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45. Underground water resources, Arm End - Gellibrand Point, South Arm

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Gellibrand Point is the northern extremity of the South Arm peninsula protruding into the Derwent estuary. It is proposed to develop that part of the arm north of Opossum Bay and consequently a source of water suitable for most purposes is required.

GEOLOGY

The promontory of Gellibrand Point is one mass of dolerite covered by various sand and sandstone deposits and tied to the siltstones of the Opossum Bay - South Arm portion of the peninsula by a large sand bar.

The siltstone and sandstone of the Malbina Formation are best exposed along the beach from Opossum Bay, although other significant outcrops occur along the east beach and the foreshore at the north end of the east beach where the formation is intruded by dolerite. South of the neck it is covered by deposits of wind-blown sand of variable thickness. The dominant rock type is siltstone although sandstone beds with fossils occur at the north end of the east beach. The rocks dip west at about 12°.

The dolerite, which forms the bulk of the promontory, is of variable grain and petrology. The only contact dolerites are to be seen at the north ends of both the east and the west beach. Coarse, pegmatitic and granophyric dolerite occurs in the region of The Spit. The dolerite is overlain by deposits of sandstone, dunes and wind-blown sand.

The Mary Ann Bay Sandstone is a semiconsolidated sand and shell deposit draped on the irregular dolerite surface. In places it is 3-9 m thick. Bedding is poorly developed generally although coarse current-bedding may be seen in the cuttings east of White Rock where the bedding is indicated by large shell fragments. Exposures of this material are to be found all over the point beneath a cover of loose wind-blown sand.

The Spit is composed of shelly sand with some clay. Sections show up to 60 cm of brown loam (wind-blown sand), about 30 cm of grey sand with many shell fragments and then about a metre of brown sand. Some calcareous or concretionary deposits have been observed in holes in the centre of The Spit and in the low banks on the north side.

Light brown, loose, wind-blown sand covers the whole area. It is generally less than 1 m thick.

Boulder beds are located at the top of Gellibrand Point and along the coast near Mary Ann Bay. They are of restricted extent and occur from sea level to 2 m above.

Beach sand is restricted to small areas at Mary Ann Bay, at Gellibrand's cemetery site and to the major beaches. The only dunes occur at Mary Ann Bay and at the Opossum Bay end of the west beach, and in each case are limited in size and extent. On the west beach wind-blown sand overlies Mary Ann Bay Sandstone to sea level.

HYDROLOGY

Springs have been observed at various places (fig. 33). They are generally small with insignificant flows although higher flows were recorded at springs near Opossum Bay and at the north end of the east beach.

Most springs are related to the interface of sand/sandstone with dolerite, where a marked change in permeability occurs (*e.g.* south of White Rock). Similarly other seepages occur at the interface of wind-blown sand and siltstone as at the south end of the west beach and the north end of the east beach.

Other seepages have been found at the base of the hill at The Spit and in the low cliffs in Mary Ann Bay Sandstone along the west beach.

Possible sources of underground water supplies are:

(1) The Spit
(2) The dunes of Mary Ann Bay
(3) The sand and sandstone of the neck
(4) The siltstone at Opossum Bay
(5) The dolerite of the point itself.

(1) *The Spit*

A series of post holes has revealed a water table peaked toward the centre of The Spit. The level in the holes is about 550-660 mm below high water mark of 240 mm above mean sea level. The level in the dams toward the back of the Spit is 50 mm higher. It may be deduced that the level as measured more than 15 m from the coast is close to low water mark.

Water quality : 1,000 ppm T.D.S.

Catchment area: 2 ha

Estimated volume of stored water : 7-9 Ml
(assumed porosity 20-25%).

Yield rates : 900 l/h per spear bore should be safe. Not more than 3 or 4 spears are recommended (fig. 33).

Estimated annual recharge : 4.5 Ml (direct)
2.2 Ml (indirect)

Safe yield-storage 6.7 Ml which at a maximum pumping rate of 4,500 l/h could be pumped for the equivalent of about 60 days continually per year.

Thus The Spit could be regarded as a significant accessory supply for gardens and parkland but is not suitable for household purposes.

(2) *The dunes of Mary Ann Bay*

Water of good quality is present in this region at shallow depth. Unfortunately the storage is very small, as is the catchment area. Consequently as the recharge characteristics are poor the dunes cannot be recommended as a water source. The sand cover in the Mary Ann Bay region is generally less than 1.8-2.4 m.

(3) *The sand and sandstone of the neck*

Due to the great thickness of sand in this region only limited investigations have been possible with the equipment available. The water table is up to 2.4 m above sea level in places and may be higher elsewhere. In

addition the sand deposit extends up to 30 m below sea level with the result that a lens of fresh water exists from about 2.4 m above sea level to the siltstone underlying the sand. This assumes that the levels inferred are true and that the water body is a single unit and not perched. With this assumption in mind the following estimates have been made:

Water quality : 800-1,000 ppm T.D.S.

