1977/52. Groundwater investigations, Chinamans Bay, Maria Island.

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As part of a general management plan for the Maria Island National Park, the National Parks and Wildlife Service is considering the development of the Chinamans Bay area at the northern end of Shoal Bay. Camping amenities are needed and the locality is a favoured site for a proposed field study centre for the Education Department. The centre may cater for up to 100 people, but development is dependant on a reliable and economical water supply. Available surface water is unsuitable and the National Parks and Wildlife Service requested that the Department of Mines investigate the groundwater potential in the area.

The locality was initially visited by P.C. Stevenson (Department of Mines) and R. Gatenby (NPWS) on 20 May 1977, when potential areas between Point Lesueur and Chinamans Bay were briefly investigated. Stevenson concluded (pers. comm.) that two sites (near Bloodstone Point and at Chinamans Bay) merited closer study.

The island was again visited on 2-3 August 1977. Studies were confined to the unconsolidated sand deposits bordering Chinamans Bay near French's Farm, as that area is most conveniently sited with regard to the proposed field centre.

GEOLOGY

The basement rocks of the region are Jurassic dolerite and Lower Parmeener marine sediments. Dolerite crops out on the headland between Edina Point and Point Lesueur and most of the western half of the island is composed of this rock type. The dolerite is faulted against Lower Parmeener sediments which are exposed on the slopes of Mount Maria and Bishop and Clerk. In the vicinity of French's Farm, small isolated outcrops of weathered pebbly sandstone occur, but elsewhere in this locality, the sediments (and to a lesser extent the dolerite) are overlain by a thin and variable veneer of unconsolidated Quaternary and Recent deposits. On the more elevated land behind Chinamans Bay, these unconsolidated sediments consist mainly of aeolian sand with varying admixtures of sand and clay derived from the weathering of the underlying basement material. West of French's Farm, in the low lying swampy area bordering the un-named tidal creek, an unknown thickness of lagoonal (?) grey sand and clayey sand overlies dolerite and sandstone. The dune system behind Chinamans and Shoal bays consists of an upper layer of Holocene aeolian sands, grading downwards to marine sand which in turn overlies a clayey horizon at about 4-5 m.

GROUNDWATER HYDROLOGY

DOLERITE AND SANDSTONE

Dolerite is generally regarded as an unreliable aquifer; the few drilling records available indicate that only small quantities of water are obtained from successful holes, and most are considered failures. The sandstone in the area probably contains useful water supplies, but it would be necessary to transport a drilling rig to the island to investigate the aquifer.

UNCONSOLIDATED SEDIMENTS

The unconsolidated deposits in the Chinamans Bay area offer the most promising prospects for obtaining groundwater. In particular, extensive dune systems (such as those bordering Shoal Bay) have been found elsewhere in Tasmania to contain large quantities of potable, easily extractable water. Accordingly, the investigations were confined to these materials.

Three sites were selected for spear bore testing (fig. 1). At each site, the hole was logged (Table 1) and pumped, and a water sample collected for analysis (Table 2).

Site 1

A 600 mm length of Number 10 screen (slot opening 0.25 mm) was installed to a depth of 4 m and the bore was subsequently pumped at a rate of 6 *l*/min for a short period. This rate was too high, since it produced an excessive drawdown and caused air to be drawn into the hole. (The hole's performance could be improved by a longer screen length and more appropriate screen slot opening). The groundwater was initially muddy (which is normal) but cleared rapidly on further pumping.

The water is totally unfit for human consumption. The analysis of a sample collected fifteen minutes after pumping started (Table 2) is almost identical to that of seawater. In comparison to seawater, the sample contains less sodium and chloride, but more calcium, bicarbonate, silica and iron, indicating a slight removal of Na and Cl by, and corresponding leaching of Ca, HCo_3, SiO_2 and Fe from, the aquifer. The high salinity of the water is not unexpected, since the locality is bounded on both sides by a tidal creek. However, the standing water level of 1.8 m (which approximates to high water mark) indicates that fresh water is virtually absent from the sediments and that the water table is an almost horizontal surface at sea level, in hydrological continuity with seawater.

