

1981/30. Groundwater investigation, Mount William National Park, north-east Tasmania

W.R. Moore

Abstract

Nine campsites were investigated for groundwater in the Mount William National Park. Six of these sites were on the coast and have to rely on shallow coastal sand aquifers using small diameter spear bores. Three sites were inland; two were underlain by highly fractured sediments and the third by porphyritic granite.

Eight shallow auger holes were drilled on the coastal sites. At six of these, investigation spear bores were jetted and pump tested where the yield and water quality warranted testing. At three of the campsites adequate supplies of drinkable water were found, while at a fourth site the spear bore gave a marginal yield, but the site has potential for improving on this yield. In the remaining two sites the water was too saline and brackish to be of any use.

Of the inland sites, the Ranger's house site, underlain by fractured sediments is the only site recommended for drilling a deep bore. A spring surface collector is recommended for the site in the granite area.

INTRODUCTION

At the request of the National Parks and Wildlife Service a groundwater investigation was carried out from April 14 to April 17 on a series of campsites in the Mount William National Park, 18 km east of Gladstone in north-east Tasmania. The general locations of where groundwater would be required were indicated by K. Harmon of the National Parks and Wildlife Service. The sites investigated, together with the campsite names, are shown in Figure 1.

Six of the sites are located on the coast and will have to rely on shallow spear bores in Recent coastal unconsolidated sand sediments that form the narrow small beaches between the granitic rocks of the points and promontories along the coast. Thin drape deposits of sand are also present on the inland side of these granitic knolls. The remaining three sites are inland along Musselroe Road, which forms the northern boundary of the park, and will have to rely on deep rock bores drilled in rock fracture aquifers.

PREVIOUS INVESTIGATIONS

In 1970-72 a geological and geophysical investigation was undertaken searching for tin and groundwater on the coastal plain area east of Mount William. The explored area extended from Stumpys Bay to Cobler Creek (Jennings, 1977). A limited drilling programme was undertaken for tin exploration and some of these bores gave groundwater yields of 40-75 l/min of good quality groundwater. The cost of redrilling these exploration bores and piping the water to the various campsites would be too costly for the National Parks and Wildlife Service resources.

In the Mount William National Park, the other known potential source areas for groundwater are the stranded longitudinal dunes near the coast in the Stumpys Bay area. These old vegetated dunes were geophysically

explored in 1971 with seismic and resistivity surveys (Leaman and Moore, 1973). These results warranted exploration drilling but unfortunately the drill was withdrawn from the Park because winter rains made the tracks impassible. Similar large diameter bores in old dunes in the Anderson Bay and Ringarooma Bay areas gave yields between 15-150 l/min. Similar yields were anticipated from the large dunes in the Stumpys Bay area.

#### NATIONAL PARKS AND WILDLIFE SERVICE BORE REQUIREMENTS

Large diameter (127-150 mm) bores with 1.8-3.0 m screens are costly and their expense is only warranted where the water is used constantly, as in a household or for intensive irrigation for cash crops. This type of bore is not suitable for isolated campsites as exist in the Park. Small diameter (40-50 mm) bores of 8-15 m depth with low yields of between 10-40 l/min are more suitable to the Park's requirements. Such bores are inexpensive and easy to maintain, and with tuition may be installed by the Park's staff.

#### INVESTIGATION PROGRAMME

The coastal sites are all dependant on the presence of coastal sand for potential supplies of groundwater either as drape deposits over the granitic knolls or as old beach deposits. The amount of groundwater present in this sand will depend on the thickness of the deposit (to form an adequate unconfined aquifer), as well as the properties of the sand such as grain size, sorting, and the presence of a clay aquiclude layer above the granite. The lack of such a clay layer allows the sand to be free draining and no water is collected in the overlying sand deposit.

With granitic rocks cropping out so profusely along the Mount William section of the coast it was anticipated that the coastal sand deposits would be thin and of limited areal extent. Therefore the best method of exploring these deposits was to drill as many of the possible sites using a small 'Triefus' portable trailer-mounted auger drill. To see the changes in the lithology and collect samples from the correct depth, the auger was withdrawn from the hole at the end of each 1.8 m flight. Where possible, each hole was drilled to bedrock. Eight holes were drilled on the seven coastal campsites. The logs of these boreholes are given in Appendix 1.

Of these holes, six had an adequate thickness of sand and groundwater was encountered. Investigation spears were washed down these holes, using a 1.8 m screen of two mesh gaps at 0.015 mm and 0.007 mm. Where the yield was satisfactory and the water had a satisfactory conductivity, a short pump test was run. The results of these investigation holes are given in Appendix 2. Of these six holes, only one would not clear and the water was so brackish and discoloured that it was not collected for chemical analysis. The chemical analyses are given in Appendix 3.

The three inland sites were inspected but no drilling was undertaken. From the surface geology, only one of these sites warrants the expense of further geophysical investigation and possible subsequent drilling; this is the site for the Park Ranger's proposed house. Resistivity soundings and a refraction seismic survey should be undertaken before drilling; as no funds had been allotted, these investigations were not undertaken on this occasion.

