COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

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GROUND WATER RESOURCES OF THE CABBAGE GUM BASIN

TENNANT CREEK - PROGRESS REPORT NO. 4

by

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TABLE OF CONTENTS

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INTRODUCTION

The Cabbage Gum Basin, situated approximately ten miles south of Tennant Creek, consists of a gentle topographic depression with a general slope to the west and south-west. In parts, this depression is underlain by up to 100 feet of poorly sorted sediments which rest on a basement of Precambrian Warramunga Group sediments and granitic rocks. Water suitable for human consumption occurs both in the superficial sediments and in a decomposed zone in the granitic rocks.

This report summarises information available in April, 1960, which includes logs of 14 wells, 23 drill holes put down by the Bureau of Mineral Resources as part of a geophysical investigation, and 23 holes drilled by the Mines Branch, Northern Territory Administration. The Mines Branch holes are spaced at 5,000 foot intervals on a grid laid out on magnetic north. In addition, results of several pump tests and analyses of water samples, mostly carried out by the Water Resources Branch and the Animal Industry Branch, Northern Territory Administration, are available.

PREVIOUS WORK

Previous reports on this basin, which are referred to in the text, are as follows:

No. 1: Preliminary report on the ground water resources of Cabbage Gum Basin, Tennant Creek. J. Hays. Bureau of Mineral Resources Record 1958/21.

No. 2: Interim report on ground water resources of Cabbage Gum Basin, Tennant Creek. J. Hays. Bureau of Mineral Resources Record 1958/61.

No. 3: Notes on Cabbage Gum Basin, Tennant Creek, and diamond drilling logs. J. Hays. File note, December 1959.

There is also an unpublished report by N.O. Jones dated November, 1955.

GENERAL GEOLOGY

Granite

The greater part of the basin is underlain by a complex of granitic rock composed of at least five different phases. There is a medium-grained granite characterised by spheroidal feldspar phenocrysts, an augen gneiss composed of quartz feldspar aggregates separated by biotite folia, and a medium-grained gneissic granite. In addition, quartz feldspar porphyry has been encountered in drill holes 190/105, 190/100, 195/100 and 200/90, and aplite or fine-grained granite in drill holes 215/105 and 210/100. The porphyry overlies gneiss or gneissic granite in all holes except 190/100, which was stopped at 75 feet before reaching the base of the porphyry. The aplite or fine grained granite occurs as small bodies (maximum apparent thickness nine feet), in gneissic granite.

The medium-grained granite with spheroidal feldspar phenocrysts is the only member of this group which crops out in the area, to the east of drill hole 200/115 and to the south of 205/115. Coarse-grained gneissic granite crops out about six miles south of Nobles Nob, but not in the basin.

Warramunga Group

Sediments of the Warramunga Group crop out at Mount Samuel and Eldorado, to the north of the area under investigation, and have been encountered in drill holes 205/120, 210/115 and 215/115, in the north-east of the area.

In addition, the central part of the basin contains a wedge-shaped roof pendant of Warramunga Group sediments, elongated in a north-easterly direction. The pendant is known to be about one mile wide by five miles long, but its south-western boundary is still undetermined; it dips to the north-west.

The sediments of the Mount Samuel and Eldorado areas are shale, slate and greywacke similar to those occurring in other parts of the Tennant Creek district. The rocks of the roof pendant in the centre of the basin locally show intense shearing, silicification and induration.

Dolerite

Dolerite has been encountered in bore hole 10A, and some fragments that may be of dolerite have been reported from bore hole 10 N. It probably occurs as a dyke or dykes.

Quartz Veins

Minor quartz veins, with thicknesses up to 12 inches, have been encountered in many of the drill holes, but the only outcrop is between drill holes 195/110 and 195/105. This consists of a steeply dipping vein, some three feet thick, which can be traced intermittently for about half a mile to the east-north-east. It probably marks the line of a major fault or shear zone.