Site 2

This site is located on the sandy track about 400 m east of Site 1. Two screens (slot openings 0.18 mm and 0.25 mm) of total length 1.2 m were installed to a depth of 3.7 m. The hole was pumped at a rate of 14 *l*/min for two hours. The water was initially muddy, but cleared rapidly on pumping. The water contains dissolved H_2S gas. (Hydrogen sulphide is a common constituent of groundwater in coastal sands, where it forms from the decomposition of original organic matter in the sediments. The gas is rapidly removed by simple aeration at the site and its occurrence does not affect the potability of the water. The subsequent analysis of the sample contained no H_2S). Small amounts of air were pumped from the hole, indicating that the yield and resulting drawdown were excessive. The safe pumping rate of the bore is considered to be about 10 *l*/min. Such a rate could be maintained indefinitely.

The water analysis (Table 2) indicates that the water is suitable for all domestic purposes, including drinking. The hardness of 170 mg/*l* is relatively high and is expected to cause encrustations ("scale") on electric heating elements (e.g. kettles and urns). The iron content of 0.7 mg/*l* is in excess of that normally recommended for domestic supplies.

No water sample was collected for biological analysis, but sand aquifers are excellent filter systems and in common with other Tasmanian coastal sands, the water is expected to be free of deleterious biological constituents.

Site 3

A 1.2 m length of screen (slot opening 0.18 and 0.25 mm) was installed to a depth of 2 m in the swampy area west of French's Farm. The area was wet at the time, with the water table at the ground surface. The hole maintained a pumping rate of 6 *l*/min. Initially muddy, the water cleared rapidly to a pale yellow colour, indicating the probable presence of dissolved humic acids. The analysis of the water (Table 2) indicates that it is high in

