

1979/3. Groundwater, mineral resources and land stability in the Tasman Peninsula.

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*Abstract*

Groundwater prospects, mineral deposits and land stability are discussed to provide information for a planning study of the Tasman Peninsula.

INTRODUCTION

This report was written at the request of the Commissioner for Town and Country Planning, and is the result of a map compilation, a search of records and field work during the period 20 - 24 November 1978.

1. Groundwater from fractured rocks

*P.C. Stevenson*

The amount of water that may be obtained from the hard rocks of the Peninsula by boreholes is controlled by the composition and conditions of weathering and fracture.

The amount of direct information is limited because only eight boreholes have been recorded, all at Koonya, Premaydena or Nubeena, but experience in other parts of the State enable some general comments to be made. The geology of the Peninsula is shown in Figure 1.

The Jurassic dolerite, which forms many of the most rugged and remote parts of the Peninsula, has not been drilled for water but is regarded throughout Tasmania as an extremely poor prospect; very hard to drill, almost always dry and where water exists it is hard and saline. It cannot be recommended.

The Permian mudstone and fine-grained sandstone have not been drilled in the Peninsula, but elsewhere are reliable producers of good quality groundwater. Yields of 20 to 150 l/min and qualities of 200 - 600 mg/l of total dissolved solids are usual. Areas of Permian rocks occur from Eaglehawk Neck south along the coast, south of Port Arthur and around Munro Bight. Where ground slope is not steep and rock fractures are abundant and open, good supplies of groundwater should be obtained. Such areas exist near Pirates Bay and between Safety Cove and Port Arthur.

The existing boreholes are all in the Triassic sandstone and mudstone rocks. These rocks cover a large part of the Peninsula West of a line from Port Arthur to Koonya. Fractures in these rocks are often widely spaced and clogged with clay, so that yields are low (2 to 75 l/min). Water quality is poor and in general suitable only for stock.

Basalt areas are mostly small, and the only extensive area is around Saltwater River. The name is significant as the hardness of the river water may derive from the rocks of the area. Basalts can be excellent producers, but may also produce poor and saline water; only drilling can show the usefulness of the resource.

CONCLUSIONS

Permian rocks offer good prospects for groundwater in limited areas but have not been drilled. Triassic rocks cover much larger areas but yields are known to be low and quality poor. All other hard rocks may be ignored.

## 2. Groundwater from unconsolidated sediments

W.C. Cromer

### INTRODUCTION

Unconsolidated sediments occur as local deposits in many places on the Peninsula (fig. 1). They include active and stable sand dunes behind beaches (e.g. Lagoon Beach near Sloping Island, Roaring Beach, Eaglehawk Beach, Sloping Main and Safety Cove), marshy deposits in flat-lying areas (e.g. Benjafields Marsh, Turners Lagoons, Sloping Lagoon) and relatively extensive areas of windblown sheet sand deposits. The marsh deposits and areas of beach dunes are not generally favourable areas from which to obtain groundwater: marshes contain too much clay and mud, and the dunes on the Peninsula are too restricted in size to contain useful or permanent water. The best prospects from groundwater lie in the sheet windblown sand which in places extends to heights above 100 m a.s.l. Despite these general comments, any body of sand at a low-lying site may contain small but useful quantities of water for local domestic uses.

Some of the unconsolidated deposits on the Peninsula have been briefly visited with the aim of determining whether they contain groundwater for camping or domestic uses.

### INVESTIGATIONS

#### *Lime Bay [EN573437]*

This camping area is in a National Park and Wildlife Service Reserve. Windblown sand to variable depths occurs over much of the area, but all of the seven shallow augered holes drilled near the camping site were dry. There is no chance of obtaining groundwater from these sediments.

#### *Lagoon Beach area*

Behind high and active foredunes is an extensive undulating area of windblown sand, marshes and lagoons. Permanent water is present in Sloping Lagoon. An exploratory spear bore was installed in sand behind the dunes at the northern end of the beach, where up to 5 m of grey clayey sand and mud are present. The spear yield was low (4 l/min) and the water unacceptably high in suspended solids. Nevertheless, the area has potential as a source of groundwater for stock and for camping sites.

#### *Plunkett Point [EN588404]*

Four exploratory auger holes were drilled near the camping site in windblown sand. The sand is quite thick (at least 10 m) in places, and extends over Coal Mine Hill. None of the seven holes drilled struck water, and there is apparently no permanent water table in these sediments.

