

1981/11. Preliminary groundwater investigation at Carlton Beach

R.C. Donaldson

Abstract

Investigations have shown that the Quaternary dune deposits at Carlton Beach comprise a sequence of aeolian, marine, and estuarine sediments which are capable of yielding a small but useful quantity of water which could be used to supplement domestic supplies. Salinities were found to range between 150 and 20 000 mg/l and spear bore yields from 36 l/min to 76 l/min. First order estimates indicate that without depleting the volume of water in storage, the amount of water available for extraction would be about 1.5×10^4 m³/year.

INTRODUCTION

Scott and Furphy Engineers, consultants to the Sorell Municipal Council, requested that the Department of Mines undertake an investigation into the feasibility of obtaining groundwater for domestic usage from the sand dunes at the mouth of the Carlton River [EN520529 - EN533523]. The request followed advice that several coastal sand areas in Tasmania are known to be capable of yielding useful quantities of potable water for domestic consumption.

The investigation involved auger drilling and spear bore pump testing. Water samples were subsequently taken for analyses. This report describes the results of the preliminary investigation which was carried out between 16 and 18 December 1980.

RESULTS OF INVESTIGATION

*Geology**Surface conditions*

According to the regional geological map (Gulline, *in prep.*), the oldest rock unit exposed in the immediate vicinity of the area under investigation (fig. 1) is Jurassic dolerite, which forms Carlton Bluff, the headland on the southern side of the mouth of the Carlton River. Triassic sediments, mainly sandstone, crop out along the 20 - 30 m high escarpment to the north of the dunes and associated backwater areas. Tertiary basalt is exposed along the northern foreshore of the Carlton River opposite Steeles Island. A veneer of unconsolidated Quaternary deposits, mainly windblown (aeolian) sand, has blanketed much of the area behind the dunes, obscuring the underlying geology.

Subsurface conditions

The major part of the investigation was centred around a drilling (augering) programme, which aimed to establish the stratigraphy of the area, and determine the presence and nature of any freshwater aquifers.

The programme of seven auger holes (fig. 1) has shown that the area is underlain by a sequence of unconsolidated sediments considered to be of Quaternary age. At this stage, only a broad stratigraphic correlation has been attempted to enable the basic subsurface geology to be established.

In summary, the unconsolidated sediments consist of an interbedded

sequence of sand and minor clay which have been grouped into the following categories:

- (i) Aeolian sand deposit at the top of the sequence
- (ii) Sand possibly derived from the weathering of Triassic sandstone (Hole 1)
- (iii) Marine sand sequence with associated shelly lenses
- (iv) Estuarine (lagoonal or backwater) sand deposits with clayey sand, sandy clay and wood lenses.

The maximum known thickness of these sediments is 13.6 m (Hole 2), however the total thickness has not been established. Local basement (Triassic sandstone) was possibly encountered at 9.0 m at the bottom of Hole 1.

Detailed descriptions of materials encountered in Holes 1-5 are appended. The hole locations are shown on Figure 1.

Hydrology

Surface conditions

No permanent freshwater surface supply (creeks, waterholes etc.) exists within the area under consideration. The Carlton River is tidal at its mouth, and the marshy flats and intermittent ponds behind the main dune set have high salinities (in the order of 25 000 mg/l). At the time of the investigation, the marshy area was largely dry, presumably due to the low summer water tables.

Subsurface conditions

Groundwater conditions were investigated by installing sand spears which were pumped for short periods (up to 30 minutes) in Holes 2, 3, 4, and 5. The water table salinities of Holes 1, 4, 6, and 7 were considered too high to warrant pump testing (fig. 1).

The testing has shown that the aquifer:

- (i) has salinities in the range of about 150 mg/l to in excess of 20 000 mg/l
- (ii) is capable of supplying water to spears at rates of between 36 l/m (480 gal/hr) and 76 l/m (1000 gal/hr)
- (iii) has a small but useful body of potable water which is broadly delineated by Holes 2, 3, and 5.

Details of spears, depths, and yield rates are included in the appended log sheets.

Water samples collected from pump testing were submitted for chemical analyses; results are shown in Appendix 2.