Superficial Sediments

With the exception of the small granite outcrops and the one quartz vein noted above, the bedrock throughout the basin is covered by superficial sediments including soil and wind-blown sand. In the area covered by scout drilling, the thickest sediments - 100 feet - are in the Cabbage Gum East bore hole. Thicknesses of more than 80 feet have also been encountered in No. 5, 10, 9 N and 10 N bore holes and in drill hole 205/95.

The sediments are clay, siltstone, sandstone and grit, and range from unconsolidated to well cemented. Both siliceous and ferruginous cement are present. There are very few well-defined beds, and none that can be traced from one well or bore to the next. In addition, interpolation and identification are complicated by strong lateritisation, which in some areas has produced a complete laterite profile with ferruginous, mottled and leached zones. In other parts of the area, portions of the profile appear to be lacking, and in a few localities, e.g. drill hole 210/100, reworked laterite fragments appear to have been incorporated in some of the beds.

The base of the succession is generally marked by a layer of reworked material derived from the immediately underlying bedrock. This may be several feet thick and appears as an impure sandstone in areas of granitic rocks and as a conglomerate or "breccia" in areas of Warramunga sediments.

The upper portion of the succession typically consists of up to twenty feet of loosely to moderately consolidated rubble, which is regarded as an incipient soil horizon, related to the present land surface. This, in turn, is overlain in places by up to ten feet of unconsolidated wind-blown sand.

The isopach map of these sediments (Plate 3), indicates a depression with about 50 feet closure. The sediments may have accumulated in such a basin or have been downwarped since deposition. Their age is very uncertain: they are younger than the granite and some at least are older than the laterite.

STRUCTURAL TRENDS

The area contains evidence of several distinct structural trends, but their relative importance cannot be fully evaluated, owing to lack of exposures over most of the basin.

Surface contours show a wide, gentle depression that slopes to the south-west, with its axis co-inciding roughly with the Warramunga roof pendant, and air photos reveal that a strong linear feature continues on the same strike for several miles to the north-east of the area under investigation. The strike of the Warramunga sediments in the Mount Samuel and Eldorado areas is generally east-west, and the trend of the outcropping quartz veins between 195/110 and 195/105 is east-north-east. The trends of the bedrock contours and of the isopachs of the superficial sediments also suggest the presence of a north-westerly trending set of structures in parts of the area. These cannot at present be related to any observed geological features.

WEATHERING OF BEDROCK

With rare exceptions, drill holes which have penetrated the granitic rocks to a sufficient depth show a profile of deep weathering, as described by Hays (Report No. 3). Typically, the profile consists of only slightly weathered rock grading downwards into strongly weathered or completely decomposed material, and thence back to slightly weathered, and finally to fresh, rock. In places, the strongly weathered material directly underlies the younger sediments, probably due to removal of the upper part of the profile by erosion before the superficial sediments were deposited.

All the granitic rocks present appear to be about equally susceptible to the development of the deep weathering profile, except for the porphyry and aplite, which are generally less altered (e.g. in drill holes 190/100 and 195/100). The distinction between slightly and strongly weathered or decomposed material is necessarily an arbitrary one, based largely on the behaviour of the rock during drilling. However, changes in the classification of doubtful sections would affect the conclusions of this report in detail only.

In general, the strongly weathered and decomposed material is thought to be potentially a good aquifer and the slightly weathered material may be a moderate aquifer.

The thickness of the decomposed zone reaches a maximum of 110 feet in drill hole 195/100. The greatest depth to the top of the decomposed zone from the present surface is 135 feet, in drill hole 205/95; and the greatest thickness of unweathered, or slightly weathered, bedrock above the decomposed zone is 106 feet in No. 13 bore hole.

The level of the base of the decomposed zone rises abruptly towards the northern and eastern margins of the area investigated, and the thickness of the zone correspondingly decreases.

In the Warramunga Group sediments, the profiles are generally simpler: they show a gradation from weathered rock at the top to progressively fresher rock at depth.

SURFACE LEVELS

Surface levels in the plans and tables accompanying this report have been taken, as far as possible, from surveys carried out by the Lands Branch and incorporated in plans 41/58 and 18/60. Where interpolation was necessary, the values are shown in parentheses.

