1980/25. Groundwater investigation at Bridport golf course

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Abstract

Following a site inspection, seismic refraction and resistivity geophysical surveys were recommended to assess the groundwater potential at the Bridport golf course. The course is situated on the crest and western slope of a ridge of metamorphosed Mathinna Beds sediments and granodiorite, overlain by draped windblown sands of varying thickness.

Two potential sources of groundwater have been identified by previous regional groundwater investigation: the Mathinna Beds sediments and the windblown sands. The quality of water from both aquifers is likely to be poor.

The geophysical work indicated a surface soil and sand layer underlain by an intermediate layer 19-20 m thick, underlain by hard bedrock. The most likely interpretation is that the surface sand layer has the water table at its base and that the intermediate layer consists of clay and weathered bedrock, and is underlain by baked Mathinna Beds. The resistivity results indicate that the groundwater is likely to be saline.

No deep drilling is recommended, but a series of shallow auger holes should be drilled to collect water samples and test the predicted lithology.

INTRODUCTION

Following a site inspection of the Bridport golf course [EQ320609] a geophysical survey was recommended to assess the groundwater potential. Five refraction seismic spreads and two resistivity soundings were undertaken, the locations of which are shown on Figure 1.

LOCATION AND TOPOGRAPHY

The golf course is situated along the crest and western slope of a N-S ridge that forms a distinct topographic feature from the Brid River [EQ321593] to Granite Point [EQ328627]. The course extends north of the Sandy Points Road for approximately one kilometre. The geophysical work was undertaken on the uniform slope between the two parallel fairways to the green on the flat that forms the western edge of the Little Forester River-flood plain. The western boundary of the course extends approximately 30 metres onto this flood plain.

GEOLOGY

The flood plain is underlain by alluvial clay and sand as exposed in a small water hole at the western boundary of the course. The N-S ridge is composed of hard erosion resistant metasediments and possibly some granodiorite. The thermal metamorphic contact zone of baked hornfelsed sandstone, slate and mudstone of the Mathinna Beds underlies the ridge and western slope; granodiorite underlies the eastern slope and is exposed along the Brid River to the south.

Windblown sand drapes this ridge and forms extensive and thick deposits on its western flank at the northern end of the ridge west of

Granite Point.

GROUNDWATER POTENTIAL

Only one deep bore was drilled on this ridge during the Department's groundwater investigation of the Scottsdale Basin. This bore was drilled in 1973, 2 km south of the golf course on the south side of the Bridport-George Town Highway in a paddock, then owned by Mr Harrison [EQ325589]. The bore (at 23 m a.s.l.) was drilled in Mathinna Beds sediments to a depth of 40 m. Pressure water rose to the ground surface when struck. During a five-hour pump test the bore produced 288 *l*/min (3800 gal/h) with a draw-down of 28 m. The water was very saline; the total salt content was 5830 mg/*l* of which 75% was common salt (Na^+Cl^-). Using Australian Water Resources Council classification (Hart, 1974, p.90) of total salt content for irrigation waters this water is Class 5, defined as water of extremely high salinity and generally not suitable for irrigation except in emergencies or for well-managed salt-tolerant pastures on well-drained sandy soils.

The other potential source for groundwater are the windblown draped sand deposits. In a spear bore investigation of the area in 1974 it was found that along the crest of the ridge and on the eastern slope these sediments were too thin to allow the accumulation of any significant supplies of groundwater, whereas on the west side of the ridge near the break in slope onto the alluvial flood plain up to 10 m of these sands were found. At the northern end of the ridge towards Granite Point, two of these areas were pump-tested and yields of 15-19 *l*/min (200-250 gal/h) were obtained from a 50 mm spear bore. The water was saline with a total salt content of 2250 mg/*l* on analysis. Using the A.W.R.C. irrigation water classification this water is Class 4 or a very high saline water not ordinarily suitable for irrigation.

From these previous investigations and drilling it appeared likely that supplies of groundwater might be obtained at the golf course but that the water quality was likely to be poor. Therefore no deep drilling could be recommended and a limited geophysical investigation was recommended; the cost of which would be approximately $80-100.