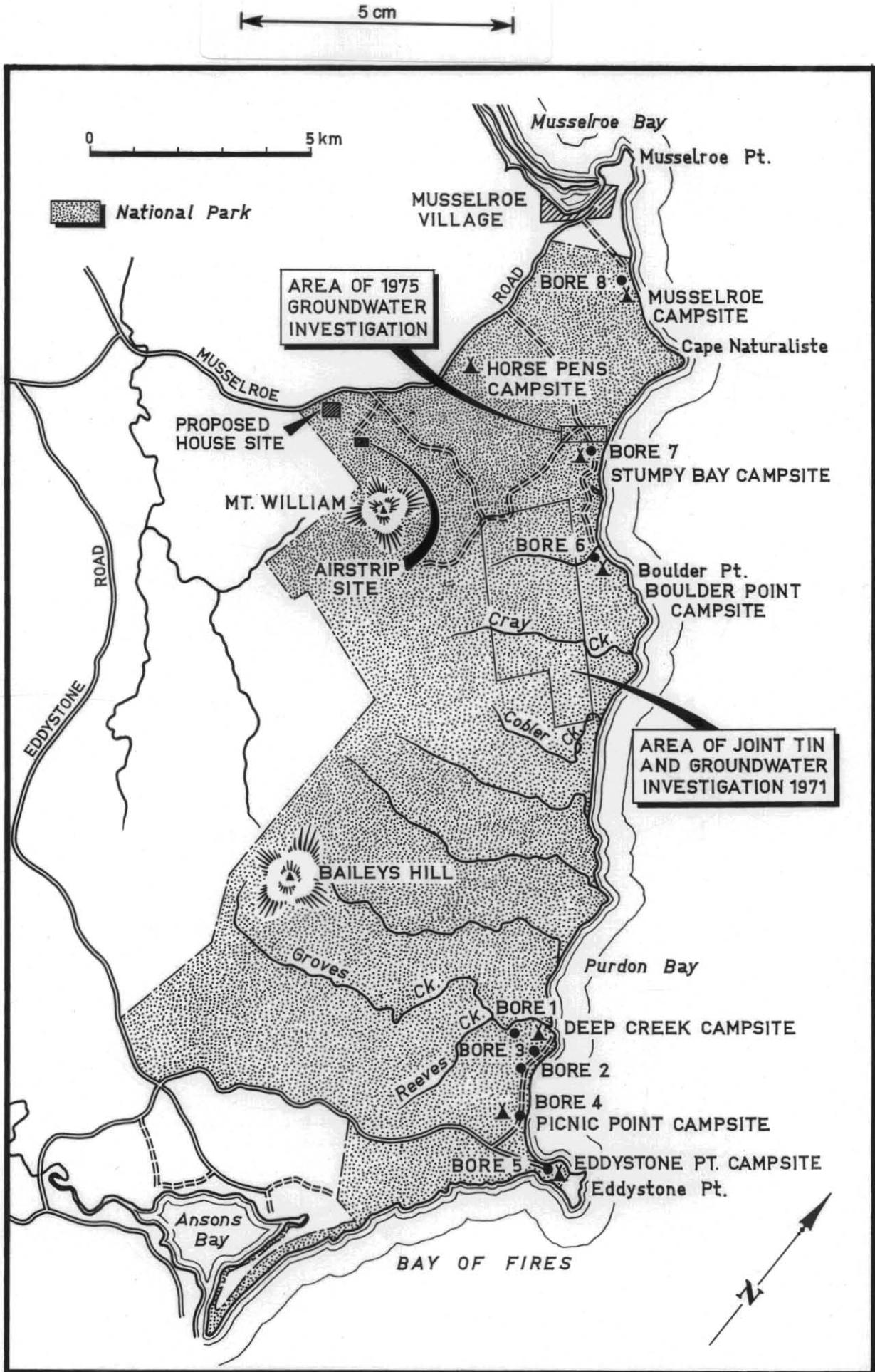


Figure 1. Location of investigations, Mt William National Park.

4/23

## SUBSURFACE INVESTIGATION

### COASTAL SITES

#### *Picnic Rock campsite*

Three exploration holes were augered in the vicinity of this campsite.

Bore 1 was sited below the junction of Reeves Creek and Groves Creek where a narrow flood plain is present. It was hoped that the sand would be sufficiently thick and areally extensive so that the contained fresh water would prevent salt water infiltration from the creek. The groundwater prospects of this area appeared very limited. Granite formed a rock bar at the creek mouth, and possible outcrops of granite appeared in the stream bed itself, indicating that the sand was thin at this locality. On drilling, only 1.2 m of sand overlain by a sandy clay was present, with granite at 2.7 m depth. The hole was dry.

Bore 2 was drilled on the edge of a marsh on an old lagoonal flat, which is present behind the pocket beach between Picnic Rocks and Picnic Point, approximately 500 m south of the Deep Creek campsite. There was 7.3 m of sediment above the granite at this site, of which 6.7 m was sand, with a layer of black organic fine sand occurring at the surface. This bore was pumped at 32 l/min for approximately 30 minutes before running dry; the water level recovered quickly after two minutes to the 2.4 m level.

A production bore could be developed on this site that would pump up to 20 l/min of water, with the correct screen size, and gravel packing. Unfortunately the water quality was poor, with 2450 mg/l total dissolved salts (TDS). The concentrations of NaCl and MgSO<sub>4</sub> are too high for the water to be of any use for camping purposes.

Bore 3 was sited on the south side of Deep Creek campsite at the foot of a coastal knoll, on which drape sand deposits have accumulated on the inland side. Nearly eight metres of sand were drilled before granite was encountered. No clay or clayey sand was present between the granite and the overlying sand. Because of the lack of a clay horizon and the likelihood of a slope on the granite, the sand at this locality is likely to be free draining. The bore was pumped at 15 l/min for fifteen minutes. Recovery was reasonably fast; within two minutes of stopping the pump, the water level had risen from 4.6 to 3.2 m. The water quality is marginal as drinking water; humans can drink water with a total salt content of up to 1000 mg/l for short periods, but less than 500 mg/l is the more acceptable level with less than 200 mg/l for town supply. With the full depth of the aquifer being used, a low yielding production spear bore could be developed on this site which would produce between 7.5-11.5 l/min of water. There is a possibility that such a bore could become dry with continuous pumping for several days in a dry summer.

If a production spear bore is to be installed on this site, a more accurate appraisal of the aquifer's potential would be desirable. It is recommended that the site be re-drilled and the hole pump tested for twenty-four hours with two observation holes drilled to the water table.

*Eddystone Point sites*

Bore 4 was located near the junction of the tracks to the Deep Creek and Picnic Point campsites. Though situated in a shallow hollow, granite outcrops surround the area. Only 1.8 m of sand with a basal granite gravel layer was drilled before granite was encountered. No groundwater was present at this site.

Bore 5 was drilled at the Picnic Point campsite at the foot of the granitic ridge that forms Eddystone Point. Seven metres of sand were drilled, followed by a thin horizon of granitic boulders and gravel above the granite. In the middle of this sand sequence was a 1.9 m thick horizon of very fine black organic sand. The water from this bore was black to very dark brown in colour; consequently no serious attempt was made to pump test the bore. The conductivity meter measured 540 mg/l TDS but the water was so discoloured by organic stain that a sample was not collected for analysis.