In general terms, the groundwater is a medium salinity, moderately hard, highly alkaline water of the sodium chloride-calcium bicarbonate type. The high pH would need to be reduced for domestic consumption. The chloride

content in Hole 5 indicates that these waters may be corrosive, and the temporary hardness figures suggest that scaling could develop on the elements of hot water services. Analysis for bacterial content of the water to test its suitability for domestic drinking has not been undertaken.

DISCUSSION

From the outset of this investigation, the major concern has not been one of obtaining a groundwater supply from the dunes, but rather whether an adequate amount of water suitable for domestic consumption was available to service the local community.

The results of the spear bore testing programme indicate the prospective area is confined broadly to the western half of the survey area as outlined in Figure 1. The quantity of potable water contained in the dunes forming the spit (Steeles Island), east of the track terminating at the mouth of the Carlton River, is considered to be negligible; the area is narrow and surrounded by saline waters.

To service the Carlton area with a permanent and reliable groundwater supply from the dunes, careful groundwater management becomes critical. In essence, the aim should be to maintain existing reserves at a relatively constant level so the resource is not depleted. It is estimated that the amount of potable water in storage represents a minimum of about 10 years recharge (assumes a net recharge of 0.2 m/year to the minimum known depth of five metres from pump tests), so any large depletion of water reserves produces a long-term net water deficit which is not easily replenished.

Thus, using the premise that existing reserves should not be drawn on and that the resource would be managed on the basis that pumping does not exceed net recharge, first order estimates (Appendix 3) suggest that the area is capable of servicing only a few households permanently. Obviously by drawing on the reserves, this figure can be increased, but only in the short term.

CONCLUSIONS

This preliminary groundwater investigation has shown that the dunes at Carlton Beach contain a small body of water that could be suitable for domestic usage. It is estimated that without depleting the volume of water in storage, the amount of water available for extraction would be of the order of about 1.5×10^4 m³/year. It is evident, even using first approximation figures, that there is insufficient water to supply the Carlton area with a permanent reticulated water system. However, the area has the potential to usefully supplement existing domestic supplies. If it was decided that water was to be extracted from the dunes, even on an intermittent supplementary supply basis, further testing would be required to delineate the boundaries and properties of the aquifer.

[9 March 1981]

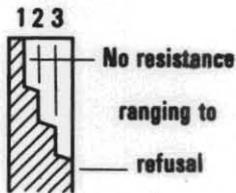
APPENDIX 1

Detail logs of auger holes

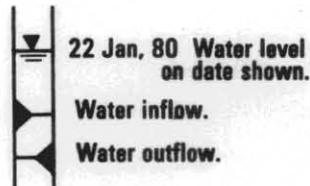
EXPLANATION SHEET FOR ENGINEERING LOGS

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

- | | | 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. | |

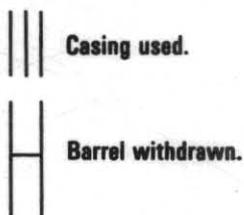
Notes: X on log is test result
— is range of results.

Density index

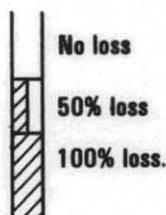
- | | | % |
|----|---------------|----------|
| VL | Very loose. | 0 - 15 |
| L | Loose. | 15 - 35 |
| MD | Medium dense. | 35 - 65 |
| D | Dense. | 65 - 85 |
| VD | Very Dense | 85 - 100 |

Cored borehole log

Case - lift



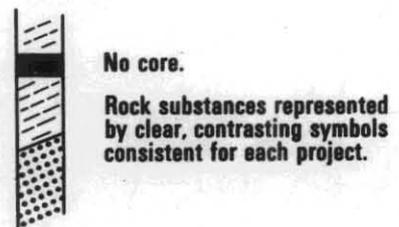
Fluid loss



Lugeons

Lugeon units (μL) 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 1×10^{-4} mm/sec.

