COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES

GEOLOGY AND GEOPHYSICS.

RECORDS.

RECORDS 1958/61.

INTERIM REPORT ON THE GROUND WATER RESOURCES OF CABBAGE GUM BASIN, TENNANT CREEK, NORTHERN TERRITORY

by

J. Hays.

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INTERIM REPORT ON THE GROUNDWATER RESOURCES OF CABBAGE GUM BASIN, TENNANT CREEK, N.T.

INTRODUCTION

Drilling started on 24th April, 1958, and 23 holes were drilled in a resistivity programme which had been worked out in the Geophysical Section of the Bureau of Mineral Resources to conform, as far as possible, with the requirements of the Director of Water Use. Included in the total were holes drilled at Ghans bore (2 miles south of Tennant Creek) and Cabbage Gum bore for comparison purposes, and holes north of number 10 well, south of number 9 well, and north and west of number 12 well, for exploration. Most of the holes were $4\frac{5}{8}$ inches in diameter but number 13a was reamed out to $5\frac{5}{8}$ inches and new holes 7 inches in diameter were drilled at 10b, 9N and MM2. Drilling ceased on 28th May, 1958. Geological logs of the bore holes are attached as an appendix. The positions of the bores and wells are shown on Plate 1. Previous information about the wells is contained in the Preliminary Report on the Ground Water Resources of Cabbage Gum Basin, Tennant Creek, Northern Territory, by J. Hays (Bureau of Mineral Resources Records 1958/21).

Because the Failing 750 drilling rig was not equipped with a test pump, it was impossible to ascertain the yield or the range of salinity in any borehole until the Director of Mines supplied a 3 inch Pomona pump to use at the reamed out number 13a bore. The single-tube core barrel was unsuitable for coring in soft formations, and very little core of the main aquifers was obtained. Core specimens have been forwarded to Canberra for porosity and permeability tests.

DRILLING RESULTS

The drilling outlined a small basin of presumed Tertiary interbedded sandstone, conglomerate, and shale between Cabbage Gum bore, number 13 well, and number 6 well, as indicated in the geological map (plate 1) and sections (plate 2). This basin appears to be the source of the fresh water tapped by the wells. The sediments were deposited upon the main ferruginous zone of a laterite profile during an interruption of the process of lateritisation. Resumption of the process resulted in partial lateritisation of these later sediments. Siliceous sinter was formed at a later date. It is possible that the main ferruginous zone acts as an aquifer. Beneath this are the mottled and pallid zones of lateritisation developed within both ferruginised gneiss and clay of unknown age and origin; the whole group acts as a partial aquiclude. It is not certain whether the clay is lateritised Warramunga Group slate or a post-Warramunga deposit.

The partial aquiclude grades downwards into a zone of decomposed rock. Where this decomposed zone occurs in gneiss, it is an excellent aquifer. This has been named the lower aquifer. It is wholly in gneiss at 13a bore, where the thickness is 90 feet, at 9N bore, where the thickness is 40 feet, and at MM1 bore, where the thickness is 51 feet. The zone appears to have a gentle slope (10 feet per mile) and a slight increase in thickness from north-east to south-west. Contours of the top of the gneiss are shown on plate 3, but there are insufficient data for contours of the decomposed zone to be plotted.

The four large-diameter holes were drilled to test the lower aquifer. The test at 13a bore showed no change in salinity (approximately 800 p.p.m.) during a 36 hour pump test. The yield was greater than the maximum capacity of the pump (2250 g.p.h.) even when number 13 well, 40 feet away, was pumped dry by a separate pump. Tests at 9N bore and 10b bore have not yet been completed. MM2 bore had to be abandoned at 82 feet because of the hardness of the ferruginous cap on the gneiss and lack of time.

If the pumping tests at 10b and 9N bores indicate fresh water in the lower aquifer, it would appear that there is a zone of fresh water on the northern, steeper flank of the Cabbage Gum Basin. Because of the salinity of the water in Cabbage Gum bore salt water is expected to occur on the southern flank. The hydrological - geological north-south section is illustrated in plate 4.