WATER LEVELS

A series of water level measurements was carried out on a number of the wells on January 7th, 1960, and on most of the accessible drill holes on March 12, 1960. These measurements showed no significant variations in the water levels of the wells, but there were discrepancies of more than twenty feet from previously recorded readings in the case of some of the drill holes e.g. 200/110. This indicates that values obtained immediately after the completion of drilling should be treated with considerable caution, although the reason for the variations is not known.

The figures used in the tables and maps accompanying this report are the latest available. As will be seen from the contour map (Plate 2), they give a general picture of a water table rising to the north-east at a gradient which increases from about five feet per mile in the south-west to about twenty feet per mile in the north-east. The only anomalous reading, which was disregarded, was that from drill hole 190/100.

Closer contouring does not appear to be warranted by the data available at present. However, more detailed work would undoubtedly reveal minor irregularities in the picture and would probably assist in throwing some light on questions of recharge and water quality. Weekly measurements of water levels in all accessible bores and wells over a period of several months would probably be required for this purpose.

AQUIFERS

Both the superficial sediments and the decomposed zone of the granitic rocks are capable of yielding useful amounts of water. The distribution and extent of both these formations are reasonably well known, but the only information on their physical characteristics comes from twenty samples which were tested for porosity and permeability by the Petroleum Technology Section of the Bureau of Mineral Resources in July 1958.

Eleven specimens of the superficial deposits had porosities ranging from 8 to 44 per cent, with an arithmetic mean of 28 per cent. The permeabilities to nitrogen gas of nine of these samples ranged from 9 to 284 millidarcies, with the majority of the values in the range 25 to 100 millidarcies. Two of the samples were unsuitable for permeability determination.

Four specimens of slightly to moderately weathered gneiss had porosities ranging from 4 to 33 per cent and permeabilities to nitrogen gas ranging from 0 to 30 millidarcies. However, several other specimens of gneiss were described as unsuitable for porosity and permeability determinations by the methods available in the laboratory of the Petroleum Technology Section, because of intense alteration and the presence of closely spaced joints. Most of the decomposed granite and gneiss in the Cabbage Gum Basin is believed to be comparable in physical properties/* so the only assumption which can be made at this stage is that the average porosity and permeability will probably be not less than those of the most weathered samples tested, i.e. porosity

/* to the rejected specimens

about 30 per cent and permeability about 30 millidarcies.

The uneven characteristics of the superficial sediments are well illustrated by the conditions encountered in No.5 well. This well first struck water in a horizontal bedding plane at 50 feet, but the main flow was derived from a vertical vugh between 57 and 65 feet. At this level drives were put out for 11 feet north, 10 feet south, 7 feet east and 12 feet west, and eleven 1¼-inch diameter drill holes were put out in various directions at an elevation of five degrees. All these openings added to the supply of water, but the contribution varied from a trace in some of the holes to a powerful jet from others, indicating that a change of a few feet in the position of a well or bore might totally alter its production potential.

Similar variability in the characteristics of the decomposed granite is indicated by the wide variation in yield from bore holes which passed through similar thicknesses of this material.

PUMP TESTS

About half the bores and wells in the basin have so far been tested for yield.

No. 5 well has been pumped intermittently since May 1958, and has produced a total of about 3,350,000 gallons. On several occasions it has produced 20,000 gallons in one day (eight hours pumping).

In November, 1957, No. 9 well was tested at 3,400 gallons per hour for ten days and No. 10 well at the same rate for six days. The resultant draw-down was 15 feet in No. 9 well and 12 feet in No. 10 well (Hays, Report No. 1). Subsequently, both wells were tested simultaneously for ten days for a combined yield of 6,600 gallons per hour.

No. 13A bore has been tested by the Water Resources Branch at 2,000 gallons per hour for 48 hours with a resultant draw-down of 21 feet and 13 B bore at 2,060 gallons per hour for 48 hours with a resultant draw-down of 69 feet.