Graphic log



Weathering

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

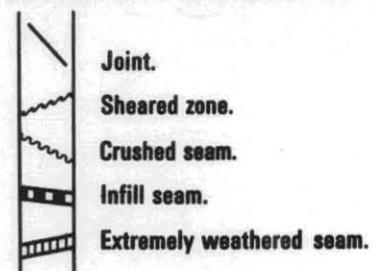
Strength

- | | | point load strength index $I_{5(50)}$ (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.



ENGINEERING LOG - BOREHOLE

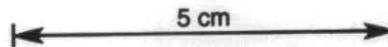
project **CARLTON RIVER GROUNDWATER** location **CARLTON BEACH**
 co-ordinates **REFER FIG 1** drill type **PROLINE** hole commenced **16 DEC 1980**
 R.L. **APPROX 1.84 M A.S.L.** drill method **AUGER** hole completed **16 DEC 1980**
 inclination **VERTICAL.** drill fluid **—** drilled by **M. TRIFFETT.**
 bearing **—** checked by **R. C. DONALDSON**
W. C. CROMER.

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
					OL	SILT: black, organic, some clay, many root fibres, trace of fine sand.	M>P				
					SP	SAND: Fine, yellow brown (10YR5/4), trace well rounded quartzite grains and angular rock fragments.	W	ND.			
			1		SP	Similar to above, colour change to dark greyish yellow (2.5YR4/2)					
			2		SP	SAND: Fine to medium, grey (9.5Y5/1), some dark minerals (fine), trace well rounded quartzite. Similar to above, sand fine, slight colour change to grey (5Y4/1)					
			3		SP	SAND: Fine, grey (7.5Y4/1), some whole and fragments of shell up to 20mm (bivalves), trace fine shell fragments. Larger fragments of shell occur mainly above 3.1 m interval.					
			4								
			5		SP	SAND: Fine, grey (5Y4/1), trace fine dark minerals.					
			6		SP	SAND: Fine, grey (5Y4/1), trace fine shell fragments.					
			7		SP	lens of woody fragments with some sandy clay - high plasticity, grey. SAND: medium, greyish olive (5Y4/2) trace coarse sand and gravel, trace weakly cemented sand fragments up to 15 mm.					
			8		SP	SAND: fine, greyish olive, trace fine dark minerals.					
			9		CH	CLAYEY SAND: fine to medium, olive black (10Y3/2) clay of high plasticity, some fragments of quartzite - grey, fresh, very high strength, sub angular.					
						DRILL REFUSED AT 9.0 M.					

ENGINEERING LOG - BOREHOLE

project CARLTON RIVER GROUNDWATER	location CARLTON BEACH.	
co-ordinates REFER FIG 1	drill type PROLINE	hole commenced 16 DEC 1980
R.L. APPROX 2.15m a.s.l.	drill method AUGER.	hole completed 17 DEC 1980
inclination VERTICAL	drill fluid —	drilled by M. TRIFFETT
bearing		logged by R.C DONALDSON
		checked by W.C. CROMER

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	
			Water Table Salinity 55mg/l.			SP	SAND: fine, dull yellow (2.5y6/3), trace fine dark minerals.	D				
		16.12.80		1			Similar to above - colour change to olive grey (2.5G7.5/2)	W	MD			
				2		SP	SAND: fine, dark greenish grey (7.5G4/4), some shell fragments to 20mm, some fine dark minerals.					
				3			SAND: fine, grey (10Y4/1), trace fine shell fragments and dark minerals. - shelly sand lens, fragments to 15mm.					
				4			Similar to above, slight colour change to grey (10Y5/1)					
				5		SP	SAND: fine, grey (10Y4/1), some shell fragments to 35mm (bivalves), trace fine dark minerals.					
				6		SP	SAND: fine, grey (10Y5/1), trace fine shell fragments and dark minerals.					
				7								
				8		SP	SAND: fine, grey (10Y5/1), some whole and fragments of shell to 20mm. Trace woody fragments.					
				9		SP	SAND: fine, grey (7.5Y5/1), trace fine dark minerals and organic matter.					
				10								



