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BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

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STRADBROKE ISLAND, NOTES ON GEOPHYSICAL SURVEY FOR UNDERGROUND WATER, QUEENSLAND 1964

by

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ILLUSTRATIONS

1. INTRODUCTION.

The object of the survey was to gain information about the underground water resources of North Stradbroke Island. The survey was undertaken on the request of the Department of Mines Queensland.

The geophysical party consisted of E.J. Polak (party leader), L. Kevi (geophysicist), J.P. Pigott (geophysical assistant), P. Barr (technical officer - Dept. of Mines) and four field assistants.

The survey was carried out from 8th June, 1964 to 15th October, 1964.

2. GEOLOGY.

The following description of the geology of the area is based on Gardener (1955).

Most of North Stradbroke Island is formed of sand dunes elongated in north-northwest direction. They are stabilised with covering vegetation. The dunes rise to a maximum of 720 feet above sea level. Carbonaceous and ferruginous cementing material indurate the sand at various localities. The carbonaceous sand appears to be restricted to two levels; one is between 30 and 60, the other between 90 and 120 feet above sea level. Concentrations of heavy minerals occur at several places.

Outcrops of hard rocks form a small area only (Plate 1). Mesozoic sandstone comes to the surface at Dunwich on the west coast, Mesozoic rhyolite at Point Lookout in the northeast. A small outcrop of lower Palaeozoic greenstone is visible at low tide on the west coast about ten miles south of Dunwich. The limits of extension of the rhyolite, sandstone and greenstone under the sand dunes is not known. The Department of Mines put down five drillholes on the island (Plate 1). Four of these reached the bedrock. Bands of peat were found inside the dune-sand at several levels.

3. METHODS AND EQUIPMENT

1. Gravity method

The object of the Gravity Survey was to gain information about the structure of the bedrock under the sand.

The gravity observations were made with Worden Gravity Meter serial number 140. The instrument was calibrated on the Melbourne calibration range on 26.5.64.

The instrument constant obtained was 0.11115 mgal/sc. div. The gravity interval of the Melbourne Calibration Range was taken as 53.04 mgal.

420 gravity stations were established in the area. The average number of gravity stations per square mile is 7.

The absolute values of the observed gravities were computed using the B.M.R. Helicopter Gravity Station No. 9629 as base. The observed gravity at this station is 9791840 mgal.

The gravity traverses were arranged so that they formed a closed network. The closing errors in the loops were computed and distributed. The greatest closing error was 0.17 mgal.

The elevation of 285 stations were obtained by topographic levelling. The levelling was done by the surveyor of the Department of Mines (Qld), by the surveyor of Cudgeons (a mining company operating on the island) and by the party. 135 stations were levelled barometrically using "Mechanism" microbarometers No. 582/64 and 583/64.

Elevation correction. The observed gravity values were reduced to sea level. The combined elevation correction factor is a combination of the Free Air Correction Factor and the Bouguer Correction Factor. The latter is directly proportional to the density of near surface rocks. This density was taken as 2.0 gm/cm^3 and the corresponding elevation correction constant (0.06854 mgal/ft) was used.

Latitude corrections were made to the international ellipsoid.

2. Seismic refraction method.

Seismic refraction method was used to determine the depth to the water table, the depth to the bedrock and the velocities of the seismic wave in several layers of rocks. The method depends upon the contrast in the elastic properties of different strata. A detailed description of seismic method is given by Heiland (1946).

Where a deeper layer of rocks shows lower velocity than the upper one the seismic ray is refracted downwards and no energy returns from the deeper layer to the surface. However, under favourable circumstances its existence can be deduced from the time-distance curve. This is called velocity reversal.

During the survey on Stradbroke Island about 33 miles of seismic traverse were made. The geophones were placed 100 ft apart and the shots were fired 50 and up to 1000 ft from the end geophone and in line with the geophone spread. Additional centre shots were also fired.

A 24 channel S.I.E. refraction seismograph with T.I.C. geophones of approximately 20 cps was used.

4. RESULTS.

1. Gravity results

The contour map of Bouguer anomalies (gravity values corrected for latitude and elevation) is shown on Plate 4.

The Bouguer anomalies show a regional trend consisting of an increase in gravity towards east-northeast. The large regional gravity gradient obscures the smaller gravity features which may be produced by the structure of the bedrock. However, the gravity high surrounded by the +69 mgal contour (about 2 miles SW of Point Lookout) appears to be caused by the high position of the bedrock. (cf. plate 1).

