

1981/5. A gravity survey of the Henry Jones Building, Old Wharf, Hobart.

R.G. Richardson

Abstract

A detailed gravity survey shows that depths of fill and alluvium under the Henry Jones building vary from less than one metre to approximately 16 m. An island located within the survey area is in partial agreement with the historical concept of Hunter Island, but it appears likely that there were a number of separate islands in the area.

INTRODUCTION

The Department of Mines was requested by Smith, Sale, and Burbury, consulting engineers, to determine the thickness of fill and sedimentary deposits overlying sandstone bedrock at the former Henry Jones buildings. The site surface is completely covered with concrete and bitumen and no plan of the area prior to building construction has been found. Cracking and movement in a number of the buildings supports the historical belief that only some of the buildings are erected on Hunter Island(s). Only one of a series of test pits at the north-western end of the site found sandstone; the remaining four finished in clay or sand.

Without removal of the surfacing materials, geological, seismic, magnetic and resistivity mapping techniques are unsuitable for locating the sandstone island(s), but the density difference between the sandstone ($2.2-2.4 \text{ t/m}^3$) and the fill ($1.5-2.2 \text{ t/m}^3$) is sufficiently large for the gravity method to provide an indication of the location of the island(s).

Because of the small gravity anomaly and high level of traffic, wind, and wave noise expected, La Coste and Romberg gravity meter G132 was borrowed for the survey from the Bureau of Mineral Resources in Canberra. This meter offers an instrument drift of less than $0.1 \mu\text{m/s}^2$ per day, a dial accuracy of $0.05 \mu\text{m/s}^2$, and a much more heavily damped movement than the Worden gravity meters normally used. The meter was read by G. Humphries and a series of checks showed the readings to have a repeatability of better than $0.2 \mu\text{m/s}^2$. As the meter was available for a maximum of only six working days, the ideal station distribution on five metre centres (830 stations) could not be achieved and a compromise with stations at ten metre centres (208 stations) was used. All readings were made relative to a datum of $9.8\ 045\ 199 \text{ m/s}^2$ and formed a series of loops from the datum point.

RESULTS

Gravity values were corrected for meter drift and tidal variation over sufficiently short time intervals for a linear correction to be valid. The values at all stations were reduced to a common elevation, the lowest reading height, using the standard free-air correction of $3.086 \mu\text{m/s}^2$ and a Bouguer correction of $0.922 \mu\text{m/s}^2/\text{m}$ (assuming an average density of 2.2 t/m^3). The maximum height correction is $2.2 \mu\text{m/s}^2$. The maximum latitude correction over the north-south extent of the readings is $1.4 \mu\text{m/s}^2$. For readings in the hop store, only a free-air correction was applied for the height difference between the wooden floor of the store and the concrete floor of the surrounding area. The resulting corrected values do not constitute a true Bouguer anomaly but differ from it only by a constant bench value.

INTERPRETATION

The gravity contour map (fig. 1) has low values in the north-west, corresponding to thickening low density material, and high values in the south-east, indicating shallow bedrock. The test pits and penetrometer data (Table 1) provide little control for the gravity data because of the lack of definite information in all but Test Pit 5.

Table 1. TEST PIT AND PENETROMETER DATA

Test Pit	Depth (m)	Bottomed in
1	1.7	Sandy clay
2	1.5	Sandy with some silt
3	1.4	Buried wood
4	2.5	Sand
5	2.4	Rock (sandstone?)