ENGINEERING LOG - BOREHOLE

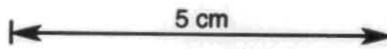
project				location							
co-ordinates				drill type		hole commenced					
R.L.				drill method		hole completed					
inclination				drill fluid		drilled by					
bearing						logged by					
						checked by					
penetration	support	water	notes samples, tests	metres R.L. depth	graphic log	classification 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	
				11		SP	SAND: fine grey (10y4/1), with thin lenses of grey sandy clay - high plasticity				
				12			lens of brown woody fragments.				
				13		SP	SAND: fine, olive grey (10y4/2), some clay (CH), trace organic matter, lenses of grey sandy clay. lens of brown woody fragments.				
							HOLE TERMINATED AT 13.6M, THE MAXIMUM LENGTH OF AUGERS.				
							NOTE: Spear jetted to 5.0m; pumped at 600g.p.h. for 30 minutes.				

ENGINEERING LOG - BOREHOLE

project **CARLTON RIVER GROUNDWATER** location **CARLTON BEACH**
 co-ordinates **REFER FIG 1** drill type **PROLINE** hole commenced **17 DEC 1980**
 R.L. **APPROX 287m A.S.L.** drill method **AUGER** hole completed **18 DEC 1980**
 inclination **VERTICAL** drill fluid **—** drilled by **M. TRIFFETT**
 bearing checked by **R. C. DONALDSON**
W. C. CROMER

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 25 100 200 400	structure, geology
			1		SP	SAND: medium some fine, dull yellowish brown (10YR5/4), trace dark minerals.		MD		
			2			Similar to above, colour change to dull yellow (2.5Y 6/3), sand fine to medium	M	W		
			3			Similar to before, colour change to dark greenish grey (10GY 3/5)				
			4		SP	SAND: medium some fine, olive grey (2.5GY 5/2), trace shelly fragments and dark minerals. - shelly sand lens. - fragments to 10 mm				
			5			- shelly sand lens. - fragments to 10 mm				
			6		SP	SAND: medium to fine, grey (10Y 5/1), some shelly fragments (5-15 mm), trace dark minerals. lens of woody fragments at 6.0m				
			7		SP	SAND: fine to medium, greyish olive (7.5Y 5/2), trace shell fragments and dark minerals. lens of shelly fragments @ 7.0m (5-10 mm)				
			8							
			9			Similar to above, slight colour change to grey (10Y 5/1)				
			10							

1800 x 50 x 25 mm screen



ENGINEERING LOG - BOREHOLE

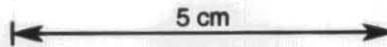
project				location							
co-ordinates				drill type		hole commenced					
R.L.				drill method		hole completed					
inclination				drill fluid		drilled by					
bearing						logged by					
						checked by					
penetration	support	water	notes samples, tests	metres R.L. depth	graphic log	classification 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	
				11			- lens of grey black CH clay (10y 3/2)				
							- lens of brown woody fragments				
				12			- lens of grey black CH clay				
							- lens of brown woody fragments.				
							HOLE TERMINATED AT 12.6 M, MAXIMUM AUGER LENGTHS.				
							NOTE: Spear jetted to 5.0m; pumped at 700g.p.h for 15 minutes.				

ENGINEERING LOG - BOREHOLE

project **CARLTON RIVER GROUNDWATER** location **CARLTON BEACH.**

co-ordinates **REFER FIG 1** drill type **PROLINE** hole commenced **18 DEC 1980**
 R.L. **APPROX 3.45M A.S.L.** drill method **AUGER** hole completed **18 DEC 1980**
 inclination **VERTICAL** drill fluid **—** drilled by **M. TRIFFETT**
 bearing logged by **R.C. DONALDSON**
 checked by **W. C. CROMER**

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	
				1		SP	SAND: medium to fine, dull yellow orange (10YR 6/4), trace dark minerals. Similar to above, slight colour change to greyish olive (5Y 6/2)	D	MD		
				2			Similar to before, colour change to grey (5Y 4/1), sand fine.	W			
				3		SP	SAND: fine, gray (5Y 5/1), trace shell fragments to 10 mm.				
				4			- shelly sand lens, fragments 5-15 mm				
				5		SP	SAND: medium to coarse, gray (7.5Y 5/1), some shell fragments to 3mm, trace dark minerals.				
						SP	- shelly sand lens at 3.7m - whole and fragments of shell (bivalves) 5-20mm				
							SAND: fine, gray (7.5Y 5/1), trace shell fragments. - shelly sand lens at 5m. fragments between 5-15mm.				
							HOLE TERMINATED AT THE REQUIRED DEPTH OF 5.4 M				
							NOTE: Spear jetted to 4.0m; pumped at 480 g.p.h. for 15 minutes. - sucking air intermittent flow.				