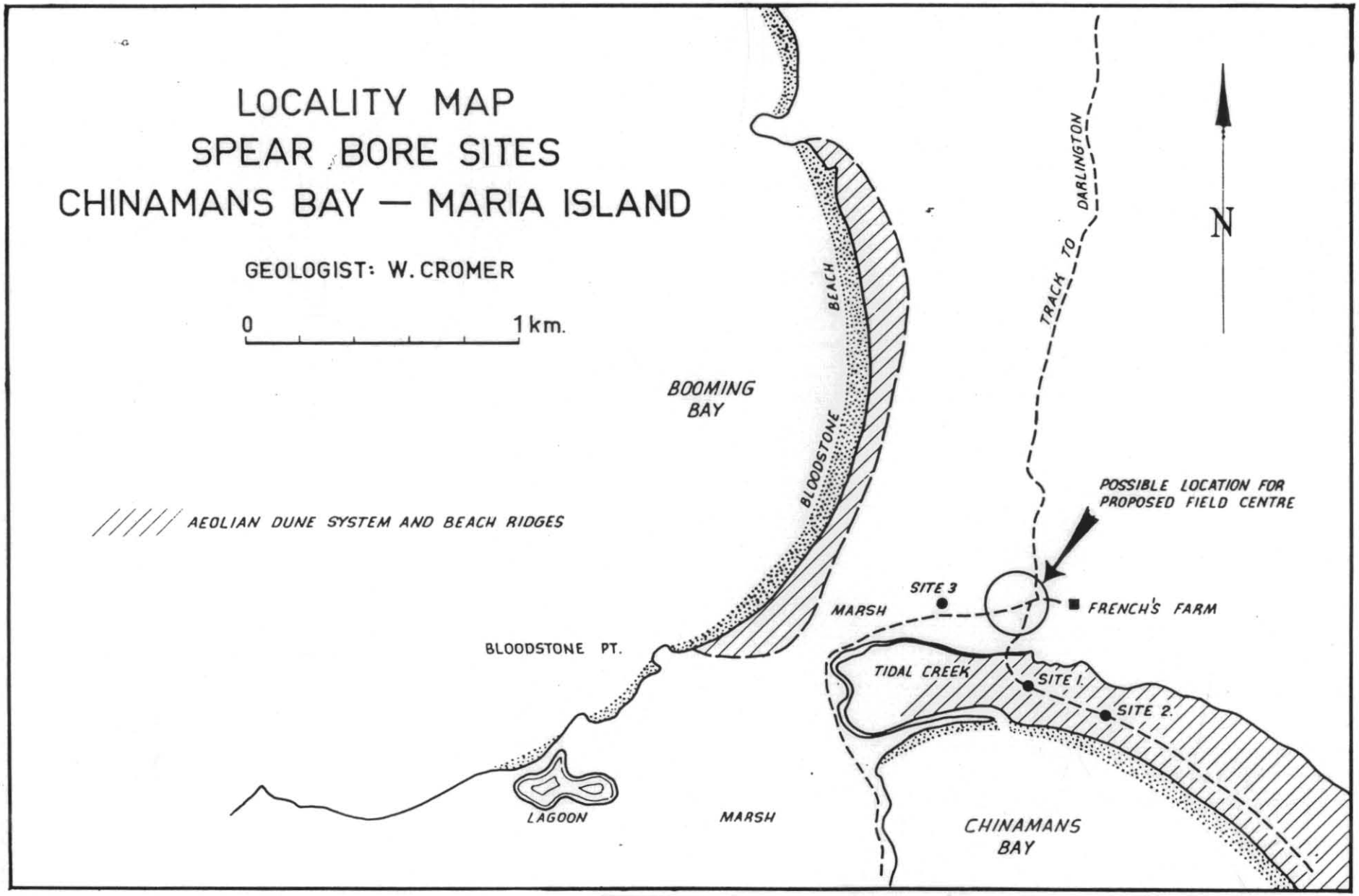
LOCALITY MAP
SPEAR BORE SITES
CHINAMANS BAY — MARIA ISLAND
GEOLOGIST: W. CROMER
0
1 km.
BOOMING BAY
BEACH
BLOODSTONE
TRACK TO DARLINGTON
N
POSSIBLE LOCATION FOR PROPOSED FIELD CENTRE
AEOLIAN DUNE SYSTEM AND BEACH RIDGES
SITE 3
MARSH
FRENCH'S FARM
BLOODSTONE PT.
TIDAL CREEK
SITE 1.
SITE 2.
LAGOON
MARSH
CHINAMANS BAY
5 cm

Figure 1.

3/6

dissolved constituents, and is unfit for most purposes except toilet facilities. The high salinity probably results from contamination with seawater, as the site is low lying and is adjacent to a tidal creek channel.

CONCLUSIONS AND RECOMMENDATIONS

The area east of, and including, site 2, contains a large supply of potable groundwater which is more than sufficient for the proposed development at Chinamans Bay. Low lying areas west of French's Farm contain large amounts of water, but the quality is influenced by tidal effects which cause seawater contamination of the fresh-water supply. For similar reasons, the sand dune system west of site 2, near site 1, contains saline water differing only marginally from seawater.

It is recommended that the groundwater supply be tapped by either of two methods.

Spears. Small diameter (40-50 mm) screened bores installed to about 3-4 m below the water table are hydrologically the most efficient means of extracting water from unconsolidated sand. At Chinamans Bay, a single spear will be capable of continuously supplying about 10 *l*/min of water, and additional yields can be easily obtained by adding extra spears to the system. Spears are unsuitable for windmill pumping (because of their small diameter) and it is necessary to install either electric, or petrol or diesel pumps. The entire system - pump included - can be buried beneath ground.