Further exploration will have to be undertaken in this locality to find an alternative site.

*North coastal sites*

Bore 6 was located near the junction of the track leading to the campsites at Boulder Point and the main track south to Cray Creek and Cobler Rocks.

Six metres of mainly fine sand were drilled, with a basal micaceous clay layer present above the granite. The bore was pump tested for thirty minutes at 8-10 l/min. The drawdown during this test was four metres from a standing water level of 2.7 metres. The water level recovered rapidly after stopping the pump, and within five minutes was within 100 mm of the original standing water level. The water is suitable for drinking, but will probably require aeration because of the strong hydrogen sulphide smell. The bore continued to pump fine sand throughout the pump test.

This is a good bore and a production bore would give a similar yield of 8-10 l/min. A production bore would require gravel packing to overcome the sand pumping problem. Spear bores are now being used extensively for water supplies for beach shacks from Bellingham to Ansons Bay in similar fine sand and their yields are in a similar range.

Bore 7 was located on the eastern edge of the Stumpys Bay campsite at the foot of the east-west longitudinal vegetated dune. The sand in this bore, in contrast with other bores, was not fine-grained, but had a coarse to medium grain size. The thickness of the sand was less than other sites, with an aquifer of only 1.5 m thick. The test bore was clearly overpumped at 34 l/min, but because of mechanical breakdown, a smaller pump was not available. The water is marginally acceptable for drinking, with a total dissolved salt content of 590 mg/l, of which 395 mg/l are common salt.

Although the results of the pump tests are not conclusive, it is considered that a production bore at this locality would produce at least 8 l/min of water from the 1.5 m of sand aquifer.

The area appears to warrant further investigation drilling to see if a site could be found where the thickness of the aquifer increases to 4-6 metres. Given that this thickness of aquifer could be located, the yield could be increased to 35-45 l/min.

Bore 8 was located two kilometres from Musselroe village on the Cape

Naturaliste track. The bore was drilled back from the beach on the coastal plain and 200 m from the campsite. The bore was drilled in lithologically different sediments from the other bores in that the sand, except for the surface layer, was not clearly a beach deposit. The sand has a low percentage of clay which increases towards the bedrock. It is also micaceous with shell fragments in the clayey sand layers above the presumed granite surface.

The aquifer is seven metres thick with a standing water level of 1.7 metres. The bore was pump tested for thirty minutes at a rate of 34-36 l/min, and the water level fell to 3.7 metres. The recovery was rapid and returned to 2.1 m in ten minutes. Except for a slight discolouration, the water is suitable for drinking, with a total dissolved salt content of 375 mg/l.

This is a good bore and gravel packing of the production hole will probably clarify the water.

*INLAND SITES*

*House and airstrip sites*

The airstrip site and the Park Ranger's proposed house site are underlain by highly fractured sandstone and mudstone of the Mathinna Beds of Devonian age. Near outcrops of these sediments occur on nearby low hill slopes.

The sediments of the Mathinna Beds are the most reliable low-yielding rock fracture aquifer in north-east Tasmania. Bores in this sediment are seldom dry, except where they are close to granite contacts or intruded by quartz veins. In such cases, the fractures have been sealed by contact metamorphism and by hydrothermal solutions precipitating quartz. To see if these two conditions are present at a site, refraction seismic spreads and resistivity soundings are generally undertaken before selecting a drill site. These hard rock holes need to be drilled 40-80 m deep, of which the upper 10-15 m may require casing.