ENGINEERING LOG - BOREHOLE

project **CARLTON RIVER GROUNDWATER** location **CARLTON BEACH**
 co-ordinates **REFER FIG 1** drill type **PROLINE** hole commenced **18 DEC 1980**
 R.L. **APPROX 2.29m A.S.L.** drill method **AUGER** hole completed **18 DEC 1980**
 inclination **VERTICAL** drill fluid **—** drilled by **M. TRIFFETT.**
 bearing checked by **R.C. DONALDSON**
 checked by **W.C. CROMER**

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	
					SP	SHELLY SAND : medium to coarse, dull yellow orange (10YR 6/4), shell fragments up to 15 mm (bivalves), trace dark minerals.	M W	MD			
			1		SP	SAND : medium to fine, dull yellowish brown (10YR 5/4), some shell fragments to 3 mm., trace dark minerals, - shelly sand lens, fragments 3-10 mm					
			2		SP	SAND : Fine some medium, grayish olive (5Y 5/2), trace dark minerals.					
			3			similar to above, sand fine					
			4		SP	SAND : medium to fine, greyish olive (7.5Y 5/2), trace dark minerals.					
			5								
						HOLE TERMINATED AT THE REQUIRED DEPTH OF 5.4 m					

APPENDIX 2
Water analyses

TASMANIAN DEPARTMENT OF MINES WATER ANALYSIS		Field No. BORE HOLE 2					
		Lab. reg. no. F10203					
		Surface sample? <input type="checkbox"/>					
		Groundwater sample? YES					
Project CARLTON RIVER GROUNDWATER		Location CARLTON BEACH					
Co-ordinates REFER FIG 1	Date sampled: 16 DEC 1980 Sampled by: R.C DONALDSON	Date analysed: 19 JAN 1981 Analysed by: DEPT MINES, LAUNCESTON					
Sampling conditions Collected from spear bore 20 min after pumping had started, at 45 l/min.		Landowner and address (if applicable)					
Field observations Colour Clear Odour Slight H₂S smell Taste - pH - Eh - Temperature (°C) - Specific conductance (µS/cm at 25°C) 300 Turbidity Precipitates Other							
LABORATORY ANALYSIS			Previous chemical analysis available?				
	mg/l	meq/l	% meq/l	Date			
Carbonate (CO ₃)	26	0.86	13.4	Lab. ref. number			
Bicarbonate (HCO ₃)	64	1.05	16.4	Bacteriological analysis available?			
Chloride (Cl)	42	1.18	18.3	Date			
Sulphate (SO ₄)	<5	<0.10	1.56	Lab. reg. number			
Silica (SiO ₂)	23	-	-	HARDNESS SCALE (Total hardness as Calcium Carbonate) Soft 0—60 mg/l Moderately Hard 61—120 Hard 121—180 Very hard more than 180			
Calcium (Ca)	8.9	0.44	6.85				
Magnesium (Mg)	9.5	0.78	12.15				
Iron in solution (Fe)	<0.1	-	-				
Aluminium (Al)	<0.2	-	-	IONIC RATIOS			
Potassium (K)	19	0.49	7.63	Ca: Mg =	Cl: total =		
Sodium (Na)	35	1.52	23.9	Na: total =	SO ₄ : total =		
Total dissolved solids (TDS)	210	6.42	-	Na: Cl =	SiO ₂ : total =		
Permanent hardness as CaCO ₃	NIL			SUITABILITY			
Temporary hardness as CaCO ₃	61			a = no problems, b = doubtful, c = excessive			
Alkalinity as CaCO ₃	95			DOMESTIC DRINKING			
Other				Total dissolved solids	a	pH	c
				Total hardness	b	Iron	a
pH			9.4	Chloride	a	Sulphate	a
Specific conductance (µS/cm at 25°C)			380	Sodium	b	Magnesium	a
Colour				Colour	a		
Turbidity				DOMESTIC HOT WATER CYLINDER			
% difference in anion and cation meq/l			0.6	Total dissolved solids	b	Chloride	b
				Cl/alkalinity ratio 0.44	a	pH	c
Remarks Medium salinity, highly alkaline, moderately hard groundwater. The high pH may affect crops under certain irrigation conditions and would need to be reduced for domestic consumption.				AGRICULTURAL USE		Suitability (a,b, or c)	
				Value			
				Salinity class (C1—C4)	C2	a	
				Sodium class (S1—S4)	S1	a	
				Percent Sodium	62.2	b	
				Sodium adsorption ratio	1.95	a	
Residual sodium carbonate	0.69	a					