Computations are in progress to find the best fitting regional gradient. The residual values (Bouguer anomaly minus the regional value) will be correlated with the bedrock contour map produced by the seismic survey and with the seismic velocities of the bedrock.

2. Seismic results.

The seismic velocities may be arranged in four groups, corresponding with the following layers :

Top layer. - This is interpreted as soil with a velocity of 1000 ft/sec to 1800 ft/sec. The layer consists of sandy soil with roots of trees, shrubs and grasses.

2nd layer. - This layer with a velocity of about 2000 ft/sec to 3500 ft/sec is interpreted as sand above the water table. The difference in the velocities may be results of different moisture content of different age and history. At several localities a thin layer of higher velocity (about 5000 ft/sec) has been indicated between the lower velocity beds (reversal of velocities). This layer was interpreted as an old land surface with a perched water table.

3rd layer. - This is interpreted as sand fully saturated with water. It shows seismic velocities from 4900 ft/sec to 6000 ft/sec.

4th layer. - A layer with seismic velocities of 8000 ft/sec to 9400 ft/sec was identified on several traverses. It was interpreted as weathered bedrock. This layer may extend over the whole of the island, but if so it is too thin to be recorded on all time-distance curves.

5th layer. - The highest velocity refractor is interpreted as a slightly weathered or unweathered bedrock. Its seismic velocity is between 10,000 ft/sec and 20,000 ft/sec.

The depth to the interfaces of separate layers was calculated using the above-mentioned velocities. The results are shown on the following plates.

Plate 1. shows the contours of the bedrock (Top of 4th layer).

Plate 2. shows the contours of the main water table. (The top of 3rd layer). The areas where the time-distance curves indicate perched water table are indicated.

Plate 3. shows the isopachs of the sandy formations saturated with water.

Plate 5. shows the sections across the area.

The depths calculated from seismic work are considered to be less than ± 20 % in error. This estimate is based on experience of results in other areas in comparable geological conditions.

5. REFERENCES

GARDNER, D.E. (1955) : Beach Sand heavy-mineral deposits of Eastern Australia - Bureau of Mineral Resouces Geology and Geophysics Bulletin No. 28.

HEILAND, C.A. (1946) : Geophysical Exploration Prentice Hall Inc. - New York.

