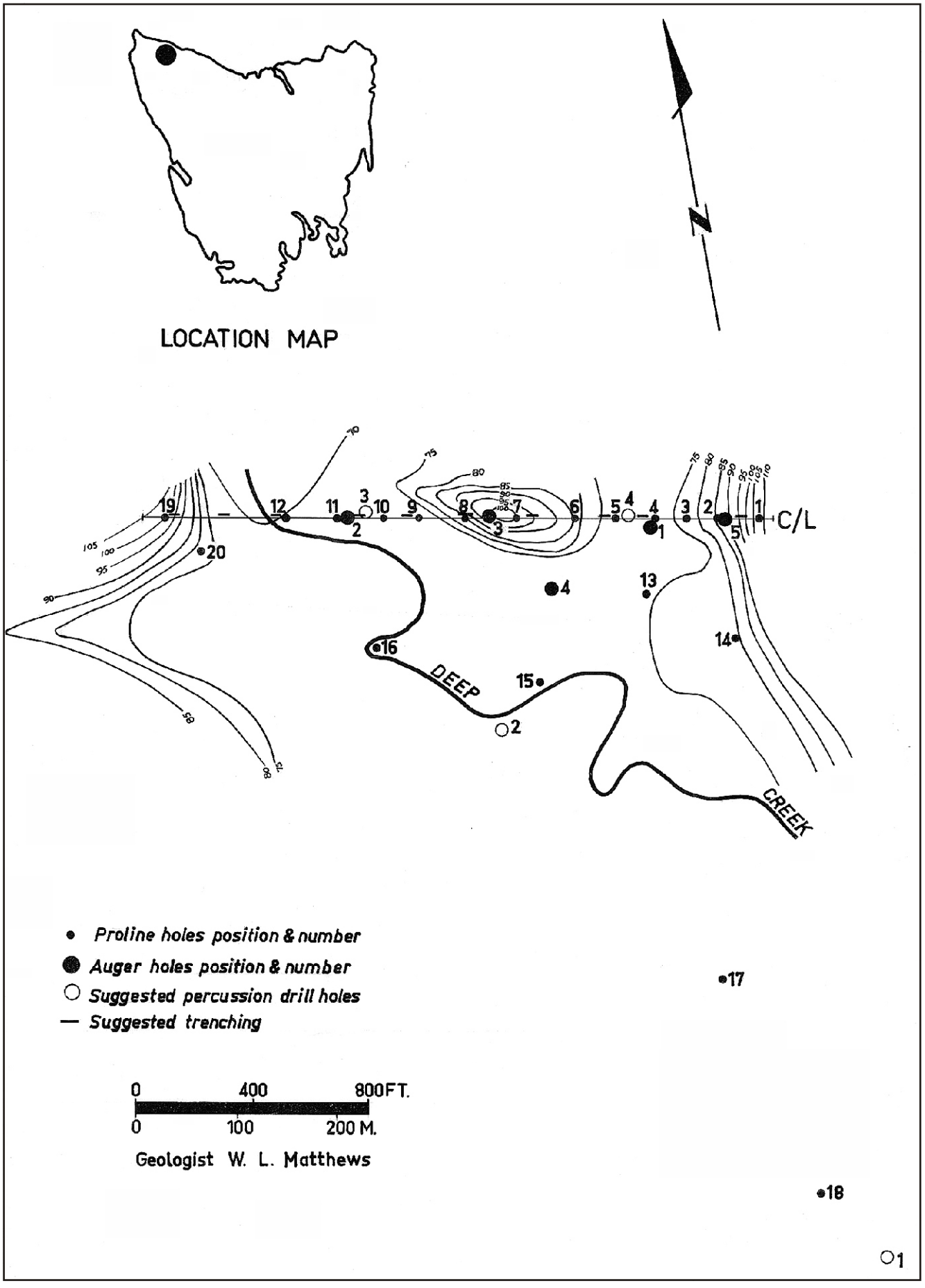


**Figure 1**

*Location of drill holes, Deep Creek dam site*

**Table 1**

*Water pressure testing*

| Hole | Depth drilled (m) | Standing water level (m) | Length of hole open during water test (m) | Water loss (litres) | Time min./sec. |
|---|---|---|---|---|---|
| 1 | 12.8 | 11.6 | 11.9 | 4.5 | 11 30 |
| 2 | 7.3 | 5.5 | 7.3 | 4.5 | 3 5 |
| 3 | 5.5 | 0.75 | 5.5 | 9.0 | 0 31 |
| 4 | 10.0 | 0.18 | 7.9 | 9.0 | 1 18 |
| 5 | 6.4 | 0.35 | 2.7 | 9.0 | 1 35 |
| 6 | 9.1 | 3.8 | 4.1 | small | |
| 7 | 9.1 | 3.8 | 6.7 | small | |
| 8 | 9.1 | 6.7 | 7.5 | 4.5 | 17 0 |
| 9 | 7.3 | 0.48 | 5.8 | 9.0 | 0 36 |
| 10 | 7.3 | 0.4 | 6.1 | 9.0 | 1 12 |
| 11 | 2.7 | 1.5 | 2.2 | small | |
| 12 | 6.7 | 0.64 | 3.0 | 9.0 | 0 25 |
| 13 | 7.3 | 0.56 | 6.4 | 9.0 | 0 9 |
| 14 | 7.3 | 3.6 | 7.3 | 4.5 | 3 45 |
| 15 | 11.0 | 0.7 | 10.4 | 9.0 | 0 12 |
| 16 | 4.9 | 0.7 | 2.3 | 9.0 | 0 22 |
| 17 | 4.9 | 0.6 | 2.6 | 9.0 | 0 49 |
| 18 | 10.7 | 0.4 | 5.9 | 9.0 | 0 22 |
| 19 | 6.4 | 5.1 | 5.9 | small | |
| 20 | 6.4 | 1.8 | 5.2 | small | |

**Logs of auger holes**

***Hole 1***

| *From (m)* | *to (m)* | *Description* |
|---|---|---|
| 0 | 0.76 | Brown soil |
| 0.76 | 0.9 | Light brown plastic clay |
| 0.9 | 1.5 | Blue-brown plastic clay |
| 1.5 | 1.8 | Light brown plastic silty clay |
| 1.8 | 4.6 | Sandy silt with quartzite and sandstone fragments, some clay |
| 4.6 | 6.9 | Light grey-brown silty clay with quartzite fragments |
| 6.9 | 7.3 | Blue plastic clay |
| 7.3 | 8.2 | Pink plastic clay, quartz fragments up to 2.5 mm |
| 8.2 | 12.8 | Brown clay, some quartz and rock fragments |

***Hole 2***

| *From (m)* | *to (m)* | *Description* |
|---|---|---|
| 0 | 0.6 | Red-brown soil |
| 0.6 | 1.8 | Red clay |
| 1.8 | 4.6 | Red clay with a few weathered rock fragments |
| 4.6 | 5.5 | Grey-brown clay with weathered rock fragments (igneous?) |
| 5.5 | 7.3 | Brown clay with a few quartz fragments towards end |

***Hole 3***

| *From (m)* | *to (m)* | *Description* |
|---|---|---|
| 0 | 0.6 | Dark brown soil |
| 0.6 | 1.8 | Brown plastic clay |