TASMANIAN DEPARTMENT OF MINES WATER ANALYSIS	Field No. BORE HOLE 3
	Lab. reg. no. 810204
	Surface sample? <input type="checkbox"/>
	Groundwater sample? YES

Project **CARLTON RIVER GROUNDWATER** Location **CARLTON BEACH**

Co-ordinates REFER FIG 1	Date sampled: 17 DEC 1980 Sampled by: R C DONALDSON	Date analysed: 19 JAN 1981 Analysed by: DEPT. MINES, LAUNCESTON
------------------------------------	--	--

Sampling conditions **Collected from spear bore 15 minutes after pumping had started, at 52 l/min.** Landowner and address (if applicable)

Field observations	Colour Clear	Odour Slight H₂S smell	Taste	Specific conductance (µS/cm at 25°C) 420
	pH —	Eh —	Temperature (°C) —	
	Turbidity	Precipitates	Other	

LABORATORY ANALYSIS				Previous chemical analysis available?			
	mg/l	meq/l	% meq/l	Date	Lab. ref. number		
Carbonate (CO ₃)	16	0.53	6.04				
Bicarbonate (HCO ₃)	105	1.72	19.61		Bacteriological analysis available?		
Chloride (Cl)	72	2.03	23.15		Date		
Sulphate (SO ₄)	<5	0.10	1.14		Lab. reg. number		
Silica (SiO ₂)	25	—	—	HARDNESS SCALE (Total hardness as Calcium Carbonate) Soft 0—60 mg/l Moderately Hard 61—120 Hard 121—180 Very hard more than 180			
Calcium (Ca)	16	0.80	9.12				
Magnesium (Mg)	19	1.56	17.79				
Iron in solution (Fe)	<0.1	—	—				
Aluminium (Al)	<0.2	—	—	IONIC RATIOS			
Potassium (K)	13	0.33	3.76	Ca: Mg =	Cl: total =		
Sodium (Na)	39	1.70	19.38	Na: total =	SO ₄ : total =		
Total dissolved solids (TDS)	260	8.77	—	Na: Cl =	SiO ₂ : total =		
Permanent hardness as CaCO ₃	3			SUITABILITY a = no problems, b = doubtful, c = excessive DOMESTIC DRINKING			
Temporary hardness as CaCO ₃	115						
Alkalinity as CaCO ₃	115						
Other							
pH			9.0	Total dissolved solids	a	pH	c
Specific conductance (µS/cm at 25°C)			440	Total hardness	c	Iron	a
Colour				Chloride	a	Sulphate	a
Turbidity				Sodium	b	Magnesium	a
% difference in anion and cation meq/l			0.1	Colour			
Remarks Medium salinity, highly alkaline moderately hard groundwater of the NaCl - CaHCO₃ type.				DOMESTIC HOT WATER CYLINDER			
				Total dissolved solids	b	Chloride	b
				Cl/alkalinity ratio 0.62	a	pH	c
				AGRICULTURAL USE			
Salinity class (C1—C4)	C2	Value	Suitability (a,b, or c)				
Sodium class (S1—S4)	S1		a				
Percent Sodium	46.2		a				
Sodium adsorption ratio	1.56		a				
Residual sodium carbonate	0		a				