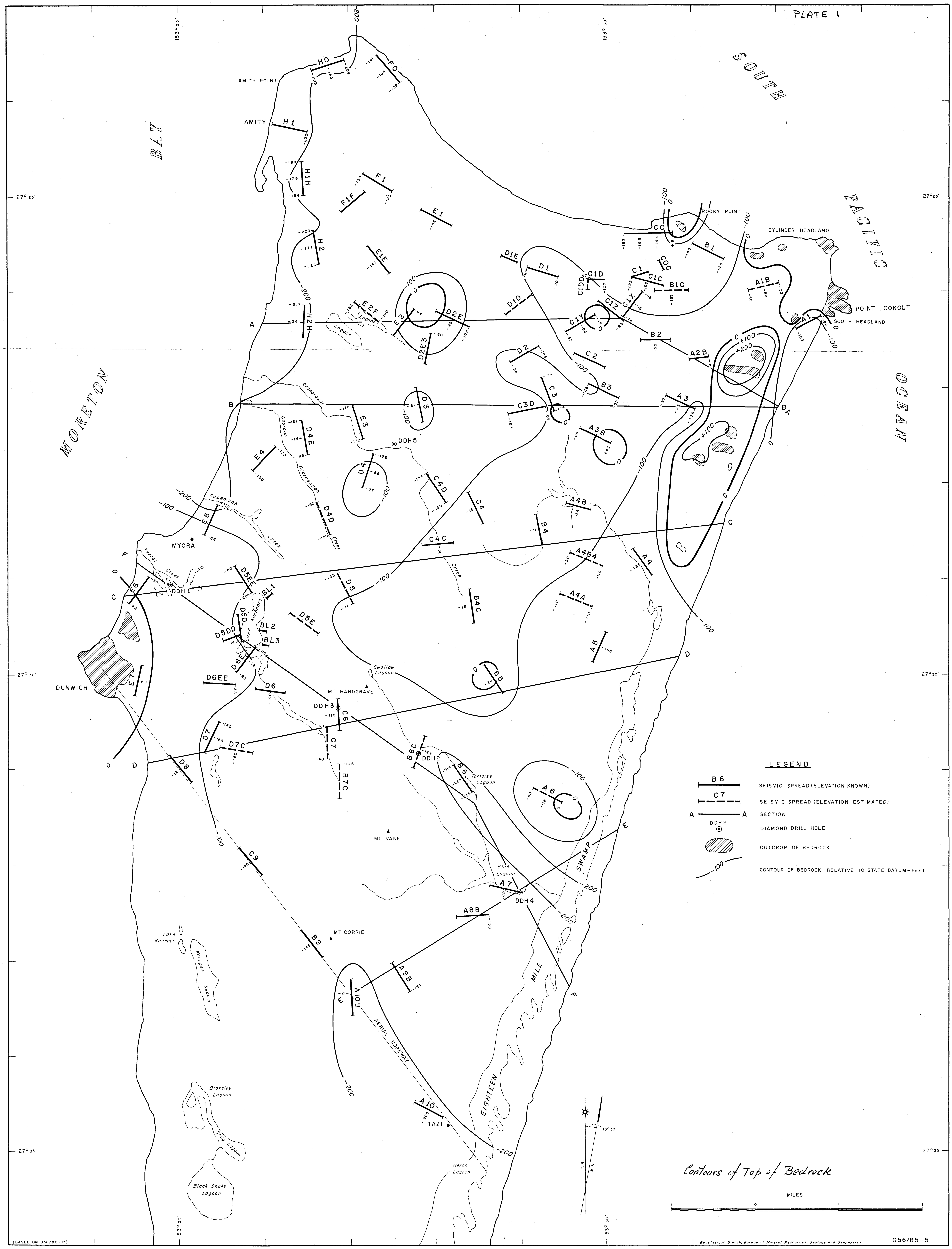


PLATE 1
SOUTH PACIFIC OCEAN
MORETON BAY
AMITY POINT
AMITY
ROCKY POINT
CYLINDER HEADLAND
POINT LOOKOUT
SOUTH HEADLAND
MYORA
DUNWICH
MT HARDGRAVE
MT VANE
MT CORRIE
TAZI
DDH 1
DDH2
DDH3
DDH4
DDH5
Capembah Creek
Yerrol Creek
Swallow Lagoon
Tortoise Lagoon
Blue Lagoon
Heron Lagoon
Lake Kounpee
Kounpee Swamp
Blaksley Lagoon
Black Snake Lagoon
AERIAL ROPEWAY
EIGHTEEN MILE SWAMP
27° 25'
27° 30'
27° 35'
153° 25'
153° 30'
LEGEND
SEISMIC SPREAD (ELEVATION KNOWN)
SEISMIC SPREAD (ELEVATION ESTIMATED)
SECTION
DIAMOND DRILL HOLE
OUTCROP OF BEDROCK
CONTOUR OF BEDROCK - RELATIVE TO STATE DATUM - FEET
Contours of Top of Bedrock
MILES
(BASED ON G56/80-15)
Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics
G56/B5-5