GEOPHYSICAL INVESTIGATIONS

The drilling programme was subject to amendment as geophysical investigation proceeded. In fact, owing to adverse working conditions, the resistivity work was slower than drilling. Every electrode had to be watered with salt water in order to obtain good contacts. Traversing was so slow that the Chief Geophysicist ordered all work to be concentrated on depth probes. The necessity for this decision was regrettable. The area between numbers 1, 11 and 12 wells had been covered in some detail and preliminary results indicated agreement with geological interpretation.

Had rapid traversing been possible it is feasible that the accuracy of the geological map of the area would have been improved. Geophysical complications make depth probes in the sedimentary area of doubtful value. The simplicity of structure in the gneiss areas is such that the decomposed layer could be located with reasonable accuracy, although it is unlikely that the salt water/fresh water interface (if present) could be detected.

RECOMMENDATIONS

Should it be possible to obtain the Failing 750 for a short period at a later date, efforts should be made to ascertain the limits that the gneiss extends for several miles east and west. Perry's number 1 and number 2 bores, 12 miles west of Cabbage Gum bore, are thought to be in gneiss, and outcrops are known east of the area (south of the Eldorado Mine). The northern limit of the gneiss is unknown but could be a well defined east-trending fault 3 miles north of the Cabbage Gum bore. The location of the northern limit is more important than that of the eastern and western limits. Some drilling must be done to locate the boundary of the salt water, thought to approximate to the line of the track going west from Cabbage Gum bore. Drilling must be followed by test pumping and provision should be made for a suitable pump to be on hand before drilling starts.

Pending arrangements for this drilling programme, it is suggested that efforts be made to ascertain salinity by pumping all existing bores with an air lift pump. Variations in salinity should be observed during a 24 hour pump test. If salt water be found, in any hole, that hole should be cemented for 10 feet and tested again. The process should continue until the salt water has been sealed off. During all pumping tests, levels should be measured at adjacent observation holes to obtain data for computing the characteristics of the aquifers concerned. For that reason priority should be given to the bores at number 13, number 10, number 9, and number 5 wells, all of which have adequate observation points.

The importance of locating saltwater, whose presence is indicated by the high salinity of the Cabbage Gum bore, cannot be overstressed. Until more is known about the salt water distribution, optimum sites for boreholes cannot be selected, and freedom from salt water interference cannot be guaranteed.

APPENDIX

LOGS OF BOREHOLES AT CABBAGE GUM BASIN

BOREHOLE 40 FEET FROM NO. 1 WELL

1a BORE

From (ft)	To (ft)	
0	10	Red sandy soil grading into travertine.
10	28	Travertine in ferruginous zone of lateritization.
28	42	Ferruginous zone of lateritisation.
42	50	Silicified and ferruginised shales.
50	53	Coring in fine-grained silicified quartz-sericite schist - 3' core - mostly small fragments - vertical foliation.
53	58	As 50'-53' - not coring.
58	59	Softer band.
59	64	Harder band.
64	75	Alternating hard and soft bands.
75	79	More ferruginous than 50'-75', could be ferruginised gneiss.
79	82	Feldspar and opalescent quartz in cuttings - some fragments of gneiss (red gneiss of No. 13 well).

BOREHOLE 40 FEET FROM NO. 4 WELL

4a BORE

From (ft)	To (ft)	
0	11	Red sandy soil - gritty at base.
11	15	Ferruginous zone of lateritisation - poorly developed.
15	35	Mottled and pallid zone in siliceous sinter and sandy beds.
35	55	Ferruginous zone of lateritisation.
55	80	Mottled and pallid zones in breccia and mudstone, 55'-60' Green-red clay. 60'-65' Grey-white sinter with ferruginous material. 65'-80' Kaolinised breccia and mudstone.
80	95	Decomposed mudstone - grey-white clay with some sand.
95	147	Decomposed gneiss - feldspar and opalescent quartz in cuttings. Kaolinised band at 125 feet.