Other tests by the Water Resources Branch gave the following results:

	Yields in gallons per hour	Duration of test in hours
No. 4 well	390	12
No. 6 well	300	12
No. 7 well	300	7½
No. 8 well	300	12
No.11 well	240	12
No.12 well	750	11

In these tests, however, the draw-down was still increasing rapidly at the end of the test, so that these yields cannot be relied on as long term yields.

Most of the Mines Branch drill holes have been tested by air-lift pump, with the following as the best results to date:

Drill hole	210/105 :	700 gallons per hour
	205/95 :	200 " " "
	190/110 :	150 " " "
	200/90 :	100 " " "

Once again, however, these are not necessarily long-term yields.

Cabbage Gum Stock Route Bore is reported to be capable of yielding at least 1,000 gallons per hour.

During the pump tests on drill hole 210/105, on March 14th, 1960, the following readings of water level were obtained:

Time		Water Level
10.45 a.m.		65' 3"
10.55 a.m.	Start pump	
11.00 a.m.		70' 4"
11.10 a.m.	Pumping about 1,000 g.p.h.	80' 0"
11.23 a.m.		85' 3"
11.55 a.m.	Pumping about 800 g.p.h.	115' 2"
12.15 p.m.		129' 10"

Subsequent results were erratic, probably due to short-circuits in the leads of the megger probe.

During the test of drill hole 200/90, on March 15, 1960, a draw-down of 20 feet was observed after 40 minutes pumping. Water levels could not be observed during the remainder of the test, as the probe became wedged between the pipe and the casing, but 15 minutes after pumping was stopped (after a total of one hour's pumping), the water level was 28 feet below its initial value.

RELATION OF TWO AQUIFERS

Hays (in Report No. 1) recorded an unconfirmed report that the Cabbage Gum Bore intersected fresh water in the superficial sediments and salt water in the decomposed zone of the bedrock. No other occurrences of different quality waters in the two formations have been recorded so far.

However, considerable variations in the quality of water from different levels in the superficial sediments occurred in No. 5 well. An analysis of the water from this well after the initial flow of water at 50 feet had been obtained, indicated a total content of dissolved salts of less than 400 parts per million, or only about half that which was obtained after the main flow had been struck between 57 and 65 feet.

There is thus a possibility of a partial barrier to the free movement of water between the superficial sediments and the decomposed bedrock, as well as between separate permeable zones in the superficial sediments; these factors may have to be taken into account in computing the probable recharge rates of the lower formations.

Of the wells and bores listed in the preceding section, wells Nos. 5, 9 and 10 must draw all their supplies from the superficial sediments, while No. 13A and 13B bore holes and drill holes 190/110, 210/105 and 200/90 must draw entirely on the decomposed granite and gneiss. The Cabbage Gum Bore and drill hole 205/95 may draw part of their water from each of the two formations.

ANALYSES

Analyses are available of water from most of the wells and several of the bores.

Well or Bore	Total dissolved solids
No. 1 well and bore	630- 650 parts per million
No. 3 well	510, 690 "
No. 4 well	550, 630 "
No. 5 well	820 -825 "
No. 6 well	360 "
No. 7 well	620 "
No. 8 well	610 "
No. 9 well and bore	520, 600 "
No.10 well and bore	450, 550, 580 "
No.11 well	560 "
No.12 well	540 "
No.14 well	640 "
MM 1 bore hole	700 "
MM 2 bore hole	1490 "
9 N bore hole	900 "
9 S bore hole	570 "
10 N bore hole	650 "
12 N bore hole	520 "
13 A bore hole	540 "
13 B bore hole	640 "
Cabbage Gum Bore	2160 "
Cabbage Gum East Bore	1010 "
Drill hole 190/110	520 "
Drill hole 195/110	1010 "
Drill hole 205/110	1360 "
Drill hole 190/105	4750 "
Drill hole 210/105	480 "
Drill hole 195/100	620 "
Drill hole 210/100	1220 "
Drill hole 205/95	1750 "
Drill hole 200/90	4440 "

Most of the analyses have been provided by the Water Resources Branch and the Animal Industry Branch of the Northern Territory Administration.