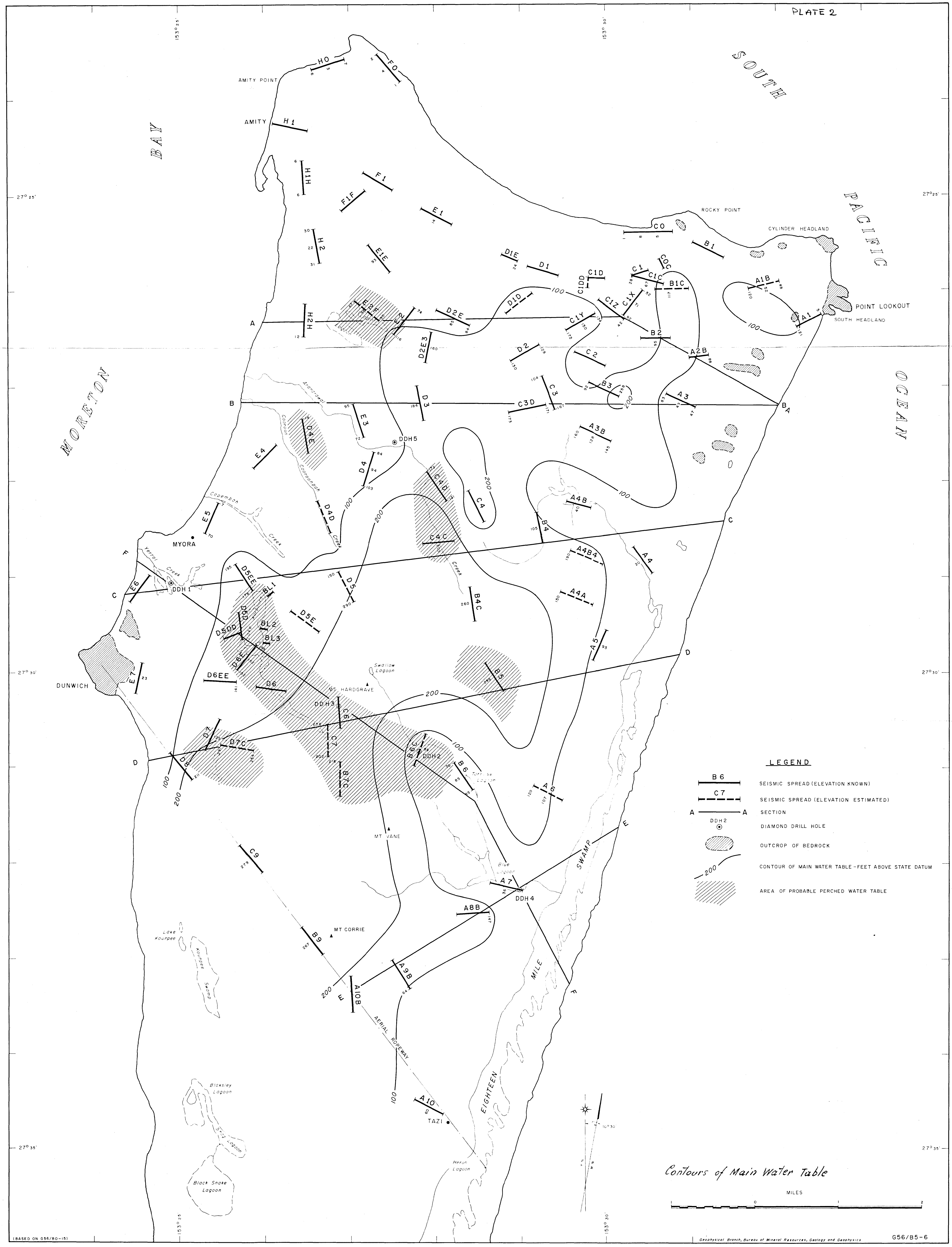