#### *Sloping Main*

The low and poorly vegetated foredunes extend a few hundred metres inland in places, and at the southern end of the beach water may be obtained from shallow wells or spear bores sunk in the sand. The area is largely uninvestigated. The marshes and lagoons behind the beach may be a useful reservoir, but the presence of clay and mud to the sediments may preclude economic extraction of useful amounts of groundwater.

Table 1. Chemical analyses of groundwater from White and Roaring Beaches, Tasman Peninsula.

	White Beach*		Roaring Beach
	(mg/l)	(mg/l)	(mg/l)
CO <sub>3</sub>	nil	nil	nil
HCO <sub>3</sub>	nil	nil	nil
Cl	150	220	190
SO <sub>4</sub>	11	26	<5
SiO <sub>2</sub>	12	16	34
Ca	5	6.8	43
Mg	11	15	29
Fe	0.1	0.3	0.2
Al	0.6	0.7	<0.2
K	3.1	4.3	5.2
Na	74	120	130
Total dissolved solids	360	520	610
Hardness - permanent	61	83	nil
- temporary	nil	nil	230
Alkalinity (CaCO <sub>3</sub> )	nil	nil	240
Conductivity (µS/cm)	490	720	900
pH	4.1	4.1	7.1

\* Collected in two separate spears about 100 m apart, at the northern end of White Beach.

Analyses by Department of Mines Laboratories, Launceston.

#### Roaring Beach

A single successful spear was sunk behind the high and active fore-dunes near the access track. The water was clear, at a depth of about one metre, and was pumped at a rate of 20 l/min. The water is acceptable for drinking (table 1) provided a bacterial analysis is satisfactory.

#### White Beach

Several holes were drilled in the low-lying sandy saddle near the cemetery at the northern end of the beach. The sediments contain large amounts of clay and mud, and although the two spears tested there were satisfactory, the water was unacceptably coloured. The water is acidic (but treatable) but of otherwise good quality (table 1) and the site deserves consideration as a groundwater source for gardens and toilets. Yields, however, will be low.

The southern end of White Beach, north of the tidal inlet, may be a favourable area and is similar topographically and geologically to the southern end of Sloping Main.

#### Other possible sites

There are few other favourable or promising areas on the Peninsula. Much depends on the quantity of water needed. Some areas will be suitable for domestic supplies, and there is none capable of yielding large amounts. Perhaps the most suitable are the southern end of Safety Cove Beach and Eaglehawk Neck Beach. Other extensive areas of windblown sand (e.g. in the valleys behind Prices Bay, Premaydena, Saltwater River, Cascades Bay, Little

Norfolk Bay, Salem Bay and Carnarvon Bay) will not contain permanent ground-water because the slope of the deposits induces rapid coastwards drainage of most of the infiltrating rainfall.

### CONCLUSIONS

Small amounts of good quality water occur in local sandy areas on the Peninsula. They are suitable for small scale and domestic purposes. None of the sites compare with the much larger groundwater reservoirs elsewhere in Tasmania (e.g. Nine Mile Beach, Seven Mile Beach and north-eastern Tasmania). Further exploratory work is necessary to prove permanent and useful supplies at the recommended sites.

### 3. Land stability and material characteristics

R.C. Donaldson

The geology of the Peninsula is relatively uncomplicated in terms of geotechnical problems likely to be associated with the rock types present. However, each rock type possess distinctive physical properties which have the potential, in certain circumstances, to create hazardous situations resulting in loss or damage to housing, services and highways.

The following comments are given in a regional context only, and are intended as a guide to the likely engineering geological conditions to be encountered. Detailed site investigation studies will still be required for proposed major construction sites including bridges, cuttings and building complexes. Salient details of existing problem areas are also discussed.

### ROCK DISTRIBUTION

The geology of the Peninsula shown in Figure 1 is largely interpretive. It portrays the geology in a regional context and should be regarded purely for preliminary reconnaissance purposes which serves to bring the physical problems to the fore. This map does not eliminate the need for subsequent detailed mapping and site investigation necessary to provide geotechnical information for proposed engineering works.

### ROCK WEATHERING CHARACTERISTICS

The degree and depth of weathering is variable, but was seldom observed to be more than a few metres thick. Irregular weathering is characteristic of the dolerite both in depth and lateral extent. Weathering in basalt may also be expected to be extremely variable. Permian sandstone/mudstone rocks are subject to uniform and usually shallow weathering, whilst the Triassic sandstone/mudstone sequences often exhibit a thick gradational weathering profile.

### SOIL DEVELOPMENT

With the exception of Quaternary deposits, the majority of the soils appear to be residual, being the direct product of weathering of the underlying parent rock.