| 1.8 | 2.7 | Small return — reddish clay, a few rock fragments including quartzite, struck water |
| 2.7 | 3.6 | Reddish and grey plastic clay |
| 3.6 | 4.6 | Poor return - reddish clay (brown clay on auger when pulled out) |
| 4.5 | 5.5 | Red clay, a few gravel fragments |

***Hole 4***

| *From (m)* | *to (m)* | *Description* |
|---|---|---|
| 0 | 0.6 | Brown soil |
| 0.6 | 0.9 | Brown plastic clay, a few quartz pebbles |
| 0.9 | 1.8 | Brown plastic sandy clay, a few pebbles (incomplete return), water struck |
| 1.8 | 3.6 | Gravelly clay |
| 3.6 | 10.0 | Very small return while drilling. Orange-red clay on augers, some rock fragments (chert-like material) |

***Hole 5***

| *From (m)* | *to (m)* | *Description* |
|---|---|---|
| 0 | 0.6 | Dark brown soil |
| 0.6 | 1.8 | Brown plastic clay |
| 1.8 | 2.7 | Reddish and grey plastic clay with varying amounts of sand and grit |
| 2.7 | 3.6 | Gravel and clay with sand and grit. Gravel (chert and quartzite) appears to be towards top of run) |
| 3.6 | 5.5 | Clay with gravel, grit and sand |
| 5.5 | 5.95 | Clay |
| 5.95 | 6.4 | Light grey silt with angular rock fragments (fine quartzite or chert?), very hard to drill towards end |

***Hole 6***

| *From (m)* | *to (m)* | *Description* |
|---|---|---|
| 0 | 0.9 | Grey sand with gravel fragments |
| 0.9 | 4.6 | Gravel, grit and sand, a little clay, water struck towards bottom |
| 4.6 | 9.1 | No return while drilling, gravel fragments on auger when removed from hole |

***Hole 7***

| *From (m)* | *to (m)* | *Description* |
|---|---|---|
| 0 | 0.9 | Grey sand |
| 0.9 | 3.6 | Brown sand, some clay |
| 3.6 | 6.7 | Brown clayey sand with sandstone fragments (incomplete return) |
| 6.7 | 8.5 | Sand, some clay, sandstone fragments |

***Hole 8***

| *From (m)* | *to (m)* | *Description* |
|---|---|---|
| 0 | 2.7 | Brown sandy clay with some gravel fragments |
| 2.7 | 7.3 | Brown clayey sand, a few rock fragments |
| 7.3 | 8.2 | Light grey clayey sand, a few rock fragments |
| 8.2 | 9.1 | Light grey gritty sand with gravel fragments, a little clay |