BOREHOLE 40 FEET FROM NO. 5 WELL

5a BORE

From (ft)	To (ft)	
0	11	Red sandy soil.
11	25	May be incomplete ferruginous or mottled zone of lateritisation or complete ferruginous zone with later sinter.
25	44	Ferruginous zone.
44	83	Mottled zone in sandy and clayey beds with some sinter. Breccia from 65' to 80'.
83	99	White-yellow clay.
99	179	Brown-yellow clay. Vein quartz band at 102', loss of circulation at 108'.

BOREHOLE 80 FEET FROM NO. 5 WELL

5b BORE

From (ft)	To (ft)	
0	10	Red sandy soil.
10	25	Siliceous sinter in ferruginous zone.
25	45	Ferruginous zone.
45	63'6"	Mottled zone - breccia fragments at 63'.
63'6"	64'6"	Silicified breccia - 1 foot of core - broken.
64'6"	69	Very siliceous, breccia fragments.
69	74	Becomes less siliceous.
74	79	Mostly clay with very little breccia.
79	85	Lighter clay - no breccia fragments - loss of circulation.

BOREHOLE 40 FEET FROM NO. 6 WELL

6a BORE

From (ft)	To (ft)	
0	10	Red sandy soil.
10	20	Ferruginous zone with sinter.
20	30	May be mottled zone or extension of ferruginous zone.
30	40	Ferruginous zone.
40	80	Pallid zone - possibly in gneiss - small grains of opalescent quartz in cuttings.
80	82	Very hard grey-green silicified mudstone.
82	84	Silicified fault breccia - core recovery 2'.

BOREHOLE 40 FEET FROM NO. 9 WELL

9a BORE

From (ft)	To (ft)	
0	10	Red sandy soil.
10	20	Pale ferruginous zone and mottled zone in shale and sandstone - 1'3" core recovery - horizontal dip.
20	30	Shale and sandstone from mottled zone, 3' core.
30	36	As 20'-30', 2' core.
36	43	As 20'-30' with pebbly bands, 2' core.
43	53.5	As 36'-43', no core.
53.5	64	Ferruginous zone above "vein breccia" which grades down into brecciated mudstone (after 70') and thence into mudstone, 2' core. The breccia may represent a regolith on a rich laterite surface.
64	70	Mottled zone in "breccia", 3' core.
70	74	Brecciated mudstone in mottled and pallid zone, 4' core.
74	80	Clay with some ferruginous material.
80	90	Soft white clay.
90	94	Hardens into quartz-sericite schist, 9" core.
94	136	Quartz-sericite schist - hard drilling.

BOREHOLE 80 FEET FROM NO. 9 WELL

9b BORE

From (ft)	To (ft)	
0	10	Red sandy soil.
10	15	Ferruginous zone and sinter.
15	37	Mottled zone in sandstone and shale.
37	39	Conglomerate band.
39	59	Mottled and pallid zone in sandstone.
59	69	Ferruginous zone with "vein breccia" in conglomerate.
69	95	Kaolinised shales with sinter.

BOREHOLE 120 FEET FROM NO. 9 WELL

9c BORE

From (ft)	To (ft)	
0	10	Red sandy soil.
10	15	Ferruginous zone and sinter.
15	37	Mottled zone in sandstone and shale.
37	39	Mottled zone in conglomerate band.
39	59	Mottled zone in sandstone and shale.
59	69	Ferruginous zone above "vein breccia".
69	74	Shale - kaolinised.

BOREHOLE AT PEG 56, $\frac{1}{4}$ MILE SOUTH OF NO. 9 WELL

PEG 56 BORE

From (ft)	To (ft)	
0	7	Red sandy soil.
7	15	Ferruginous zone.
15	30	Mottled and pallid zones with sinter.
30	33	Ferruginous zone.
33	35	Very hard drilling in crystalline quartz.
35	36	1 ft. of broken core - silicified fault rock or large mass of opalescent quartz - hole stopped because of slow drilling.