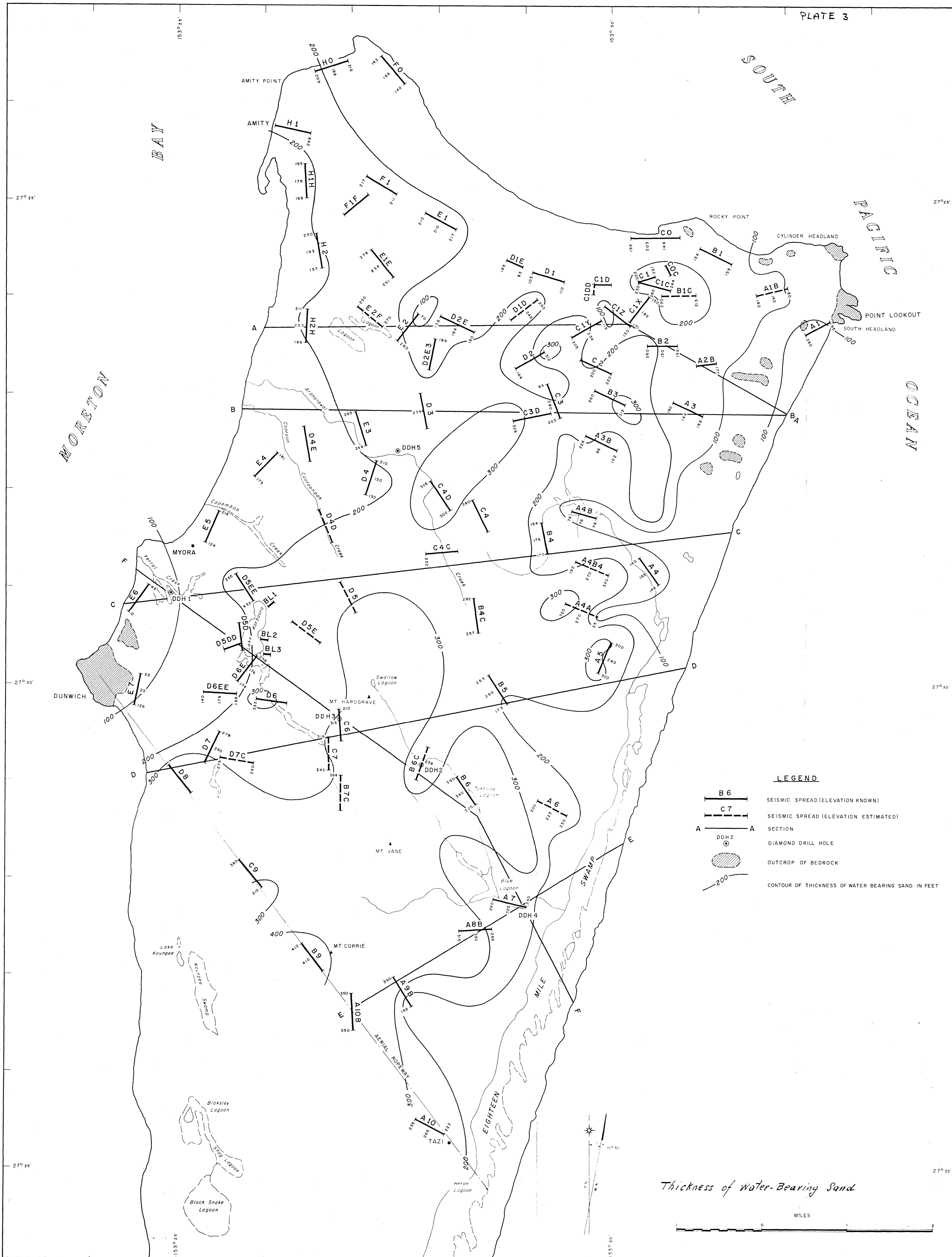


