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1977/11. Groundwater prospects at the Stony Head artillery range.

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At the request of the Department of Defence (Army Office) a groundwater investigation was undertaken at the army artillery range at Stony Head. The investigation covered an area between the camp site [DQ981575] and the rifle range [EQ006580], 2.5 km to the east. Four suitable potential bore sites were selected by the army. A groundwater supply of about 75 *l*/min is required for domestic purposes.

TOPOGRAPHY AND GEOLOGY

The area investigated (fig. 1) forms part of a coastal terrace rising to 45 m above sea level. The terrace surface is composed of marshy shallow basins, old E-W dune ridges, and flats covered with scrub or tussock grass. There are a few non-permanent westward flowing streams. The area lies west of Ryans Hill, a 220 m high hill on a narrow steep ridge which runs from Stony Head on the coast, to Turquoise Bluff, north of the Bridport-George Town road. This ridge is underlain by cleaved sandstone, siltstone and phyllite of the Mathinna Beds. These sediments extend west from the ridge and underlie the grey sand, brown organic clay and grey-brown sandy clay that form the surface of the coastal terrace.

Mathinna Beds consisting of cleaved sandstone and slate, overlain by 2 m of white brown clay and a surface layer of grey sand with angular quartz pebbles, crop out in a bank excavated during the construction of the butts for the rifle range. The remainder of the area is covered by grey sandy soil and windblown sand, with some basalt boulders occurring on the camp parade ground. An old E-W dune system with fine, white windblown sand is located on the northern margin of the area. North of the dunes the land falls to a shallow marshy elongate basin which extends eastward from Oak Hill towards Ryans Hill, crossing the rifle range east of the low rounded hill east of bore site 4 (fig. 1). A wide shallow valley south of the camp site is occupied by a tributary of Curries River. This creek was dry and there was only one water hole in its bed close to the ford near the camp.

The topography, soil and boulders indicate that the lower ground in the western and centre section of the area investigated is underlain by basalt whereas the higher eastern end is underlain by Mathinna Beds.

GEOPHYSICAL WORK

Three refraction seismic spreads were fired to confirm the geological interpretation. High velocities in Spreads 1 and 3 (table 1) indicate that unweathered basalt is within 3.5 m of the surface. This was confirmed in auger holes 1, 1a and 2 in which basalt boulders were encountered within 4 m of the surface (table 2). The seismic velocities in Spread 2, on the eastern section of the area, were lower than Spreads 1 and 3 and stepped, indicating that the Mathinna Beds underlie this area.

A resistivity probe was undertaken to see if the clays that overlie the weathered sandstone and slate cropping out at the rifle butts were present in the eastern section. The sounding, 300 m in length using a Wenner configuration, gave a complex curve. Low apparent resistivity values occurred below the high initial surface layer values of the dry grey superficial sand. The low values indicate a thick clay with the water table occurring in the middle of the layer.

The apparent resistivity increased slightly beneath this clay layer

but then declined. The water quality is probably suspect in the clay and in the weathered and saturated fractured zone of the sandstone beneath the clays.

DRILLING

After firing the shot at the west end of Spread 3, water flowed into the hole at a depth of 1.5 m. The calculated depth of sand at this location was 4 m and there appeared a possibility that the dune may provide enough water for the camp by using a series of shallow spear bores at little cost compared to deep drilling. A tractor mounted auger drill was used to drill at this location (Site 2) and also at five other locations (fig. 1). The drilling results are given in Table 2. A sand thickness greater than one metre was only found in Hole 2 but the water flow in the clayey sand was slow and the hole did not warrant pump testing. The holes drilled confirmed that basalt underlies the western and central section of the area investigated and that Mathinna Beds sediments underlie the eastern section below a thick clay layer.

CONCLUSIONS

Two rock aquifers are available in the area selected by the army; the basalt in the west and centre and the sandstone and slate of the Mathinna Beds in the east.

The nearest bore to Stony Head is at the Heemskirk Vineyards at Pipers River, some 25 km south-east. This bore was drilled from basalt into thin Tertiary gravels into underlying slate and tested at 758 *l*/min with a water quality of 630 ppm total dissolved solids after pump testing. Most of this water came from the basal 10 m of the basalt and the 3 m of underlying gravels.