BOREHOLE 4000 FEET SOUTH OF NO. 9 WELL

9S BORE

From (ft)	To (ft)	
0	11.5	Red sandy soil.
11.5	26	Ferruginous and mottled zone and sinter.
26	31.5	Clay from ferruginous, mottled, and pallid zones.
31.5	40	Sandy clay.
40	43	Ferruginous zone.
48	60	Mottled zone - mostly clay.
60	68	Fragments of "breccia".
68	69	White clay.
69	76	Sinter (pallid zone).
76	90	Ferruginous zone grading into mottled zone.
90	115	Mottled and pallid zones.
115	135	Kaolinised shales becoming hard and silicified.

BOREHOLE 4000 FEET NORTH OF NO. 9 WELL

9N BORE

From (ft)	To (ft)	
0	7	Red sandy soil.
7	17	Ferruginous and mottled zone.
17	47	Siliceous sinter or pallid zone.
47	54	Less siliceous - more sand and clay.
54	70	Sandy clay.
70	75	Very sandy clay.
75	83	Mostly white-grey clay.
83	93	Sandy clay with mudstone fragments.
93	95	Sandy and ferruginous clay.
95	108	Gneiss? - opalescent quartz, biotite and partially kaolinised feldspar.
108	117	Micaceous clay.
117	120	Harder drilling - sandy.
120	135	Decomposed gneiss.
135	148	Grades into hard gneiss.

BOREHOLE 40 FEET FROM NO. 10 WELL

10a BORE

From (ft)	To (ft)	
0	10	Red sandy soil.
10	15	Siliceous sinter.
15	25	Ferruginous zone.
25	50	Mottled and pallid zones in assorted sand, clay, and conglomerate bands.
50	57	Ferruginous zone.
57	90	Mottled and pallid zones in clay which becomes yellow-green.
90	110	White sandy band.
110	115	Yellow-green clay.
115	120	Deeper yellow colour with red and green patches - may be result of decomposition of dolerite.
120	184	Yellow green clay.
184	184.5	Dolerite.
184.5	185.5	Dolerite - 8 ins. of core.

BOREHOLE 80 FEET FROM NO. 10 WELL

10b BORE

From (ft)	To (ft)	
0	10	Red sandy soil.
10	15	Siliceous sinter.
15	25	Ferruginous zone.
25	50	Mottled and pallid zones in sand, clay, and conglomerate bands.
50	57	Ferruginous zone.
57	90	Mottled and pallid zones in yellow clay.
90	120	Sandy clay.
120	158	Easy drilling in sandy beds or decomposed gneiss.
158	168	Hardens into gneiss - feldspar, mica and opalescent quartz in cuttings.

BOREHOLE 2500 FEET NORTH OF NO. 10 WELL

10N BORE

From (ft)	To (ft)	
0	5	Red sandy soil.
5	20	Ferruginous zone with sinter or with mottled zone.
20	50	Ferruginous zone grading into mottled zone.
50	60	Mottled zone.
60	80	Green clay with fragments of dolerite(?).
80	85	Grades into yellow clay as in 10a bore.
85	145	Vein quartz chips in clay. Clay gradually decreases and is replaced by tiny fragments of slate or phyllite.
145	152	Hard drilling - vein quartz and dark grey phyllite (a silicified schist) fragments in cuttings.

BOREHOLE 2500 FEET WEST OF NO. 12 WELL

12W BORE

From (ft)	To (ft)	
0	8	Red sandy soil.
8	15	Ferruginous zone with sinter.
15	32	Silicified ferruginous zone grading into pallid zone.
32	36	Grades into ferruginised gneiss - feldspar and opalescent quartz in cuttings.