Wells. A well is probably marginally cheaper to install than a spear, and it can be effectively utilized by a windmill. However installation is slower and more difficult, yield is lower, and the well is susceptible to inadvertant contamination and deliberate vandalism.

In an isolated area such as Chinamans Bay, where both wind power and petrol motors will at times be unreliable, it may be judicious to install either two wells, or a spear and a well, with provision for both windmill and petrol pumps. Any site east of, and including site 2, is a suitable locality for installing the system.

[15 November 1977]

Table 1. LOGS OF SPEAR BORE HOLES, CHINAMANS BAY, MARIA ISLAND.

Spear 1 [EN856768] On sandy track, across bridge from French's Farm.
Standing water level : 1.84 m.

Depth (m)	*Description*
0-1	White, medium grained aeolian quartz sand.
1-1.2	Harder, brown partly cemented and iron-stained quartz sand.
1.2-2	White medium grained aeolian quartz sand.
2-4	Buff-light brown medium-fine grained marine(?) sand containing rare angular quartzite fragments.
>4	Possibly a clay or sandy clay base.

Spear 2 [EN860767] On sandy track.
Standing water level : 1.65 m.

Depth (m)	*Description*
0-0.3	Pale grey-white medium grained aeolian quartz sand.
0.3-1.5	Brown-buff aeolian quartz sand.
1.5-1.8	Dark brown, partly cemented iron-stained quartz sand.
1.8-3.5	Medium grained brown-buff marine(?) sand, becoming finer towards 3.5 m; fragmented shells abundant near 3.5 m.
3.5-3.8	Fine grey shelly sand, grading possibly to grey clay.

Spear 3 [EN854772] Near track, 0.5 km west of French's Farm.
Standing water level : 0.0 m.

Depth (m)	*Description*
0-0.2	Grey sandy loam, humus
0.2-1	Grey-white medium grained aeolian(?) sand
1-1.2	Medium-grained yellow-buff marine sand
1.2-3	Grey-brown shelly marine sand; shells abundant near 3 m.

Table 2. WATER ANALYSES, COASTAL SANDS, CHINAMANS BAY.

Constituent	Site 1 772650[2]			Site 2 772649			Site 3 772648		
	mg/l[3]	meq/l[4]	%meq/l[5]	mg/l	meq/l	%meq/l	mg/l	meq/l	%meq/l
CO_3	-	-	-	-	-	-	-	-	-
HCO_3	380	6.23	0.6	150	2.46	16.2	450	7.38	6.1
Cl	16500	465	44.4	170	4.79	31.5	1630	45.9	38.1
SO_4	2410	50.1	4.8	6.1	0.13	0.85	220	4.58	3.8
SiO_2	12.8	-	-	12.4	-	-	10	-	-
Ca	700	34.9	3.3	45	2.25	14.8	180	8.98	7.5
Mg	1200	98.7	9.4	13.9	1.14	7.5	130	10.7	8.9
Fe	0.7	0.04	0.0	0.7	0.04	0.3	0.7	0.04	0.0
Al	<0.2	<.02	0.0	<0.2	<.02	<0.1	<0.2	<.02	0.0
K	380	9.72	0.9	6.7	0.17	1.1	42	1.1	0.9
Na	8800	383	36.6	97	4.23	27.8	960	41.8	34.7
H_2S	-			-					
TDS	34500	1048		590	15.23		4000	121	
Hardness[6]	6600			170			980		
Alkalinity[6]	310			130			370		
Conductivity	36500 mhos			700 mhos			4950 mhos		
pH	7.5			7.0			8.0		
Collection Date	2.8.77			3.8.77			3.8.77		

1. Analyses by Department of Mines Laboratory, Launceston.
2. Department of Mines Registered number.
3. Concentration of constituent in milligrams per litre.
4. Concentration of constituent in milligram equivalents per litre.
5. Concentration of constituent in percentage milligram equivalents per litre.
6. Hardness (total) and alkalinity calculated as $CaCo_3$.