The Mathinna Beds have been found to be the most reliable low yielding rock aquifer in north-east Tasmania. The groundwater quality is variable but is drinkable at most locations, but may have a high iron content. Two dry bores in the Mathinna Beds sediments occur at Seawood Ranch and Little Pipers River, 25 km east of Stony Head. The first of these bores was in sediments with a very high seismic velocity and which were thought to have been baked contact metamorphism. The other bore was in sediments with low seismic velocities, and which were found to be clay overlying a considerable thickness of weathered Mathinna sediments. On drilling, 65 m of clay were encountered overlying slate with quartz veins.

The seismic velocities of Mathinna sediments indicate that a 30-40 m deep hole should yield 80-240 *l*/min. The thickness of the basalt is variable in north-east Tasmania and the rock has given some of the highest and lowest yielding bores, but with a stable quality averaging less than 500 ppm T.D.S.

If the thickness of basalt at the camp site is similar to that exposed along the coast at Stony Head, a sufficient supply of groundwater for the army requirements should be available from this rock.

RECOMMENDATIONS

Because of the potentially better quality of the groundwater from the basalt (Site 1) it is recommended in preference to the Mathinna Beds (Site 4) for deep drilling. If the basalt is found to be thin at this site drilling should be continued at Site 4 where drainage from the higher country to the east is likely to give better groundwater than from drilling into Mathinna sediments beneath the basalt at Sites 1, 2 and 3.

COST

The cost of drilling for the type of drill and drilling methods likely to be used is approximately $800 per week plus the cost of casing at approximately $23.56 per metre for 6-inch steel. Normally when rock aquifers are drilled no great footage of casing is required. Often plastic casing is adequate for support if such a rock aquifer has to be cased for its entire length.

[4 March 1977]