BOREHOLE 2500 FEET NORTH OF NO. 12 WELL

12N BORE

From (ft)	To (ft)	
0	6	Red sandy soil.
6	15	Ferruginous zone.
15	25	Ferruginous zone with sinter or mottled zone.
25	47	Mottled and pallid zones in slate or silicified shale.
47	48	Breccia (fault), 1 foot of core.
48	60	"Vein breccia" or same breccia as 47'-48'.
60	120	Light brown clay.
120	140	Silty clay with chips of slate and mudstone.

BOREHOLE 40 FEET FROM NO. 13 WELL

13a BORE

From (ft)	To (ft)	
0	10	Red sandy soil.
10	20	Ferruginous zone with sinter.
20	59	Mottled and pallid zones in gneiss.
59	95.5	Hard ferruginised granitic gneiss.
95.5	126.5	Softer, less ferruginous gneiss.
126.5	188	Loss of circulation - very easy drilling in gneiss.
188	189	Harder drilling.
189	189.5	Gneiss - biotite rich - vertical foliation, 6" core.

STANDARD HOLE NEAR GHANS BORE, 2 MILES SOUTH OF TENNANT CREEK.

From (ft)	To (ft)	
0	5	Sandy soil.
5	25	Ferruginous zone.
25	50	Mottled and pallid zones in Warramunga Group slate and shale, altering to soft clay.
50	65	Clay with jasperite cuttings.
65	106	White - grey clay. Complete loss of circulation at 100'.
106	115	Jasperite chips in clay.
115	118	Fine cuttings of grey-green kaolinised shales.
118	160	No cuttings - very fine red silt or silty sand.
160	164	Much harder drilling.

BOREHOLE 150 FEET WEST OF CABBAGE GUM BORE

C.G.W. BORE

From (ft)	To (ft)	
0	10	Sand.
10	15	Quartz rubble on ferruginous zone of lateritisation.
15	30	Mottled and pallid zones or sinter in ferruginous zone.
30	35	Ferruginous zone.
35	60	Mottled and pallid zones in arenaceous material.
60	68	"Vein breccia".
68	74	Decomposed and kaolinised gneiss.
74	79	Kaolinised gneiss, 4' core recovery.
79	98	Coarse chips of red gneiss.
98	140	Finer grained - mainly quartz and feldspar with sand.
140	160	Finer grained - with increasing biotite.
160	168.5	Finer grained - abundant biotite.
168.5	169	Coring - vertical foliation in gneiss, 6" core recovery.

BOREHOLE 600 FEET NORTH-EAST OF CABBAGE GUM BORE

C.G.E. BORE

From (ft)	To (ft)	
0	5	Red sandy soil.
5	22	Ferruginous zone.
22	33	Mottled zone.
33	48	Ferruginous zone.
48	68	Mottled zone - "vein breccia" may occur at 64'.
68	80	Pallid zone - sinter with harder band at 73'.
80	98	May be "vein breccia" - softer band at 96'.
98	100	Siliceous band.
100	105	Ferruginous band - may be conglomerate or surface of gneiss.
105	148	Sandy clay - may be kaolinised gneiss.
148	150	Opalescent quartz and feldspar, ? gneiss.
150	154	Abundant biotite in gneiss.
154	184	Less biotite in gneiss.
184	194	Easy drilling in gneiss.
194	195	Hard drilling in gneiss.

NO. 1 BOREHOLE ON LINE MM

MM1 BORE

From (ft)	To (ft)	
0	10	Ferruginous zone with some sandy soil above it.
10	35	Mottled zone of lateritisation in siliceous sinter and sandy beds.
35	45	Ferruginous zone or ferruginised cap on granitic gneiss.
45	55	Mottled zone in gneiss.
55	80	Pallid zone in gneiss.
80	85	Moderately hard decomposed gneiss.
85	136	Finer grained and much easier drilling than 80'-85'.
136	137	Very hard - no core.
137	158	Recognisable fragments of gneiss with opalescent quartz, mica, and feldspar.