Soil development is generally poor and soil mechanics problems are few. The soils are thin (less than one metre) on Permian rocks and Jurassic dolerite, but are up to 3 m thick on Triassic sediments.

SHRINKAGE - SETTLEMENT CHARACTERISTICS

Depending on the degree of saturation and seasonal moisture variations a high degree of shrinkage/expansion can be expected from the dolerite and basalt derived soils.

All the soils will, under load, settle slightly. Under load from a normal dwelling, these soils are unlikely to consolidate sufficiently to cause major damage if the building is properly constructed. However, surface structures (paths etc.) may require reinforcement or to be constructed of flexible materials to prevent cracking and differential movement.

LAND STABILITY

Mass movement, whether it takes the form of erosion, soil creep, landslides or rockfalls is not a major problem. Factors such as poor soil development, low rainfall, moderately flat lying rocks and few groundwater seepage problems ensure that the rock materials and their soils generally possess a high degree of natural stability.

*Erosion*

Erosional effects are prevalent in the deeply weathered Triassic rocks where gullying processes are prone to develop. The Quaternary aeolian sand and dune deposits are also liable to erosive processes particularly where there is a lack of vegetation to stabilise such deposits. The recent beach dune deposits at Roaring Beach are a typical example.

*Soil creep*

Soil creep can be expected on most steep slopes exhibiting a moderate to deep soil profile. Creep cannot in itself be regarded as an engineering hazard, but where present, caution should be exercised as it is an indication of the potentially unstable state of the subsurface materials. Soil creep is more prone in soils which have a tendency to expand and contract; for example, the dolerite soils.

Rock creep was also noted to be prevalent on some of the steeper slopes. Again it is an indication that the shear stresses acting on the system are approaching the level at which shear failure could result. This should be borne in mind when contemplating development in such areas.

*Landslips*

Landslips were observed to be associated with both the Jurassic dolerite and Triassic sandstone-mudstone rocks, including the talus and scree deposits derived from the parent material.

Characteristically they take the form of small localised shallow translatory type failures developed on moderate to steep slopes where either thick soils or talus are present or water conditions are such that the subsurface soil is saturated or both. As a result, most earth movements tend to develop either in the head region of gullies where both steep slopes and surface run-off water provide the conditions necessary for failure; or on more moderate slopes lower down the hillside where a thicker accumulation of weathered material, soil, or talus combined with the emergence of springs and seepages issuing onto the slope, initiates the instability.

Insufficient data are available to accurately specify the lower slope limits on which movement is likely to occur, however, slopes of less than 15° appear to be stable.

The highest incidence of landslip activity within the confines of the study area (land within 200 m of trafficable roads) occurs in the Nubeena Back Road region between Nubeena and Koonya. This is due largely to the coincidence of moderate to steep cleared terrain coupled with the geological and groundwater conditions necessary to initiate instability. The slips around Grooms Hill [EN635297] are a good example of this interaction between the geology, slope and groundwater. They occur on moderate slopes at about the contact between the Triassic sediments and dolerite. Water, in the form of springs and seepages also issues from and around this interface, saturating the near subsurface materials and inducing movement.

CONCLUSIONS

- (1) Engineering problems relating to soil and rock properties are few. Generally the soils are thin and the underlying rock materials possess a high degree of natural stability when exposed in excavation.
- (2) The expansion/shrinkage characteristics of some soils are a potential problem for inadequately designed structures especially where high seasonal moisture variations exist.
- (3) Mass movement processes are not a major problem. However, landslips are known to exist on 15° slopes underlain by dolerite and the Triassic sandstone-mudstone rocks where thick soils are present and water conditions are such that the subsurface soil is saturated.

Steeper slopes with similar geological conditions must therefore be regarded as potential landslip areas and proposed developments should be preceded by additional investigations to determine their stability.

4. Mineral resources

*V.M. Threader*

The only mineral resources of current economic interest are sand and gravel deposits. These are quarried in several locations (fig. 1) and have been investigated as part of the Tasmanian Construction Materials Register. The characteristics of these deposits are summarised in Table 2.

[15 February 1979]

Table 2. (continued).