GEOPHYSICAL WORK

Seismic refraction survey

The results of the five seismic spreads are summarised in Table 1 and their location is shown on Figure 1. Three seismic velocity layers are apparent: a surface layer (V_0 = 500-700 m/s), an intermediate layer (V_1 = 1000-1700 m/s) and a third layer (V_2 = 3000-4500 m/s).

The surface layer (500-700 m/s) is thought to be sandy soil and grey windblown sand with a calculated thickness of 2-3 m. The middle layer has a wide range of velocities, mainly in the 1100-1400 m/s range. There is limited evidence for a higher velocity layer in some of the spreads (ranging from 1500-1800 m/s). The thickness of the middle layer is calculated at 14-21 m. The depth to the V_1/V_2 interface is calculated at 19-21 m in those spreads in which the interface is horizontal.

If this middle layer was a water saturated coarse sand for most of its calculated thickness it could be a reasonable aquifer giving adequate supplies of groundwater. The more likely interpretation of it is clay or sandy clay with some water saturated layers ranging to a weathered bedrock material giving rise to the higher seismic velocities (1500-1800 m/s) seen

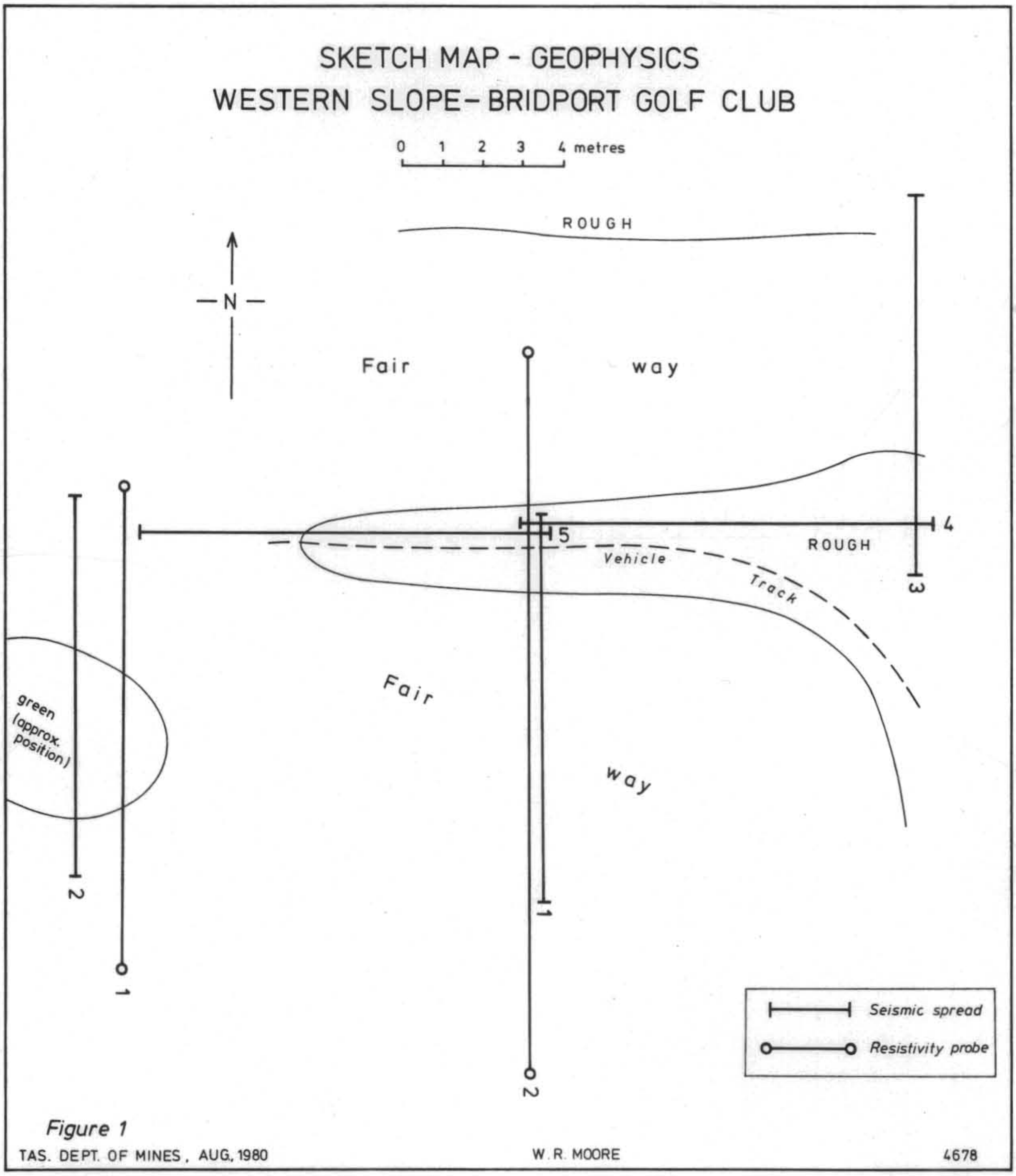
SKETCH MAP - GEOPHYSICS
WESTERN SLOPE - BRIDPORT GOLF CLUB
0 1 2 3 4 metres
ROUGH
N
Fair
way
Fair
way
Vehicle
Track
ROUGH
green (approx. position)
1
2
3
4
5
1
2
Seismic spread
Resistivity probe
TAS. DEPT. OF MINES, AUG. 1980
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Figure 1