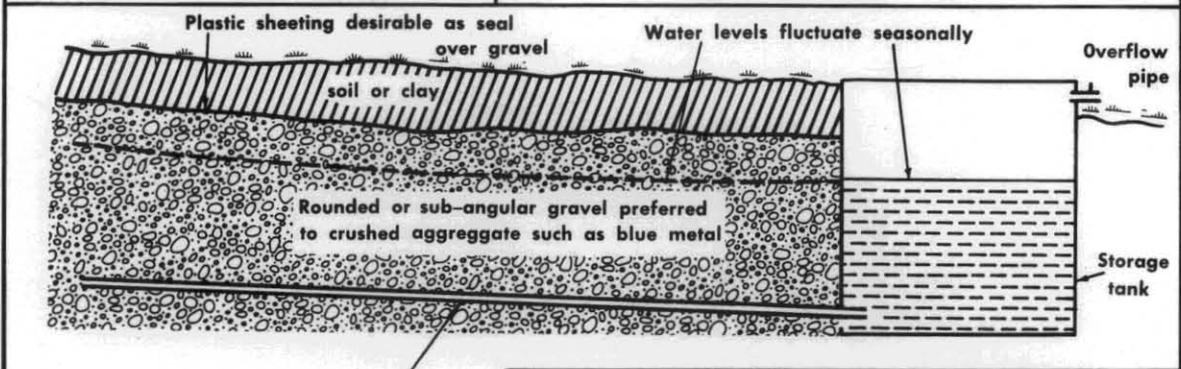
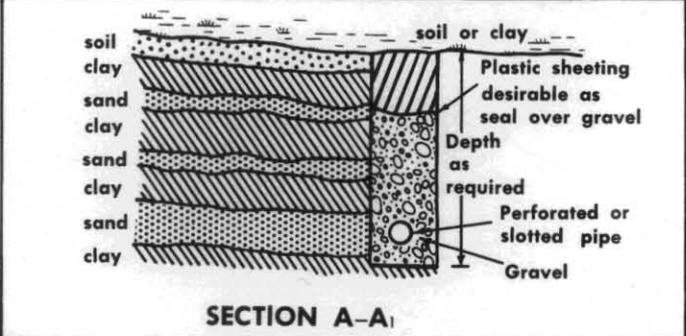
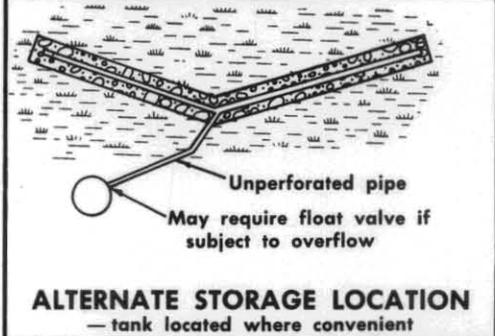
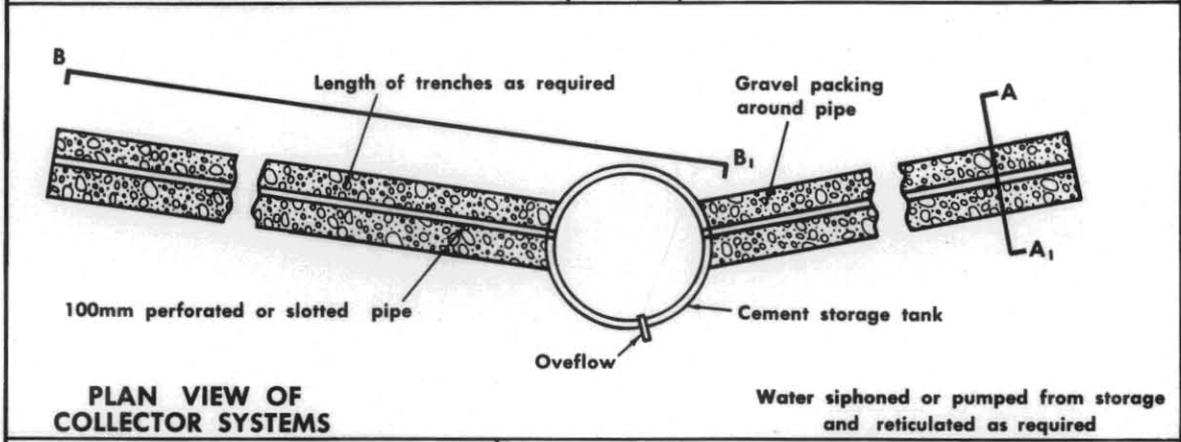
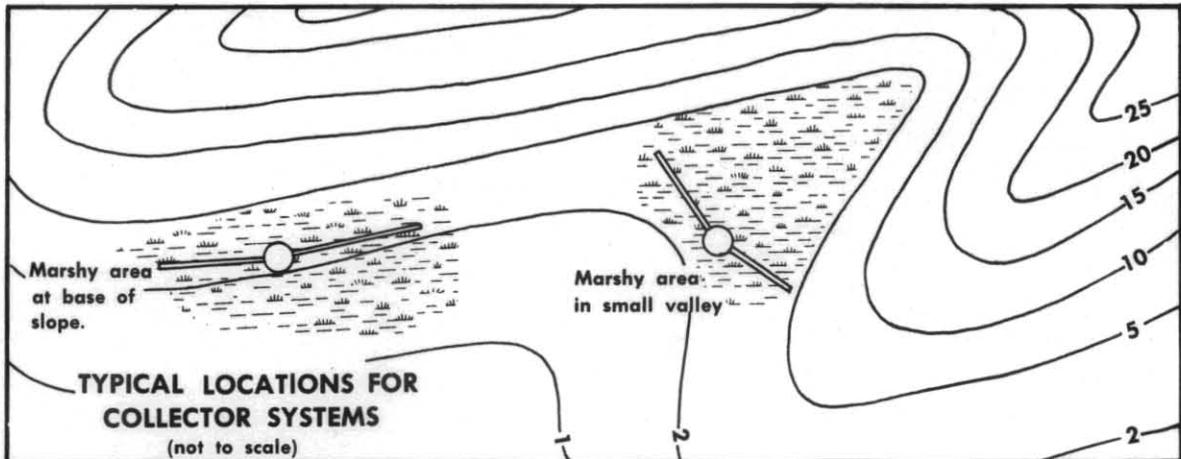
With cost of drilling being so high, only the proposed house site is likely to be considered.

*Horse Pens campsite*

This site is in a porphyritic granite area with this rock forming low hills above alluvial flats. Groundwater has been obtained from this rock type, but rarely in north-east Tasmania. The success rate of bores drilled in granite of all types in the north-east is very low (less than one in five holes).

A series of small localised springs are situated near the break in slope between the alluvial flats of sand and silt and the low granite hills close to where the horse pens are situated. This site would be better served by a surface spring collector system, as used widely in New South Wales.

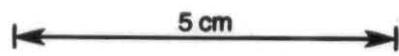
A bore in granite would be expensive, needing 50-100 m drilling to ensure success. Two or more bores may be required. The collector system, as shown in Figure 2, would cost far less and could be built and sited by the staff of the Mount William National Park.



Little gradient of pipe is required  
1:100 should be adequate

WATER RESOURCES COMMISSION  
HYDROGEOLOGICAL SECTION - WATER RESOURCES BRANCH  
**SHALLOW GROUNDWATER COLLECTOR SYSTEMS**  
NOT TO SCALE

Figure 2.



8/23

## SUMMARY

### *Southern coastal sites*

*Deep Creek campsite.* Only one site explored (bore 3) is considered to have potential as a production spear bore site. Here a low yielding bore of 7.5-11.5 l/min is possible. The water is not ideal for drinking, but is just outside the range considered possible for town supply in the arid areas of Australia (i.e. Alice Springs 500 mg/l TDS compared with bore 3, 590 mg/l TDS).

Further pump tests with observation holes will be required. The aquifer appears to be of limited areal extent and appears to lack area for recharge. If larger quantities of water are required, some storage tanks may be required into which the bore water can be pumped.

Of the other two sites tested, bore 2 gave adequate supplies but the groundwater was too saline. In bore 1, little sand was present and it was dry.

*Picnic Point and Eddystone Point campsites.* No potential sites that gave good quality groundwater were found in this area. Where water was found, as in bore 5, it was so discoloured and brackish that it was of no use. The area is difficult as much of it has little sand cover, and the area needs further exploration drilling and testing, particularly to the south of Eddystone Road.

### *Northern coastal sites*

*Boulder Point campsite.* This site is suitable for a low yielding spear bore with yields of 8-10 l/min, producing good quality water with a total dissolved salts content of 310 mg/l. The groundwater from this bore will require aeration. In view of the low yield, it is best that the bore be pumped for long periods at a low rate into a tank, with the outlet of the bore situated above the tank. The water should cascade from this outlet pipe over a small race so it can be aerated successfully. This method will rid the water of the offensive hydrogen sulphide smell. The bore should be gravel packed to reduce the amount of fine sand being pumped.