No.	Name	Locality	Dust Ratio	Liquid Limit	Plast. Index	Linear Shrink.	Classification†	Material	Age#
1	D.M.R.	Fort Arthur						Dolerite	J
2	Hansen	Stormlea Road	0.53	50	30	12	GP-SP	Siltstone	P
3	Shoobridge	Roaring Beach Rd.	0.47	47	24	11		Dolerite gravel	J
4	Nicholls	Nubeena	0.45	40	17	8	GP-GC	Dolerite gravel	J
5	Noye	Nubeena					GP-GC	Dolerite gravel	J
6	Tasman Council	Saltwater River	0.54	59	38	17	GP-GM	Dolerite gravel	J
7	Kingston	Newmans Creek	0.44	34	16	8	GP-GC	Dolerite gravel	J
8	Robinson	Robinsons Road					GP-GC	Dolerite gravel	J
9	Jenkins	Prices Bay	0.66	68	45	15	GP-GW	Dolerite gravel	J
10		Oakwood					GP-GM	Dolerite gravel	J
11	Griffiths	Koonya	0.61	49	26	12	GP-GW	Dolerite gravel	J
			0.62	51	30	14			
			0.70	45	27	13			
			0.53	41	22	11			
			0.66	54	32	14			
12	D.M.R.	Radnor Road						Dolerite	J
13	Crown Reserve	Eaglehawk Neck					GP	Dolerite gravel	J
<i>SAND</i>									
S1	Nye	Nubeena					SP	White sand	Q/Tr
S2		Nubeena					SP	White sand	Q/Tr
S3		Arthur Highway					SP-SM	White-yellow sand	Q
S4	Bannon	Premaydena					SP	White sand	Q
S5	D.M.R.	Prices Hill					SP	Grey sand	Q/Tr

† S = sand, C = clay, G = gravel, W = well graded, P = poorly graded, M = mixed non-clay fines

# J = Jurassic, P = Permian, Tr = Triassic, Q = Quaternary

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Table 2. SIZING ANALYSIS AND PHYSICAL PROPERTIES OF CONSTRUCTION MATERIALS, TASMAN PENINSULA

No. +	AMG Reference	Sizing Analysis														Status*	Est. Prod. (m <sup>3</sup> )	Res. x	
		Cumulative % passing (mm)																	
		75	53	37.5	26.5	19	9.53	4.76	2.36	1.18	0.6	0.425	0.30	0.15	0.075	0.038			
1	EN673232																D	12 500	S
2	EN616252				100	95	89	80	67		35			19			D	19 000	S
3	EN576291			100		98	94	86	78	73		44		21			D	150	S
4	EN605291	100	97	97		95	89	84	77	69		27		12			FW	90 000	L
5	EN618257																OW	10 000	M
6	EN582375			100		97	82	62	45	33		17		9			D	5 000	VS
7	EN675286				100	95	90	74	52		25			11			FW	30 000	L
8	EN630226																OW	20 000	M
9	EN608348	100	90	65		60	50	39	33	28				15			D	3 500	S
10	EN705275																D	3 000	S
3-8	EN672315	100	85	74		60	52	43	33	23		12		8			OW	40 000	M
		100	92	80		67	56	46	36	28		16		10					
		100	82	65		52	41	33	27	22		13		9					
		100	97	84		75	64	43	31	25		16		9					
		100	91	70		54	43	35	28	22		12		8					
12	EN653217																CW	500	M
13	EN753357																D	750	VS
<i>SAND</i>																			
S1	EN613278																D	2 500	S
S2	EN603290																OW	50	S
S3	EN709359																D	250	S
S4	EN621328																D	600	S
S5	EN633246																FW	3 000	M

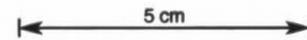
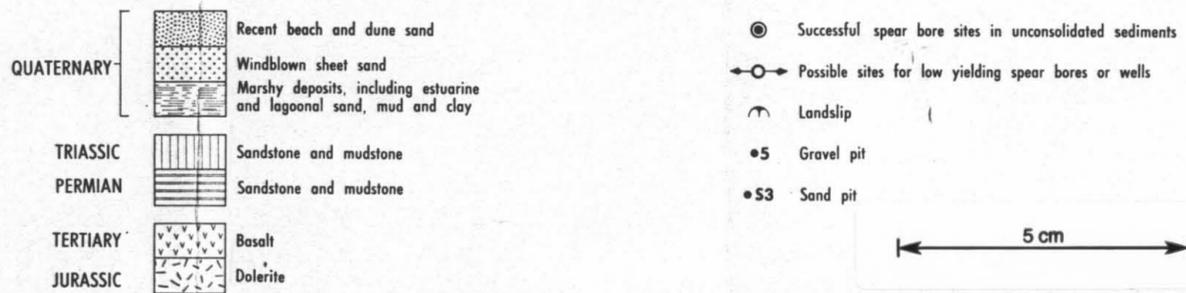
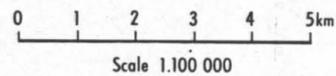
+ Pit locations shown on Figure 1.