***Hole 9***

| *From (m)* | *to (m)* | *Description* |
|---|---|---|
| 0 | 1.8 | Dark brown clay, a few rock fragments |
| 1.8 | 2.7 | Light grey-brown clay |
| 2.7 | 7.3 | Grey to brown clay, a few pebbles |

***Hole 10***

| *From (m)* | *to (m)* | *Description* |
|---|---|---|
| 0 | 1.8 | Brown clay, a little sand |
| 1.8 | 2.7 | Brown clay and gravel |
| 2.7 | 5.5 | Grey-blue clay, a little sand |
| 5.5 | 7.3 | Grey-blue-brown clay, a little sand and silt |

***Hole 11***

| *From (m)* | *to (m)* | *Description* |
|---|---|---|
| 0 | 0.9 | Brown soil |
| 0.9 | 1.8 | Blue-grey clay passing into gravel (quartzite fragments) |
| 1.8 | 2.7 | Gravel-quartzite fragments up to 0.04 mm, some clay |

Unable to drill any further because of hardness

***Hole 12***

| *From (m)* | *to (m)* | *Description* |
|---|---|---|
| 0 | 0.9 | Brown soil |
| 0.9 | 1.8 | Brown plastic clay |
| 1.8 | 6.7 | Very poor return while drilling, grey and brown gravelly clay on augers when removed from hole. White sand with some clay and gravel fragments on bottom auger |

Unable to drill any further because of hardness

***Hole 13***

| *From (m)* | *to (m)* | *Description* |
|---|---|---|
| 0 | 0.46 | Brown soil |
| 0.46 | 2.6 | Brown and reddish plastic clay |
| 2.6 | 2.7 | Grey sandy clay, struck water |
| 2.7 | 3.6 | Grey-brown plastic clay with bands of sand (incomplete return) |
| 3.6 | 4.6 | Sand and clay (very small sample return) |
| 4.6 | 7.3 | Blue-grey clay, a little sand, some gravel fragments (chert) which might belong to the 2.7 to 4.6 m section |

***Hole 14***

| *From (m)* | *to (m)* | *Description* |
|---|---|---|
| 0 | 0.9 | Grey silty soil and clay |
| 0.9 | 2.7 | Grey to brown silty plastic clay |
| 2.7 | 3.6 | Gravelly clay and clay |
| 3.6 | 6.1 | Blue-grey clay, occasional pieces of vein quartz |
| 6.1 | 7.3 | Gravelly clay (gravel appears to be mainly quartz vein material) |

***Hole 15***

| *From (m)* | *to (m)* | *Description* |
|---|---|---|
| 0 | 0.9 | Brown soil and clay |
| 0.9 | 1.8 | Brown plastic clay |
| 1.8 | 2.7 | Brown plastic clay passing into sandy brown-grey clay |
| 2.7 | 3.6 | Gritty and gravelly clay (water struck) |
| 3.6 | 9.1 | Grey-blue clay with some grit |
| 9.1 | 11.3 | Clay and grit with gravel fragments (chert? and quartz) |

***Hole 16***

| *From (m)* | *to (m)* | *Description* |
|---|---|---|
| 0 | 0.9 | Brown soil |
| 0.9 | 1.8 | Brown clay and soil |
| 1.8 | 3.6 | Sand and clay |
| 3.6 | 5.5 | Grey and brown clay |

***Hole 17***

| *From (m)* | *to (m)* | *Description* |
|---|---|---|
| 0 | 0.15 | Soil |
| 0.15 | 1.8 | Brown plastic clay |
| 1.8 | 2.7 | Mainly grey-brown plastic clay with occasional pebbles |
| 2.7 | 3.6 | Gravelly clay |
| 3.6 | 5.5 | Clay with gravel becoming more common towards bottom (chert and white quartzite) |

***Hole 18***

| *From (m)* | *to (m)* | *Description* |
|---|---|---|
| 0 | 0.9 | Brown soil and clay |
| 0.9 | 4.6 | Grey-brown clay, a few pebbles |
| 4.6 | 10.0 | Mainly gravelly clay with more gravel towards end (chert? fragments) |

Unable to drill any further

***Hole 19***

| *From (m)* | *to (m)* | *Description* |
|---|---|---|
| 0 | 0.9 | Brown-grey silty soil with occasional quartzite fragments |
| 0.9 | 2.7 | Grey-blue clay |
| 2.7 | 4.6 | Light brown clay |
| 4.6 | 6.4 | Blue-grey plastic clay |

***Hole 20***

| *From (m)* | *to (m)* | *Description* |
|---|---|---|
| 0 | 0.9 | Brown to grey soil |
| 0.9 | 1.8 | Light brown to cream silty clay |
| 1.8 | 3.6 | White silty clay (occasional quartz fragments) |
| 3.6 | 6.4 | White and brown gravelly clay |