*Stumpys Bay campsite.* This site appears to have greater potential than indicated from the existing results. Further exploration drilling should be undertaken as it is thought that yields higher than the 7.5 l/min achieved from the brief pump test at the investigation bore can be improved. At this site the coastal sands were thin and their thickness should increase inland along the longitudinal dune. In retrospect this bore was poorly located.

*Musselroe campsite.* This site had the best located bore in the current investigation. In a production spear bore with correct screen size, the yield is likely to increase from that tested in the investigation bore (34-36 l/min).

The water is drinkable and the slight cloudiness is likely to be diminished by gravel packing and continual pumping.

### *Inland sites*

The Park Ranger's proposed house site is the only one of these three sites that warrants drilling. The bore will be drilled into

9/23

fractured sediments of the Mathinna Beds. The location of the bore will be dependent on a geophysical investigation. The water quality is normally good for these sediments, except occasionally at some locations where a high ferrous ion content occurs that causes rust to appear when the water is exposed to the air.

The airstrip site has the same potential for groundwater as the house site, but the expense of drilling a hard rock bore for a campsite would not be justifiable. If any excess water is available from a bore at the house site, it could be piped to the airstrip campsite for little cost.

Horse Pen campsite. This area is underlain by porphyritic granite. Granite is a high risk rock aquifer with extremely variable and unpredictable yields in north-east Tasmania. The water quality is invariably good from granite. It appears to the writer that a surface collector system from the known springs is a more feasible scheme at this locality.

### COSTS

#### *Spear bores*

The current price for stainless steel screens of 50 mm diameter for 1.8 m length varies between \$150-\$160, depending on the fineness of the mesh gap required. Smaller diameter screens are available, but they have been found to be less successful in the fine-grained coastal sands of north-east Tasmania. As well as a screen, a wash-down nipple (\$20.00) is required for each screen, plus varying lengths of heavy duty PVC 50 mm piping. The total cost of a spear bore varies between \$200-\$250. This cost does not include the cost of the bore pump and its motor or windmill.

Placing the screens in gravel packing is a relatively simple operation with no complicated equipment required. National Parks and Wildlife Service staff could undertake to install the spear bores by themselves, once the technique has been demonstrated by Department of Mines personnel.

#### *Hard rock bore - Ranger's house site*

The current advertised drilling contractors price for a rotary drill using down-the-hole hammers varies between \$30-\$60 per metre for a 127-150 mm hole. A further cost is an extra days work pump testing the bore. This is vital in order to obtain the correct pump size and the level below which the pump should be placed. All of this should be known before the permanent pump is installed. The normal practise of blowing air down the hole by a compressor and measuring its flow is not a reliable indicator of the bore's yield, yet this is the universal practice of all Tasmanian drilling contractors.

Additional to the drilling and pump testing costs will be the cost of casing for the hole, the bore pump, and its motor or windmill necessary to drive it.

The Department of Mines current drilling costs are \$1500-\$2500 per week, depending on the size of drill and compressor used. Given that the drilling rig does not have to travel a distance greater than 15-20 km, similar bores in the same rock type have been completed within 3-5 days in north-east Tasmania. To the drilling cost must be added the cost of the casing, which is heavy duty PVC 127 mm diameter piping. This casing costs, when last priced, \$60.00 per six metre length. Even though the hole is a hard rock fracture hole, which will stand up initially without casing,

trouble has developed in some uncased holes in Mathinna Beds after two-three years pumping, with small fragments falling in and damaging the bore pump or jamming in the hole. The cost of pump and motor etc. must be added to the Departmental drilling costs.

*Further geophysical and exploration investigation*

It is estimated the geophysical investigation of the Ranger's house site will take one day with two field assistants and one geologist. Materials used should be twenty electrical detonators and half a case of 6 mm diameter gelignite. The installation of two production spear bores is estimated at a day each using Department of Mines staff as above with the 'Triefus' trailer mounted drill. This work could be in conjunction with the National Parks and Wildlife Service staff. A further three days would be required exploring the Stumpys Bay and Eddystone Point areas. No costs are possible for this work as the costs and policy of charging other Departments has as yet to be finalised.

RECOMMENDATIONS

- (1) Consideration be given to allocating funds for a deep bore drilling and geophysical investigation of the Park Ranger's house site. These funds should be available during 1981 when a Department of Mines drill is likely to be drilling at Boobyalla Plains, thus avoiding the extra cost of moving a drill into the Park area.
- (2) Two production spear bores be installed at the Musselroe and Deep Creek campsites using Department of Mines staff and equipment. The materials required for these two bores should be funded by N.P.W.S., and the Park staff should be made available to learn the technique of installing spear bores.
- (3) A production spear bore be installed at the Deep Creek campsite and a twenty-four hour pump test be run with two observation holes used.
- (4) The Boulder Point campsite be redrilled and 102 mm PVC piping installed so that the Park staff can install the spear bore at a later date.
- (5) Further exploration drilling be undertaken at the Stumpys Bay campsite and casing be installed at the most successful location.
- (6) A further 3-4 holes be augered and tested for water quality in the Eddystone Point area. Any successful bores should be cased off.
- (7) The bores at Boulder Point - Stumpys Bay and hopefully in the Eddystone Point area be brought into production by the Park staff when funds are available.
- (8) The Horse Pens campsite be explored by the Park staff using a back hoe on the most likely spring localities. A surface collection system should be built if adequate supplies of water are available in the exploration cross trenches after a period with no rain.

## REFERENCES

JENNINGS, D.J. 1977. The search for tin at Mt William, in GROVES, D.I.; COCKER, J.D.; JENNINGS, D.J. 1977. The Blue Tier Batholith. *Bull. geol.Surv.Tasm.* 55.

LEAMAN, D.E.; MOORE, W.R. 1973. Geophysical survey, Mt William area. *Tech.Rep.Dep.Mines Tasm.* 16:86-88.