5 cm

in spreads 1, 2 and 4.

The third layer has an apparent seismic velocity range of 2100-4500 m/s due to the effect of the slope of the V_1/V_2 interface. The true velocity lies between 3000-3500 m/s, typical of unweathered granodiorite.

The presence of granodiorite beneath the western flank of the ridge appears unlikely judging from the exposures along the Brid River. The rock is more likely to be hard-baked Mathinna Beds sediments in which jointing and bedding planes have been welded by heating and intruded by quartz veins and granodiorite similar to the exposures along the foreshore at Bridport. The baking and quartz veining and sealing of the joints give these sediments a higher seismic velocity than is normal for Mathinna sediments and the seismic plots do not show the 'stepped' velocities which are characteristic of open-jointed Mathinna sediments.

Resistivity Soundings

The two resistivity soundings (150 and 180 m length in a N-S direction) were undertaken at approximately the same location as seismic spreads 1 and 2. A Wenner configuration was used for the soundings. The resistivity values were all very low with probe 1 having a range from 10 to 54 ohm-m and probe 2 from 17 to 38 ohm-m. With such low resistivity values neither soundings could have reached unweathered bedrock.

The curve for the first probe (at seismic spread 2) on the alluvial flats rose steadily from 10-11.5 ohm-m to 54 ohm-m with the two low values representing a thin water-saturated soil layer with saline water overlying an impervious thick clay horizon. The second probe (at seismic spread 1) showed three resistivity layers. The upper layer was a declining curve of moist sandy soil from 38-17 ohm-m with the water table of saline water at a depth of 3-5 m with low resistivity values of 17 and 18 ohm-m. The second layer was indicated by rising resistivity values of 18-27 ohm-m followed by a third layer of constant resistivity values between 27 and 25 ohm-m. The upper layer is moist sandy soil with a thin water table at its base, overlying clay layers of low but differing resistivity values.

CONCLUSIONS

(1) For a deep bore the correct geological interpretation of the third layer velocity is not critical. If this third velocity layer is granodiorite as appears likely from the geophysical evidence, the writer knows no bore drilled in north-eastern Tasmania into definite granodiorite that has produced any water. This rock has few vertical and sheet joints and these soon become tight below the ground surface so that all holes so far drilled in it are completely dry.

If alternatively baked Mathinna Beds sediments with quartz veins are present, as appears likely from the geology, the likelihood of much groundwater is also low. Such quartz vein areas exist at Lefroy, Lilydale, Winnaleah and Gladstone and when drilled generally produce low yields of groundwater often with a high iron content that gives considerable rust deposits when irrigating.

(2) The surface layer of grey sandy soil and sand is too thin to be of any significance as a potential aquifer.

(3) The intermediate seismic velocity layer has an adequate calculated thickness to be a good aquifer if most of it was composed of a coarse sand; the resistivity results indicate that this is most unlikely. Resis-

tivity probes indicate clay layers underlain by deeply weathered Mathinna Beds clay or silt of the deeply weathered granodiorite. This more probable interpretation indicates that little or no groundwater occurs and that any present is likely to be saline.