TASMANIAN DEPARTMENT OF MINES WATER ANALYSIS	Field No. BORF HOLE 5
	Lab. reg. no. F10205
	Surface sample? <input type="checkbox"/>
	Groundwater sample? YES

Project CARLTON RIVER GROUNDWATER	Location CARLTON BEACH
--	-------------------------------

Co-ordinates REFER FIG 1	Date sampled: 18 DEC. 1980 Sampled by: R.C DONALDSON	Date analysed: 19 JAN 1981 Analysed by: DEPT MINES, LAUNCESTON
------------------------------------	---	---

Sampling conditions Collected from spear bore 15 min after pumping had started, at 76 l/min	Landowner and address (if applicable)
--	---------------------------------------

Field observations	
Colour Clear	Odour Slight H₂S smell Taste -
pH - Eh -	Temperature (°C) - Specific conductance (µS/cm at 25° C) 600
Turbidity -	Precipitates - Other -

LABORATORY ANALYSIS				Previous chemical analysis available?			
	mg/l	meq/l	% meq/l	Date			
Carbonate (CO ₃)	NIL	-	-	Lab. ref. number			
Bicarbonate (HCO ₃)	135	2.21	17.36	Bacteriological analysis available?			
Chloride (Cl)	130	3.67	28.83	Date			
Sulphate (SO ₄)	21	0.44	3.46	Lab. reg. number			
Silica (SiO ₂)	14	-	-	HARDNESS SCALE (Total hardness as Calcium Carbonate) Soft 0 - 60 mg/l Moderately Hard 61 - 120 Hard 121 - 180 Very hard more than 180			
Calcium (Ca)	38	1.90	14.93				
Magnesium (Mg)	15	1.23	9.66				
Iron in solution (Fe)	<0.1	-	-				
Aluminium (Al)	<0.2	-	-	IONIC RATIOS			
Potassium (K)	5.7	0.15	1.18	Ca: Mg =	Cl: total =		
Sodium (Na)	72	3.13	24.59	Na: total =	SO ₄ : total =		
Total dissolved solids (TDS)	360	12.73		Na: Cl =	SiO ₂ : total =		
Permanent hardness as CaCO ₃	47			SUITABILITY a = no problems, b = doubtful, c = excessive DOMESTIC DRINKING			
Temporary hardness as CaCO ₃	110						
Alkalinity as CaCO ₃	110						
Other							
pH			6.9	Total dissolved solids	a	pH	a
Specific conductance (µS/cm at 25°C)			640	Total hardness	c	Iron	a
Colour				Chloride	a	Sulphate	a
Turbidity				Sodium	b	Magnesium	a
% difference in anion and cation meq/l			0.71	Colour			
Remarks Medium salinity, near neutral, hard groundwater of the NaCl - CaHCO₃ type.				DOMESTIC HOT WATER CYLINDER			
				Total dissolved solids	b	Chloride	b-c
				Cl/alkalinity ratio 1.18	a	pH	a
				AGRICULTURAL USE			
Salinity class (C1 - C4)	C2	Value	Suitability (a, b, or c)				
Sodium class (S1 - S4)	S1		a				
Percent Sodium	57.2		b				
Sodium adsorption ratio	2.50		a				
Residual sodium carbonate	0		a				