\* D = disused, CW = continuously worked, FW = frequently worked, OW = occasionally worked

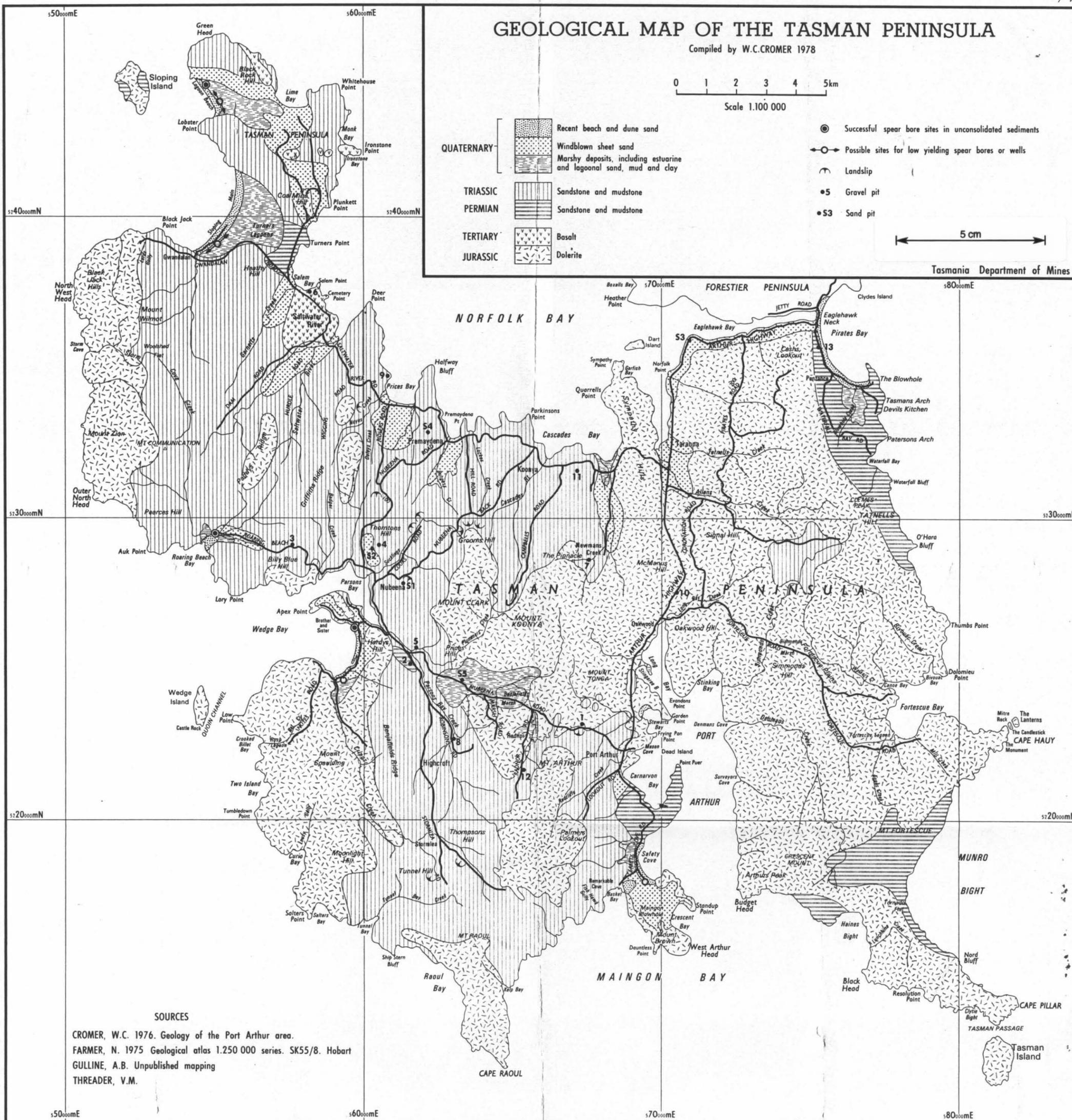
x Reserves VS = <1000m<sup>3</sup>, S = <10 000m<sup>3</sup>, M = <50 000m<sup>3</sup>, L = <200 000m<sup>3</sup>

# GEOLOGICAL MAP OF THE TASMAN PENINSULA

Compiled by W.C. CROMER 1978



Tasmania Department of Mines



### SOURCES

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- FARMER, N. 1975 Geological atlas 1:250 000 series. SK55/8. Hobart
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Figure 1