RECOMMENDATIONS

(1) The possibility of obtaining groundwater in sufficient quantity and of good enough quality for the purpose of irrigating the greens and fairways of the Bridport Golf Course appears very marginal, and therefore no expensive deep bore should be contemplated until more is known about the quality of the groundwater.

(2) Three of four shallow auger holes should be drilled 10-15 m to observe the lithology and test any groundwater for quality. If the quality of the water is better than anticipated and groundwater appears sufficient in any of these holes a spear bore should be jetted down below the water table and pump tested. This work would be undertaken by the Department as it would provide extra information for the groundwater investigation of the area. The club would only be responsible for the cost of any materials not recovered.

(3) If these tests are at all successful a resistivity mapping programme should be undertaken in an attempt to determine the extent of the aquifer.

(4) Even if the groundwater quality is unsatisfactory from the shallow aquifers, the writer is reluctant to recommend an expensive deep bore into the bedrock unless very favourable terms can be negotiated with a drilling company. The risk of a dry hole on seismic evidence appears high and the likelihood that the water quality will be poor is indicated by Harrison's and other bores.

REFERENCE

HART, B.T. 1974. A compilation of Australian water quality criteria. *Tech.Pap.aust.wat.Resour.Counc.* 7.

[14 August 1980]

Table 1. SEISMIC REFRACTION RESULTS, BRIDPORT GOLF COURSE

Spread	Direction	Shot point and geophone interval (m)	Velocity layers metres/sec	Slope	Calculated interface depths (m)	Geological interpretation	Remarks
1	N-S	SP N & S = 15 Mid SP Geo.Int. = 7.5	V_0 500-700 V_1 1500-1600 V_2 2500-3000	None	$\frac{V_0}{V_1}$ 2.2 - 2.8 $\frac{V_1}{V_2}$ 16 - 21	*Upper* Soil & grey sand *Intermediate* Clay & sands etc. below water table and weathered bedrock *Lower* Mathinna sediments or granodiorite	Some stepping present in the seismic velocities
2	N-S	SP N & S = 15 Mid SP Geo.Int. = 7.5	V_0 500-600 V_1 1100-1400 V_2 3000-4500	Down to N	$\frac{V_0}{V_1}$ 2.9 - 3.7 $\frac{V_1}{V_2}$ 21 - 24	*Upper* Soil & sand *Intermediate* Water table - clay grading to weathered bedrock *Lower* Granodiorite or baked Mathinna sediments	Large velocity range in V_2 due to interface slope

Table 1. (continued)

Spread	Direction	Shot point and geophone interval (m)	Velocity layers metres/sec	Slope	Calculated interface depths (m)	Geological interpretation	Remarks
3	N-S	SP N & S = 15 Mid SP Geo.Int. = 7.5	V_0 400-700 V_1 1100-1400 V_2 3250-3500	None	V_0/V_1 2.3 - 2.5 V_1/V_2 19 - 20	*Upper* Sandy soil & grey sand *Intermediate* Clay & sand & weathered bedrock *Lower* Granodiorite or baked Mathinna beds	Definite 1700-1800 m/s layer indicates weathered bedrock.
4	E-W	SP W = 13 SP E = 15 Mid SP Geo.Int. = 7.5	V_0 500-700 V_1 1200-1500 V_2 2100-3500	Strong, W	V_0/V_1 2.5 - 4.0 V_1/V_2 17 - 23	*Upper* Sandy soil & grey sand *Intermediate* Water table, clay & weathered bedrock *Lower* Granodiorite or baked Mathinna beds	Large range of velocities of V_2 due to slope

Table 1. (continued)

Spread	Direction	Shot point and geophone interval (m)	Velocity layers metres/sec	Slope	Calculated interface depths (m)	Geological interpretation	Remarks
5	E-W	SP W = 15 SP E = 25 Geo.Int. = 7.5	V_0 500-700 V_1 1200-1500 V_2 2500-3000	Slight, to W	$\frac{V_0}{V_1}$ 2.1 - 3.4 $\frac{V_1}{V_2}$ 17 - 21	*Upper* Soil & sand *Intermediate* Water table clay and weathered bedrock *Lower* Baked Mathinna Beds or granodiorite	Upper layer thicker at west end