NO. 2 BOREHOLE ON LINE MM

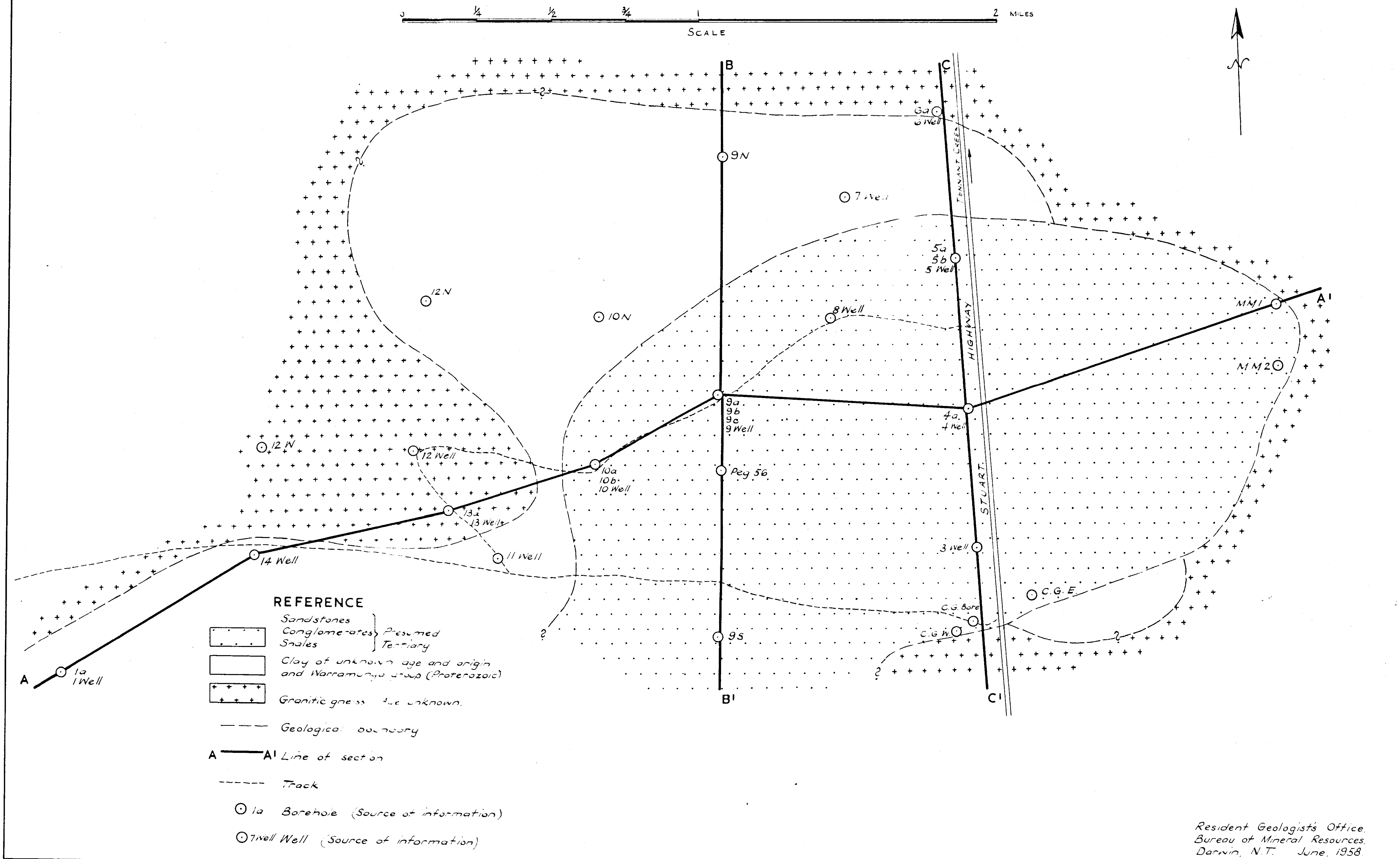
MM2 BORE

From (ft)	To (ft)	
0	3	Red sandy soil.
3	10	Ferruginous zone.
10	30	Mottled and pallid zones grading into ferruginous zone.
30	33	Ferruginous zone.
33	46	Ferruginous zone or ferruginised cap on gneiss - recognisable gneiss cuttings.
46	70	Mottled and pallid zones or weathered zone in gneiss becoming harder at 70'.