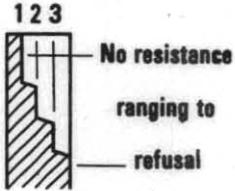
[25 May 1981]

12/23

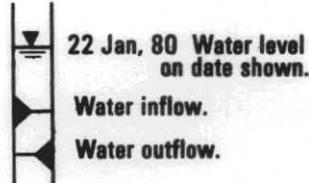
# EXPLANATION SHEET FOR ENGINEERING LOGS

## Borehole and excavation log

### Penetration



### Water



### Notes - samples and tests

- U50 Undistributed sample 50mm diameter.
- D Disturbed sample.
- N Standard penetrometer blow count for 300mm.
- N\* SPT + sample.

### Material classification

Based on Unified Soil Classification System.  
In Graphic Log materials are represented by clear contrasting symbols consistent for each project.

### Moisture content

- D Dry, looks and feel dry.
  - M Moist, no free water on hand when remoulding.
  - W Wet, free water on hand when remoulding.
  - LL Liquid limit.
  - PL Plastic limit.
  - PI Plasticity Index.
- eg. M > PL - Moist, moisture content greater than the plastic limit.

### Consistency

- | Consistency     | hand penetrometer (kPa) |
|-----------------|-------------------------|
| VS Very soft.   | < 25                    |
| S Soft.         | 25 - 50                 |
| F Firm.         | 50 - 100                |
| St Stiff.       | 100 - 200               |
| VSt Very stiff. | 200 - 400               |
| H Hard.         | > 400                   |
| Fb Friable.     |                         |

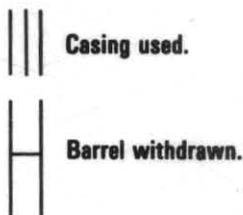
Notes: X on log is test result  
— is range of results.

### Density index

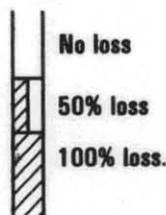
- | Density index    | %        |
|------------------|----------|
| VL Very loose.   | 0 - 15   |
| L Loose.         | 15 - 35  |
| MD Medium dense. | 35 - 65  |
| D Dense.         | 65 - 85  |
| VD Very Dense    | 85 - 100 |

## Cored borehole log

### Case - lift



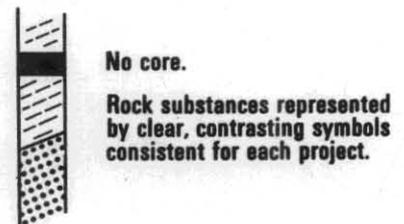
### Fluid loss



### Lugeons

Lugeon units (pL) are a measure of rock mass permeability. For a 48 to 74mm diameter borehole 1 Lugeon is defined as a rate of loss of 1 litre per metre per minute. 1 Lugeon is roughly equivalent to a permeability of  $1 \times 10^{-4}$  mm/sec.

### Graphic log



### Weathering

- Fr Fresh.
- SW Slightly weathered.
- HW Highly weathered.
- EW Extremely weathered.

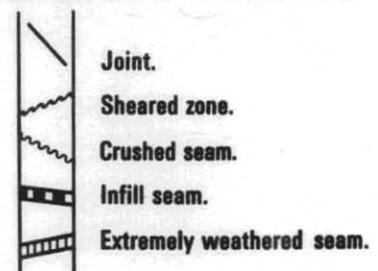
### Strength

- | Strength           | point load strength index $I_{s(50)}$ (MPa) |
|--------------------|---|
| EL Extremely low.  | < 0.03                                      |
| VL Very low.       | 0.03 - 0.1                                  |
| L Low.             | 0.1 - 0.3                                   |
| M Medium.          | 0.3 - 1                                     |
| H High             | 1 - 3                                       |
| VH Very high.      | 3 - 10                                      |
| EH Extremely high. | > 10  |

Note: X on log is test result.

### Significant defects

Significant defects shown graphically.





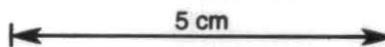
borehole no. 1  
sheet 1 of 1

13/23

# ENGINEERING LOG - BOREHOLE

project Groundwater investigation, Mount William National Park	location Deep Creek campsite, behind shacks	
co-ordinates FQ101634	drill type Triefus	hole commenced 7.4.81
R.L. Approximately 1 m a.s.l.	drill method Auger	hole completed 7.4.81
inclination Vertical	drill fluid Nil	drilled by B. Cox
bearing -		logged by W.R.M.
		checked by R.C.D.

penetration	support	water	notes samples, tests	metres	R.L.	depth	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency	density index	hand penetrometer kPa	structure, geology
1 2 3													25 50 100 200 400	
			Nil					SP	SAND. Fine, grey well sorted, quartz - Beach sand	D	VL			Beach sand
						1.0			Sand, iron-cemented layer. Dark brown					'Coffee rock'
	None					2.0		SC	SANDY CLAY. Clay - grey-green, low plasticity, micaceous. Sand very fine, approximates 30% of total.	M	S			Micaceous clay
		Dry				2.7			Stopped at refusal - granite					Granite
									[Logged visually]					

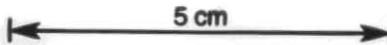


14/23

# ENGINEERING LOG - BOREHOLE

project	Groundwater investigation, Mount William National Park	location	500 m south of Deep Creek campsite on west side of track.
co-ordinates	FQ105625	drill type	Triefus
R.L.	Approximately 2 m a.s.l.	drill method	Auger
inclination	Vertical	drill fluid	Nil
bearing	-	hole commenced	7.4.81
		hole completed	7.4.81
		drilled by	B. Cox
		logged by	W.R.M.
		checked by	R.C.D.

penetration	support	water	notes samples, tests	metres		graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	hand penetr- ometer kPa	structure, geology
				R.L.	depth							
1 2 3			Grain size									
	None		S1		1	SP	SAND with some clay, poorly graded. Sand, fine, dark grey to black with organic material	D	VL			Organic lagoonal sand
			S2		2			W				
			S3		3							
			S2		4	SP	SAND, fine, brown. No clay present	W	VL			Sand
			S3		5							
			S4		6	SP	SAND, coarse, brown, well sorted	W	VL			Sand
						CL	CLAY, grey-green, low plasticity, micaceous	M	St			Clay
					7.3		Granite, deeply weathered	M	EW			Granite
							Drilled to refusal					
							[Samples logged visually. Grain size analyses of samples not available].					