Catchment area: 40 ha

Estimated volume of stored water : at least 110 Ml (porosity = 20%).

Yield rates : 900-1,350 l/h per spear. A grid of such spears would be required at a spacing to be determined once the drawdown characteristics are known.

Estimated annual recharge : at least 90 Ml (direct)
at least 22 Ml (indirect)

Safe yield-storage : 90 Ml/y

(4) *Malbina Formation siltstone*

No really first class sites for bores exist in this area because of the nearness of the sea and limited catchment areas. However sites for three bores have been recommended south of the neck. Each would need to be drilled to about 30 m and would yield 2,000-4,500 l/h of good quality water (about 400 ppm T.D.S.). Pumping should be continuous.

Approximate annual supply : 55-110 Ml

(5) *Dolerite*

Whilst the dolerite contains some water, the problems associated with its limited recharge, likely low water table and very limited storage capacity rule against it as an accessory supplier in this instance.

SUMMARY AND RECOMMENDATIONS

Region	Annual Volume *Ml*	Quality (*ppm*)	Individual bore/well rate (*l/h*)
The Spit	7-9	1,000	900
Mary Ann Bay dunes	-	-	-
Sand/sandstone of the neck	(*a*)	800-1,000	900-1,350
Malbina Siltstone	(*a*)	400-600	2,000-4,500
Dolerite	not recommended		

(*a*) restricted only by well capacity and maximum number of non-interfering wells.

It should be noted that while the estimated volumes of water available and quality may be reliable figures there is no guarantee of being able to remove or circulate all the water present. Further, as no long period tests

of yield have been possible it is recommended that should the underground water available be considered a suitable source of water the following final feasibility tests should be undertaken. A test production bore should be drilled in the Permian siltstone, and a production well should be dug in the neck. These are needed in order to:

(1) Determine reliably the actual safe yield of the materials under production conditions. (The figures quoted above are estimates based on either limited on-site tests or experience with similar source rocks elsewhere and could be ±100% in error).

(2) Determine the actual quality of the water, although the estimates given are believed to be reliable.

(3) Enable reliable estimates of cost to be made. Should such test production holes prove to be successful, and there is no reason on present information to believe otherwise, at least two more bores will be required and/or up to a dozen wells.

(4) An alternative to wells would be a trench collecting gallery which would have the added advantages of high yield with limited drawdown compared to simple wells.

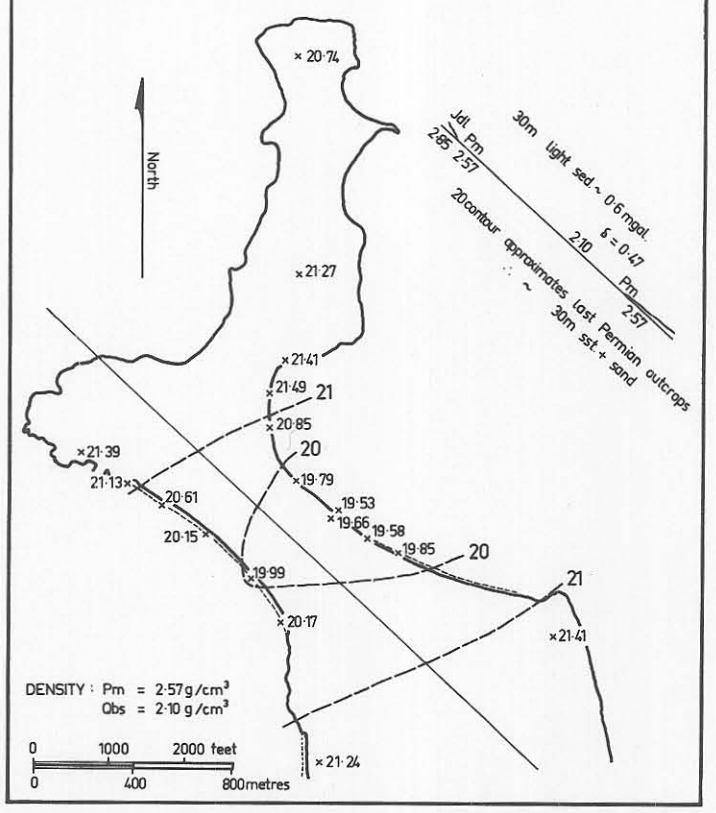
The area has the potential and recharge capacity to supply comfortably 36,000-45,000 l/h if necessary, pending verification by production testing. The water quality is quite good and could be used for most purposes with the specific exceptions of domestic uses and certain vegetable crops. Even so it should be noted that water of comparable quality is used in many United States cities.