PLATE I

SUB-SURFACE GEOLOGICAL MAP (BELOW DESERT SAND)

CABBAGE GUM BASIN, TENNANT CREEK, N.T.



DIAGRAMMATIC SECTIONS THROUGH WELLS AND BORES

PLATE 2

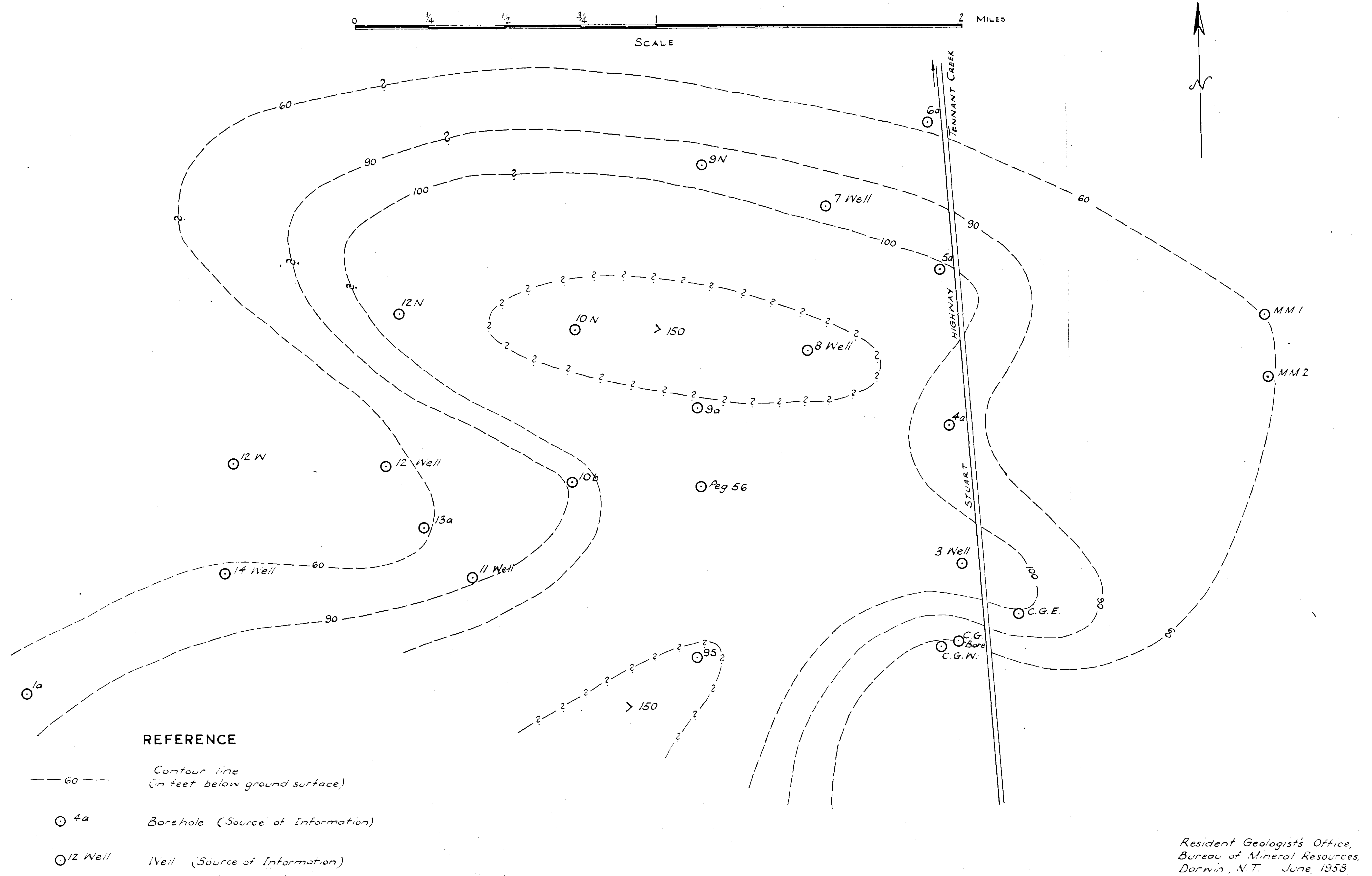
CABBAGE GUM BASIN, TENNANT CREEK, N.T.