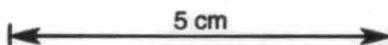


15  
23

# ENGINEERING LOG - BOREHOLE

Groundwater investigation, project Mount William National Park		location Deep Creek campsite, south side of campsite on track	
co-ordinates FQ105633	drill type Triefus	hole commenced 7.4.81	
R.L. Approximately 3 m a.s.l.	drill method Auger	hole completed 7.4.81	
inclination Vertical	drill fluid Nil	drilled by B. Cox	
bearing -		logged by W.R.M.	
		checked by R.C.D.	

penetration 1 2 3	support water	notes samples, tests	metres R.L. depth	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	hand penetr- ometer kPa 25 50 100 200 400	structure, geology
		Grain size	1.0		SP	SAND, fine, grey. Well sorted, wind blown beach sand.	D	VL		Beach sand
		S1	2.0		SP	SAND, iron cemented layer. Dark brown	D			'Coffee rock'
	None		3.0		SP	SAND, fine brown, well sorted	D	VL		Fine sand
		S2	4.0				W			
		S3	7.0		SW	SAND, coarse, brown. Grain size changes gradually	W	St		Coarse sand
		S4	7.9			Drilled to refusal. Presumed granite	D	H		Granite
						[Logged visually - grain size analyses not available at time of logging].				

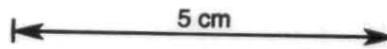


16/23

# ENGINEERING LOG - BOREHOLE

project	Groundwater investigation, Mount William National Park		location	Picnic Point campsite, junction of two tracks	
co-ordinates	FQ111612		drill type	Triefus	
R.L.	Approximately 1 m a.s.l.		drill method	Auger	
inclination	Vertical		drill fluid	None	
bearing	-		hole commenced	7.4.81	
			hole completed	7.4.81	
			drilled by	B. Cox	
			logged by	W.R.M.	
			checked by	R.C.D.	

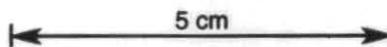
penetration 1 2 3	support water	notes samples, tests	metres		graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	hand penetr- ometer kPa	structure, geology
			R.L.	depth							
	None Dry	Nil		1.0		SP	SAND, fine, grey. Well sorted, poorly graded	D	VL		Beach sand
				1.7		GP	GRAVEL. Granite boulder, sand, pebbles.				Boulders
				2.0			Granite. Drill could not penetrate.				Granite
[Logged visually]											



# ENGINEERING LOG - BOREHOLE

project	Groundwater investigation, Mount William National Park	location	Eddystone Point campsite, at foot of climb to lighthouse settlement.
co-ordinates	FQ122610	drill type	Triefus
R.L.	Approximately 1 m a.s.l.	drill method	Auger
inclination	Vertical	drill fluid	None
bearing	-	hole commenced	7.4.81
		hole completed	7.4.81
		drilled by	B. Cox
		logged by	W.R.M.
		checked by	R.C.D.

penetration 1 2 3	support water	notes samples, tests	metres		graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	hand penetr- ometer kPa	structure, geology
			R.L.	depth							
	None	Grain size		1.0		SP	SAND, fine, grey, well sorted.	D	VL		Beach sand
		S1		2.0		SP	SAND, fine, brown. Well sorted with thin ironstone horizon.	W	VL		Brown sand
	Hole collapsed			3.0							
		S2		4.0		SP	SAND, fine, black. Very well sorted and very fine grade. Low percentage of silt (<1%). Organics high	W	VL		Black organic sand
				5.0							
		S3		6.0		SP	SAND, fine grey, well sorted.	W	VL		Grey sand
				7.0		GW	GRAVEL, pebbles and boulders of granite. None recovered by drill.	?	VD		Granite gravel
							Hole kept collapsing at 2 metres during drilling - consequently samples contaminated. Drilled to refusal at 7.5 metres.				Granite
							[Logged visually, grain size analyses of sample not yet available].				



18/23

# ENGINEERING LOG - BOREHOLE

project	Groundwater investigation, Mount William National Park		location	Boulder Point campsite		
co-ordinates	FQ042726		drill type	Triefus	hole commenced	7.4.81
R.L.	Approximately 3 m a.s.l.		drill method	Auger	hole completed	7.4.81
inclination	Vertical		drill fluid	None	drilled by	B. Cox
bearing	-				logged by	W.R.M.
					checked by	R.C.D.

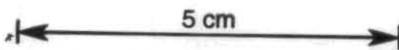
penetration 1 2 3	support water	notes samples, tests	metres R.L. depth	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	hand penetr- ometer kPa	structure, geology
	None	Grain size	1.0		SP	SAND, white, fine, well sorted. Poorly graded	D	VL		Beach sand
		S1	2.0		SP	SAND, brown. Medium grain size, well sorted. Iron stained.		VL		Sand
		S2	3.0				W			
		S3	4.0		SP	SAND, white, fine, well sorted. Some small rounded quartz pebbles, 1-4 mm diameter.	W	VL		Sand
		S4	5.0		CL	CLAY, grey-green, low plasticity with mica. Some granite fragments.	M	St		Micaceous clay
			6.0			Drilled to refusal.				
			7.0							
						[Logged visually. Grain size analyses not available].				



# ENGINEERING LOG - BOREHOLE

Groundwater investigation, project Mount William National Park.		location Stumpys Bay campsite	
co-ordinates FQ029757	drill type Triefus	hole commenced 7.4.81	
R.L. Approximately 2 m a.s.l.	drill method Auger	hole completed 7.4.81	
inclination Vertical	drill fluid Nil	drilled by B. Cox	
bearing -		logged by W.R.M.	
		checked by R.C.D.	

penetration 1 2 3	support water	notes samples, tests	metres R.L. depth	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	hand penetr- ometer kPa 25 50 100 200 400	structure, geology
	None	Grain size	1.0		SP	SAND, white, medium to coarse, well sorted.	D	VL		Beach sand
		S1	2.0		SP	SAND, brown, coarse, well sorted.		VL		Coarse sand
	Hole collapsed		3.0				W			
			4.0							
		S2	5.0		SC	SANDY CLAY, black, organic, medium plasticity. Abrupt change from sand to sandy clay.	M	F		Organic sandy clay
			6.0			Hole abandoned because of sandy clay layer.				
			7.0			Hole collapsed on withdrawal of augers.				
						[Visual logging, grain size analyses not available].				