A storage system would be needed since it is not recommended that water be pumped directly from the ground to the consumers because of erratic demands. Any pumping undertaken should be continuous at the minimum hourly requirement to supply and replenish the storage for the daily demand.

A full analysis of water recovered from a test production well is also recommended in case corrosion problems arise.

GELLIBRAND POINT : GRAVITY SURVEY

Anomaly with regard to sand overlying Permian siltstone is about 0·6—0·8 mgal. This is equivalent to 30–38 metres of sand in the neck centre. 30-35metres was verified by seismic refraction methods

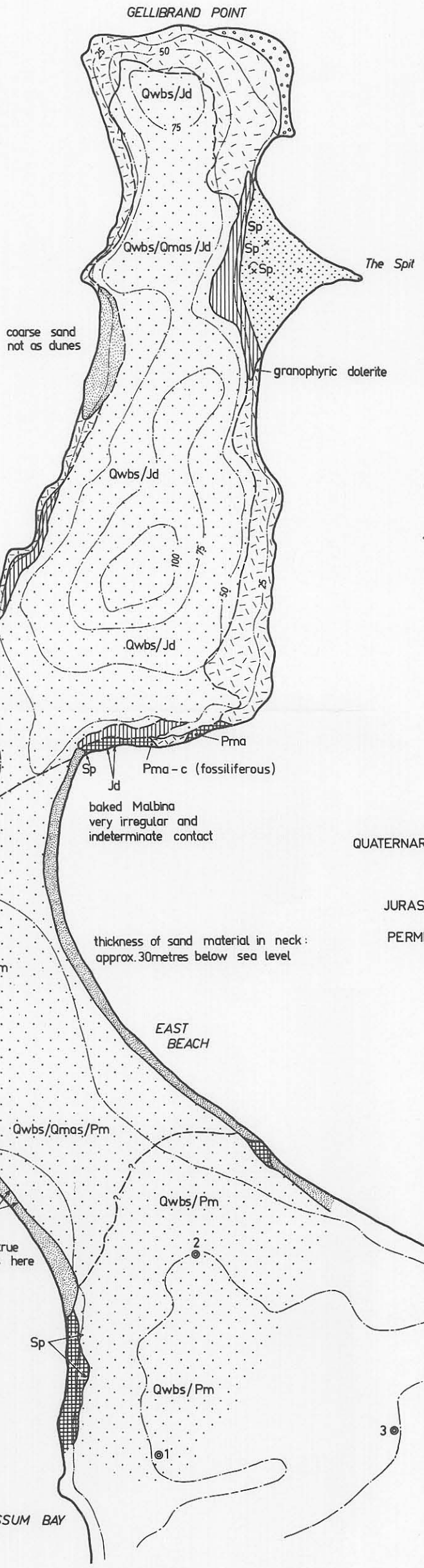


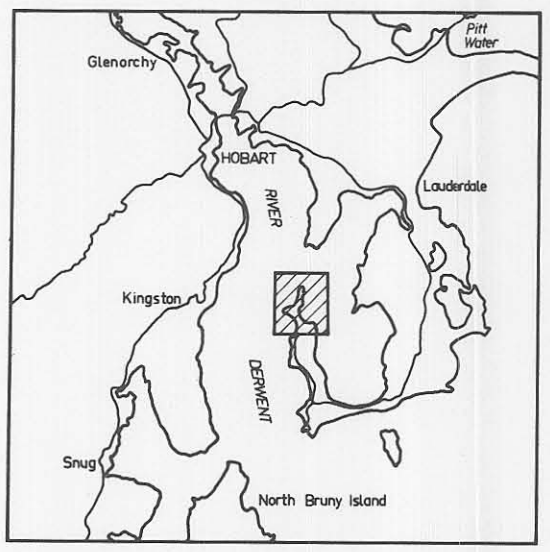
GEOLOGY OF GELLIBRAND POINT

Feet 0 400 800 1200 1600 2000 Feet

Metres 0 100 200 300 400 500 600 Metres

Geology by D.E. LEAMAN
Drawn by T.R Bellis
October 1970





North

QUATERNARY
- Boulder beach deposits (dolerite boulders)
- Windblown sand cover
- Dune or beach sand. Sand deposits with shells and clays
- Mary Ann Bay Sandstone

JURASSIC — Dolerite

PERMIAN — Malbina Formation (sandstone and siltstone)

Sp — Spring or seepage

× — Suggested well sites

◎ — Suggested bore sites

Contours in feet

Base map should be regarded as approximate only

3371 – 82

Figure 33.

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5 cm