Penetrometer test

1	7.7
2	2.5
3	7.7
4	5.5

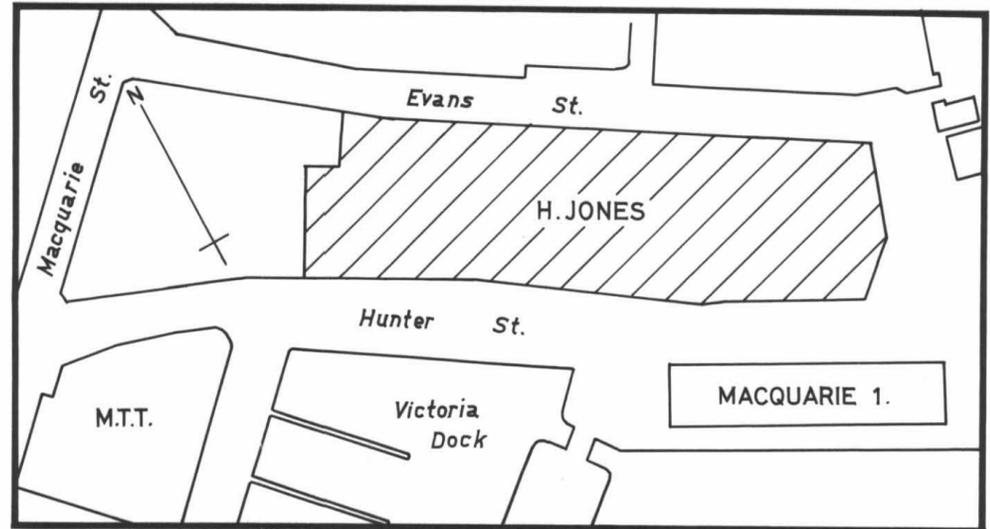
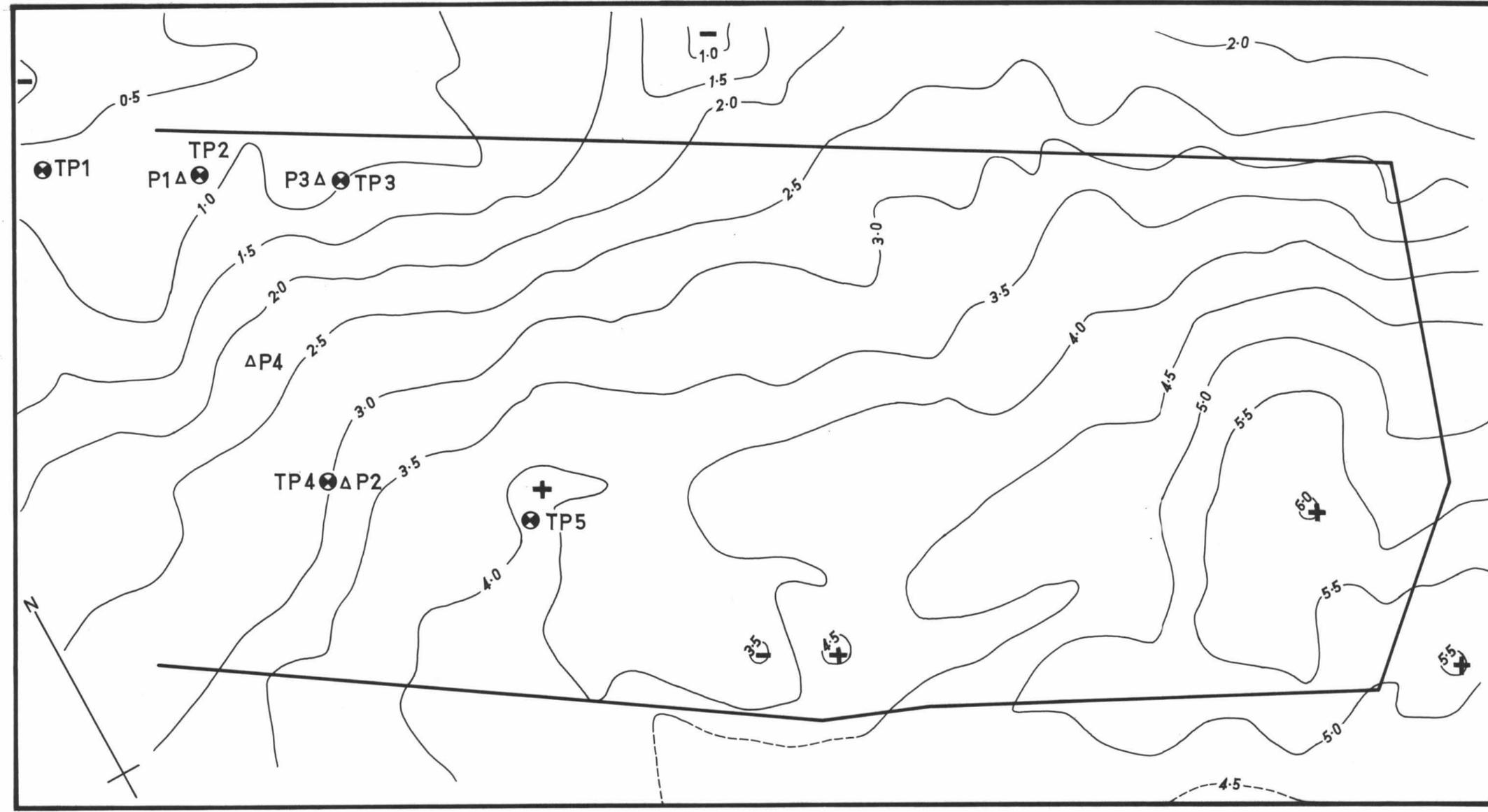
Assuming a density contrast of -0.8 t/m^3 for the fill (bedrock 2.4 t/m^3 , fill 1.6 t/m^3) the attraction of a slab of fill of infinite horizontal extent would be $0.335 \mu\text{m/s}^2$ per metre of vertical thickness. Truncation of the slab reduces the attraction, but provided the thickness of the slab is less than 0.1 of the horizontal extent, the approximation is valid. Thus a change in gravity value of $0.5 \mu\text{m/s}^2$ corresponds approximately to a depth change of 1.5 m. As the gravity value is affected by all material near the reading point, the depth of fill corresponding to a given gravity value is a function of contour shape and location, but approximations are given in Table 2. The depth predicted near Test Pit 3 is consistent with the pile length of $>13 \text{ m}$ used under the structure in this position.

Table 2. GRAVITY VALUE : DEPTH OF FILL

Gravity value ($\mu\text{m/s}^2$)	Depth of fill (m)
5.5	<1
5.0	1 ± 0.5
4.5	2.8 ± 1
4.0	3 ± 1
3.5	4.5 ± 1
3.0	6 ± 1.5
2.5	8 ± 1.5
2.0	10 ± 2
1.5	12 ± 2.5
1.0	14 ± 3
0.5	16 ± 4

The original low-water shore line of the island would be closely approximated by a $3.75 \mu\text{m/s}^2$ contour and the contour shape suggests that the island covered by this survey would be linked only by a sandbar to any islands to the west. If a suitable gravity meter became available, an extension of the survey area would accurately define the location of Hunter Island(s).

5 cm



LOCATION PLAN

0 50 100 m

TP3 ⊙ Test pit
 P2 Δ Penetrometer test
 Corrected gravity values
 Contour interval 0.5 μm/s²

GRAVITY SURVEY – JONES & CO. BUILDING

0 10 20 30 40 m.

5 cm

Fig. 1