PLATE 2
SOUTH PACIFIC OCEAN
MORETON BAY
AMITY POINT
AMITY
ROCKY POINT
CYLINDER HEADLAND
POINT LOOKOUT
SOUTH HEADLAND
MYORA
DUNWICH
DDH1
DDH2
DDH3
DDH4
DDH5
MT HARDGRAVE
MT VANE
MT CORRIE
TAZI
AERIAL ROPEWAY
EIGHTEEN MILE SWAMP
Swallow Lagoon
Blue Lagoon
Lake Kounpee
Blaksley Lagoon
Black Snake Lagoon
LEGEND
SEISMIC SPREAD (ELEVATION KNOWN)
SEISMIC SPREAD (ELEVATION ESTIMATED)
SECTION
DIAMOND DRILL HOLE
OUTCROP OF BEDROCK
CONTOUR OF MAIN WATER TABLE - FEET ABOVE STATE DATUM
AREA OF PROBABLE PERCHED WATER TABLE
Contours of Main Water Table
MILES
(BASED ON G56/B0-15)
Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics
G56/B5-6



Thickness of Water-Bearing Sand

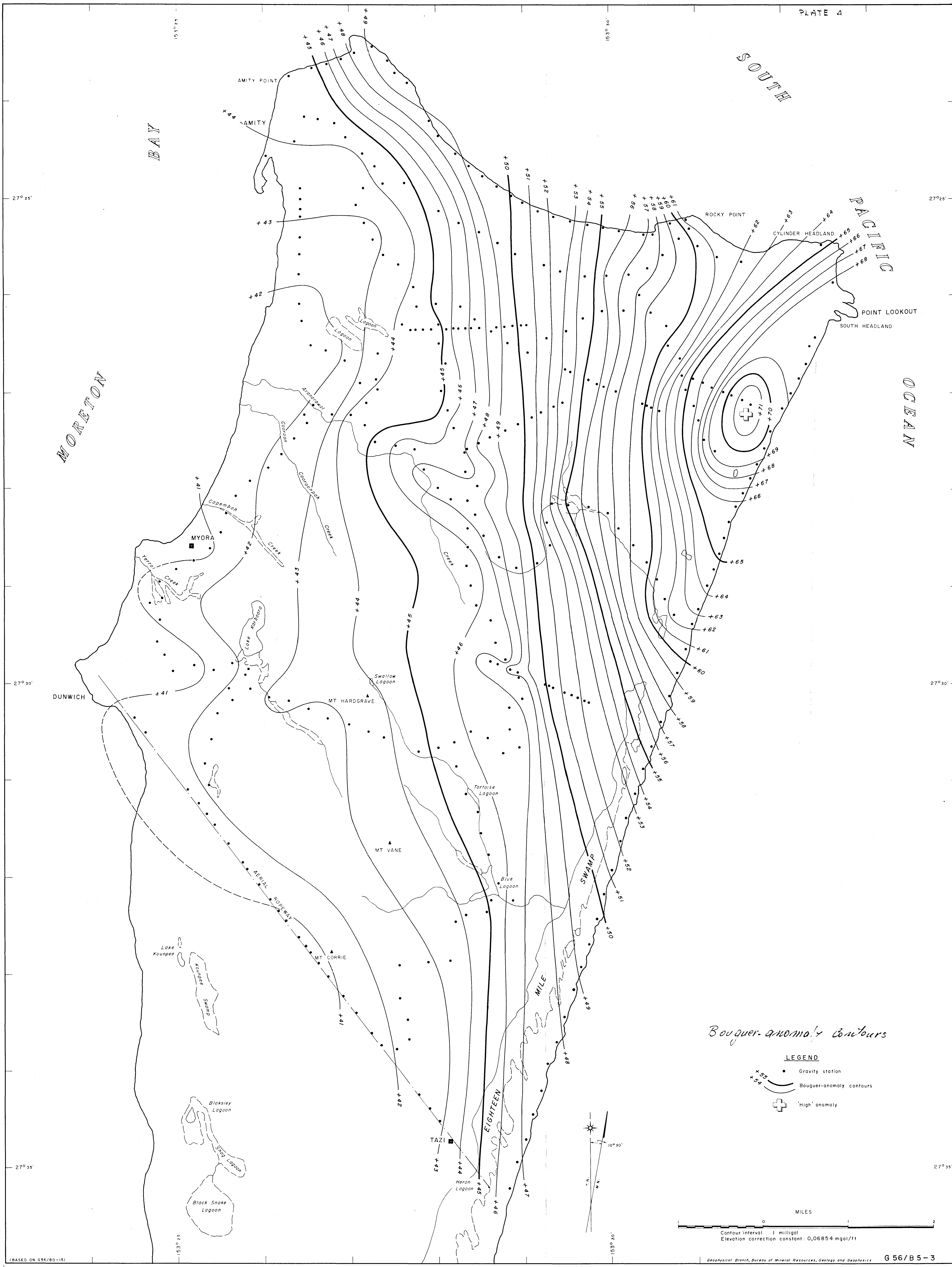


PLATE 4
SOUTH PACIFIC OCEAN
MORETON BAY
AMITY POINT
AMITY
ROCKY POINT
CYLINDER HEADLAND
POINT LOOKOUT
SOUTH HEADLAND
MYORA
DUNWICH
MT HARDGRAVE
MT VANE
MT CORRIE
TAZI
Swallow Lagoon
Tortoise Lagoon
Blue Lagoon
Heron Lagoon
Lake Karboora
Lake Kounpee
Kounpee Swamp
Blaksley Lagoon
Shag Lagoon
Black Snake Lagoon
Capembah Creek
Yerrol Creek
Coolonpah Creek
Aranarawai
AERIAL ROPEWAY
EIGHTEEN MILE SWAMP
27° 25'
27° 30'
27° 35'
153° 25'
153° 30'
10° 30'
Bouguer-anomaly contours
LEGEND
Gravity station
Bouguer-anomaly contours
'High' anomaly
MILES
Contour interval 1 milligal
Elevation correction constant: 0.06854 mgal/ft
(BASED ON G56/B0-15)
Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics
G 56/B 5-3

PLATE 5

SECTION F-F
SEISMIC PROFILE
WEST
EAST
FEET
Sea Level
Profile of Bouguer Anomalies (A-A)
M.Gal
SECTION A-A
SEISMIC PROFILE
Profile of Bouguer Anomalies (B-B)
SECTION B B
SEISMIC PROFILE
Profile of Bouguer Anomalies (C-C)
SECTION C-C
SEISMIC PROFILE
SECTION D-D
SEISMIC PROFILE
Profile of Bouguer Anomalies (E-E)
SECTION E-E
SEISMIC PROFILE