Resident Geologist's Office
Bureau of Mineral Resources
Darwin, N.T. June 1958

PLATE 3

ESTIMATED SUB-LATERITE CONTOURS OF GRANITIC GNEISS

CABBAGE GUM BASIN - TENNANT CREEK, N.T.



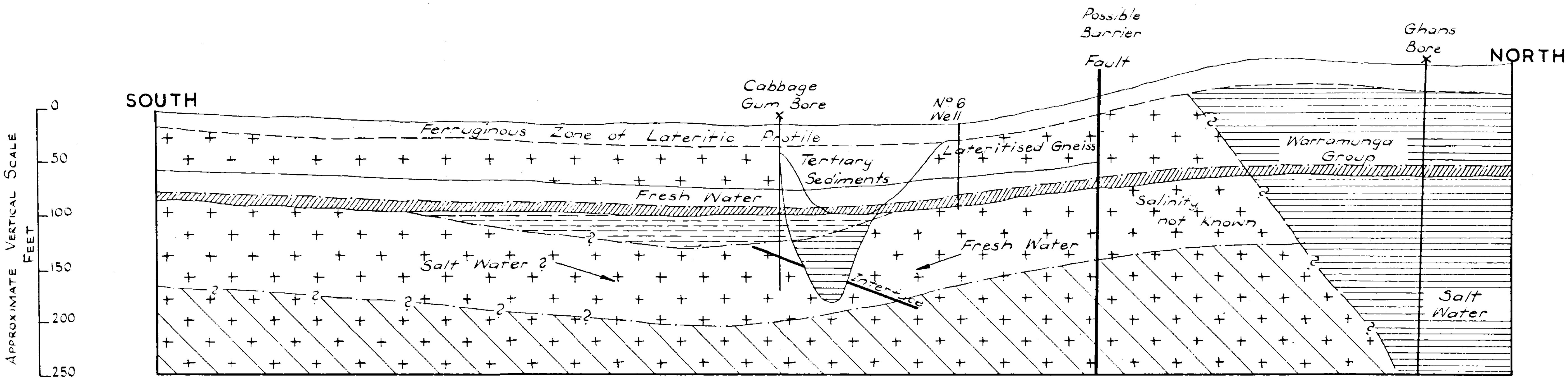
POSTULATED HYDROLOGICAL/ GEOLOGICAL SECTION

CABBAGE GUM BASIN, TENNANT CREEK, N.T.

SCALE EXAGGERATION: $\frac{\text{HORIZONTAL}}{\text{VERTICAL}} = \frac{500}{1}$

1 ¾ ½ ¼ 0 1 2 3 MILES

APPROXIMATE HORIZONTAL SCALE



AQUICLUDES (PARTIAL)

- Lower Level of Lateritic Profiles.
- Ferruginous Cap on Granitic Gneiss, etc.
- Unweathered Gneiss.
- Warramunga Group Sediments.

AQUIFERS

- Upper Aquifers within Lateritic Profiles.
- Lower (Main) Aquifer in Weathered Gneiss.

Resident Geologists Office.
Bureau of Mineral Resources.
Darwin, N.T. June, 1958.