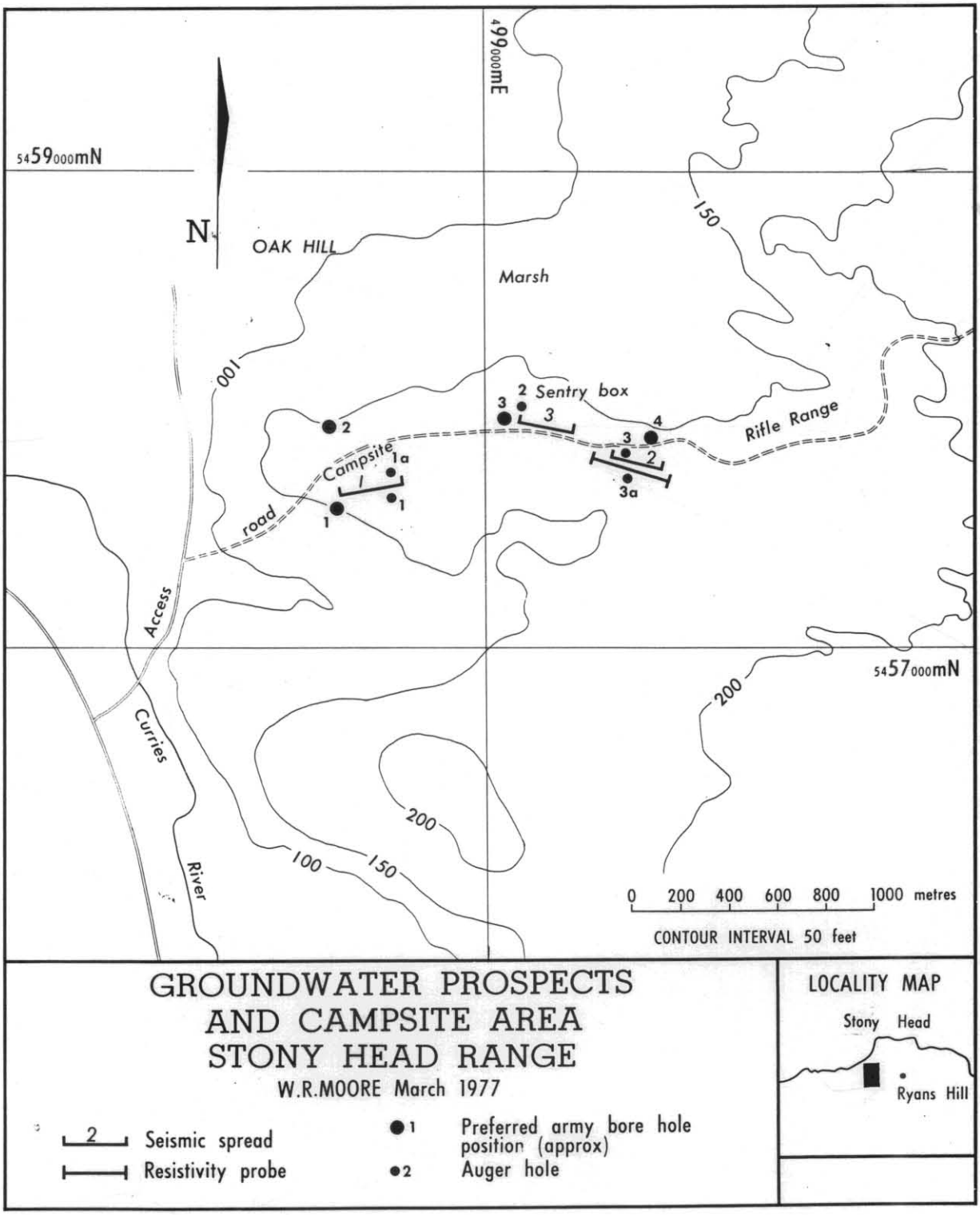

Figure 1.

5 cm

Table 1. *SEISMIC RESULTS, STONY HEAD.*

Spread	Location	Length of spread (m)	Geophone spacing (m)	Shot point distance from geophone (m)	Velocity layers (m/s)	Calculated depth to V_0/V_1 interface	Shape of time velocity plot	Geological interpretation	Remarks
1	E-W at camp site.	220	15	W = 30 E = 23 Mid SP = 15	V_0 = 915-1210 V_1 = 3350-3660 *Mid SP* V_0 = 915-1210 V_1 = 2130-2430 V_2 = 3040-3350	9 m. (Not reliable. SP at too great a distance). 4-5 m	Symmetrical Not stepped	V_0 Surface sand and brown clay. V_1 Basalt.	V_0 layer slightly thicker at east end of spread.
2	E-W at rifle range shelter shed.	230	15	E and W = 30 Mid SP = 15	*West end* V_0 = 1120 V_1 = 1830-2130 *East end* V_0 = 760 V_1 = 2140-2740	3 m 5 m	Asymmetrical and very stepped. V_0/V_1 interface slopes down to east.	V_0 Surface sand grey and white clay weathered zones. V_1 Cleaved sandstone and slate. Mathinna Beds.	
3	E-W. Geophone line near sentry box at fence.	230	15	E and W = 30 Mid SP = 15	V_0 = 760-1070 V_1 = 2440-2740 V_2 = 3350-4570	3-4 m	Slightly asymmetrical interface non-stepped slope to west end.	V_0 Grey sand brown clay and weathered zone with small boulders. V_1 Weathered but hard basalt. V_2 Unweathered basalt.	

Table 2. *LOGS OF AUGER HOLES, STONY HEAD*

Hole No.	Depth (m)	Lithology
1	0-1	Brown-grey clay with iron nodule and basalt pebbles.
1a	0-0.75	Grey white windblown quartz sand.
	0.75-1.75	Brown-grey sandy clay with basalt pebbles.
2	0-1	Fine grey windblown sand.
	1-2	Brown-grey clayey sand.
	2-3	Red and green clay.
	3-4	Brown clay with basalt pebbles. Clay derived from weathering of basalt.
		Water table at 2 m.
3	0-1	Grey windblown sands.
	1-2	Brown sandy clay.
	2-3	Light grey and white clay.
3a	0-1	Grey windblown sand and brown sandy clay.
	1-2	White clay.
	2-3	Yellow clay.
	3-4	Red-yellow clay.
	4-8.5	Brown pebbly clay.
		Water table at 2 m.