20  
23  
borehole no. 8  
sheet 1 of 1

# ENGINEERING LOG - BOREHOLE

project	Groundwater investigation, Mount William National Park	location	Musselroe campsite, 2 km on Cape Naturaliste track
co-ordinates	FQ009780	drill type	Triefus
R.L.	Not known, about 3 m a.s.l.	drill method	Auger
inclination	Vertical	drill fluid	None
bearing	-	hole commenced	8.4.81
		hole completed	8.4.81
		drilled by	B. Cox
		logged by	W.R.M.
		checked by	R.C.D.

penetration 1 2 3	support water	notes samples, tests	metres		graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	hand penetr- ometer kPa	structure, geology
			R.L.	depth							
		Grain size				SP	SAND, dark brown, fine, well sorted. Organic material present.	D	VL		
		S1		1.0							
				2.0		SP	SAND with trace of clay, light brown, fine, sorted. Clay % low <5%.	D			
				3.0				W	VL		
		S2		4.0		SP	SAND with trace of clay, grey, very fine, micaceous, well sorted. Clay % very low <1%.	W	VL		
				5.0		SC	CLAYEY SAND, grey, very fine, mica- ceous. Clay % <12% Shell layer at base	W	VL		
		S3		6.0							
				7.0		SC	CLAYEY SAND, grey-green, fine, mica- ceous. Clay approx. 20%. Abundant shell fragments	W	VL		
		S4		8.0							
						Dg?	Drilling heavy, gravel or granite. Would not penetrate.				
		S5									

APPENDIX 2

Spear bore results

BORE 2

Location: 500 m south of Deep Creek campsite, west side of track

Depth of hole: 5.3 m; 50 mm diameter PVC casing and 1.8 m length of screen used

Screen gap: 0.015 mm

Standing water level: 1.41 m

Pumping rate: 32 l/min (480 gallons/hour)

Pumping duration: 25 minutes

Drawdown: 4.9 m

Recovery: 2.4 m two minutes after stopping pump

Water quality: Very poor - saline, unsuitable. 2450 mg/l TDS. No smell, water clear

BORE 3

Location: Deep Creek campsite

Depth of hole: 4.6 m; 50 mm diameter PVC casing and 1.8 m length of screen used

Screen gap: 0.015 mm

Standing water level: 2.8 m

Pumping rate: 15 l/min (200 gallons/hour)

Pumping duration: 15 minutes

Drawdown: 4.6 m

Recovery: 3.2 m two minutes after stopping pump

Water quality: Marginal for drinking. 530 mg/l TDS. H<sub>2</sub>S odour. Water slightly turbid after 20 minutes pumping.

BORE 5

Location: Eddystone Point campsite

Depth of hole: 5.6 m; 50 mm diameter PVC casing and 1.8 m length of screen used

Screen gap: 0.007 mm

Standing water level: 2.0 m

Pumping rate: 8 l/min (100 gallons/hour)

Pumping duration: 5 minutes

Drawdown: 4.7 m

Recovery: Not recorded

Water quality: Water black in colour and brackish, no sample collected

Appendix 2 (continued)

BORE 6

Location: Boulder Bay campsite  
 Depth of hole: 5.6 m; 50 mm diameter PVC casing and 1.8 m length of screen used  
 Screen gap: 0.007 mm  
 Standing water level: 2.7 m  
 Pumping rate: 8-10 l/min (100-120 gallons/hour)  
 Pumping duration: 30 minutes  
 Drawdown: 4 m  
 Recovery: 2.8 m five minutes after pump stopped  
 Water quality: Reasonable for drinking. 310 mg/l TDS. Strong H<sub>2</sub>S odour. Water clear, but fine sand pumped through screen

BORE 7

Location: Stumpys Bay campsite  
 Depth of hole: 5.3 m; 50 mm diameter PVC casing and 1.8 m length of screen used  
 Screen gap: 0.007 m  
 Standing water level: 2.4 m  
 Pumping rate: 34 l/min (450 gallons/hour)  
 Pumping duration: 5 minutes  
 Drawdown: 4.9 m  
 Recovery: 4.0 m five to ten minutes after pump stopped  
 Water quality: Marginal for drinking. 590 mg/l TDS. No odour, water clear

HOLE 8

Location: Musselroe campsite  
 Depth of hole: 5.3 m; 50 mm diameter PVC casing and 1.8 m length of screen used  
 Screen gap: 0.015 mm  
 Standing water level: 1.7 m  
 Pumping rate: 34-37 l/min (450-480 gallons/hour)  
 Pumping duration: 30 minutes  
 Drawdown: 3.7 m  
 Recovery: 2.1 m ten minutes after stopping pump  
 Water quality: Reasonable for drinking. 370 mg/l TDS. No odour, slight discolouration

20/23

APPENDIX 3

Chemical analyses of groundwater, Mount William National Park

Spear No.	2	3	6	7	8
Location	Deep Creek	Deep Creek	Boulder Point	Stumpys Bay	Musselroe
Registered No.	811869	811868	811867	811866	811865
pH	5.8	5.0	5.6	6.5	6.3
Conductivity ( $\mu$ S/cm)	2800	730	380	800	520
<i>Item (mg/l)</i>					
CO <sub>3</sub>	Nil	Nil	Nil	Nil	Nil
HCO <sub>3</sub>	115	3.9	7.1	83	115
Cl	995	260	125	250	130
SO <sub>4</sub>	145	24	17	35	16
SiO <sub>2</sub>	23	7.7	9.3	13	14
Ca	68	11	4.3	26	34
Mg	80	16	8.6	17	7.6
Fe	0.3	0.1	0.1	<0.1	<0.1
Al	2.6	0.3	0.3	<0.2	<0.2
K	14	2.8	2.3	7.7	3.7
Na	540	140	66	145	80
TDS	2450	530	310	590	370
Permanent hardness	320	92	42	67	20
Temporary hardness	96	3.2	5.8	68	96
Alkalinity (as CaCO <sub>3</sub> )	96	3.2	5.8	68	96
Sample date	9.4.81	9.4.81	9.4.81	9.4.81	9.4.81