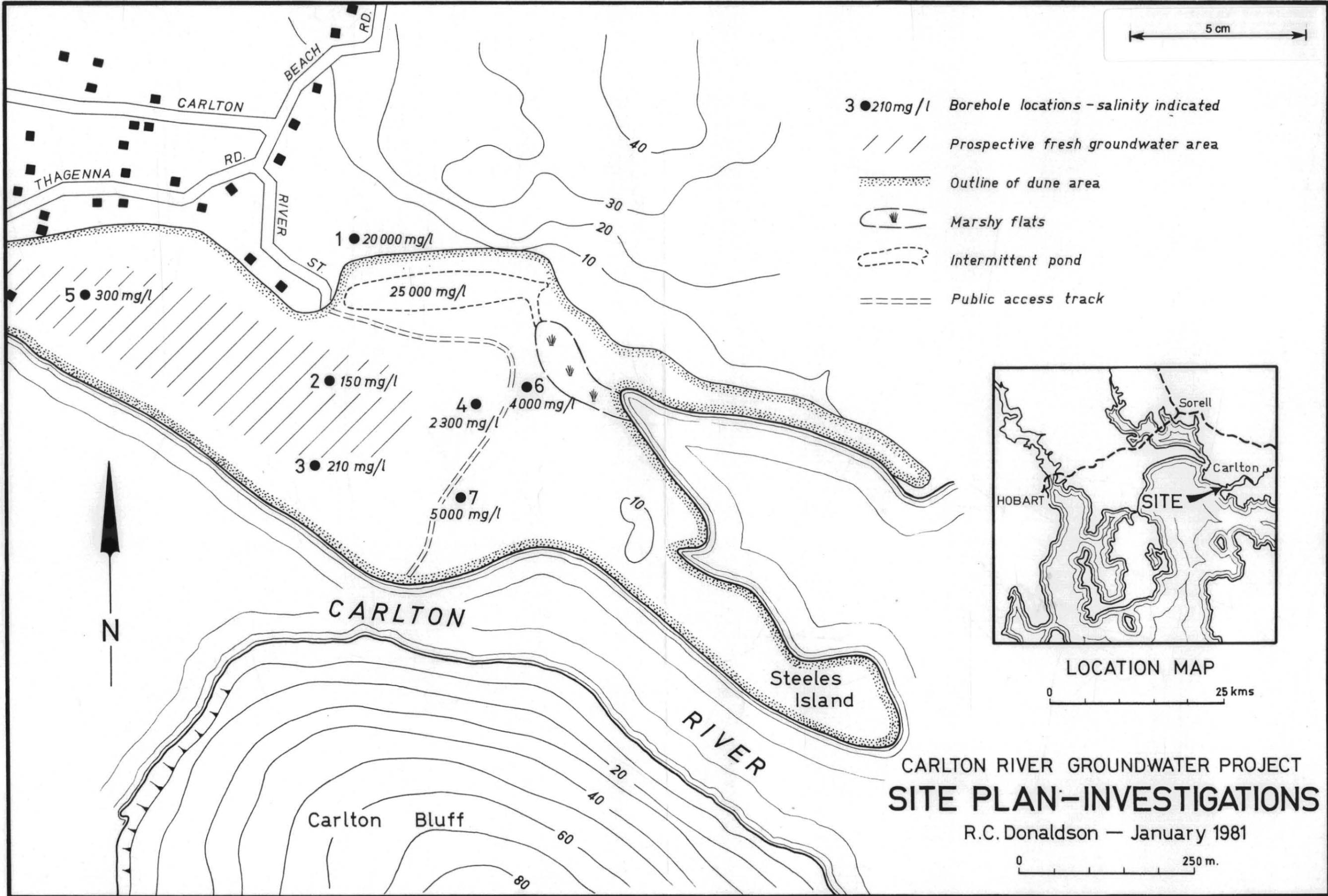
APPENDIX 3

Groundwater reserve estimates

1. Assume the prospective fresh groundwater area outlined by drilling (fig. 1) is about 78 750 m².
2. Assume the average rainfall is 0.6 m/year
3. Assume the rainfall available for recharge (infiltration) is approximately 33% of the annual rainfall, i.e. 1/3 of 0.6 m or 0.2 m/year.
4. Assume no depletion of existing reserves, that is, no change in storage occurs within the aquifer.

Now the volume of water available for extraction/year is in the order of 15 750 m³.

Thus, based on the published daily household water consumption figures for Tasmania (4500 - 5000 l/day) this body of water could fully service about ten households only on a permanent basis.



CARLTON RIVER GROUNDWATER PROJECT
SITE PLAN- INVESTIGATIONS

R.C. Donaldson - January 1981

FIG 1.
4752