In the centre of the basin, the quality of the water ranges from 360 to 900 parts per million of dissolved solids, with most values in the range 500 to 700 parts per million.

To the south of a line joining Cabbage Gum Bore bore hole MM2 and drill hole 210/100, there is a sudden increase in salinity; this marks the southern limit of the area from which water suitable for human consumption may be obtained. The only other record of very saline water is in drill hole 190/105; the area of saline water possibly extends east-north-easterly towards drill hole 205/110. It is probably significant that both these occurrences of very saline water are situated in areas where the slope of the base of the decomposed granite has a northerly component, opposed to the regional slope of the water table, and they therefore probably represent pockets of relatively stagnant water. Insufficient information is available at present to assess the danger of encroachment of this saline water into adjoining areas of good quality water.

Differences of salinity between samples from the central portion of the area do not show any systematic variation and are probably of local importance only.

VOLUMES OF WATER BEARING FORMATIONS

Two isopach maps have been prepared **for** each of the aquifers. One shows the extent and thickness of the formation as a whole, while the other shows them only for that portion of the formation which lies below the present water table.

In the case of the superficial sediments, the maps indicate that the formation below water table occupies an area of about 2½ square miles and reaches a maximum thickness of 55 feet (Plate 7).

In the case of the decomposed granite and gneiss, two potentially productive areas may be distinguished. The main occurrence straddles the Warramunga roof pendant in the centre of the basin and has an area of approximately 5 square miles, with a maximum thickness below water level of 110 feet. The second occurrence, in the north-west part of the basin, is centred on drill hole 190/110, and, as far as it has been delineated, has an area of about 1¼ square miles and a maximum thickness below water level of 90 feet (Plate 8).

By integrating the areas enclosed by the various isopach lines, the volumes below water level of these various occurrences can be estimated. The results are as follows:

Superficial sediments:	2,100 million cu. ft.
Decomposed granite and gneiss:	
Main area, between grid lines 190 E and 215 E and north of a line trending east-north-east from Cabbage Gum Bore:	7,500 million cu. ft.
North-west area, east of grid line 190 E:	1,700 million cu. ft.

Using the figures for porosity quoted in a previous section, the approximate quantity of water stored in these rocks would be as follows:

Superficial Sediments:	3,000 million gallons
Decomposed Granite, Main area:	10,000 million gallons
North-west area:	2,500 million gallons.

The anticipated consumption at Tennant Creek, based on experience at Alice Springs, is approximately 250 gallons per head per day, so that a storage of about 250 million gallons would be required to assure a three-year supply for the present population.

The calculated figure for water stored in the basin greatly exceeds the likely storage requirements. Only a small percentage of this water may be available for withdrawal but, on these preliminary figures, storage requirements would be met with a specific yield of less than 1%. A series of further pump tests, closely controlled from observation holes, will be required to determine the amount of water actually available.

POSSIBLE EXTENSIONS OF WATER BEARING FORMATIONS

Plate 7, showing the distribution of the superficial sediments below water level, indicates that no extension of this occurrence can be expected. Any other occurrences would be entirely separate and there are at present no criteria which would enable their position to be predicted.

The comparable map for the decomposed granite (Plate 8), shows that the boundaries of the main occurrence have been reached on the east, north and north-west, while the southern limit of the potentially useful area is set by the increasing salinity of the water. There is a possibility of a slight extension to the south-west, but this could only be small, as the trend of the Warramunga roof pendant continues into this sector.

The north-west occurrence, on the other hand, appears to continue strongly to the west of the area investigated to date, and scout drilling to determine its full extent is now being carried out by the Mines Branch.

RECHARGE

The ability of the basin to provide a permanent water supply will be in the long run dependent on recharge as much as on initial storage, and recharge is a factor about which practically no information is available at present. The lack of defined water courses in the area suggests that only the precipitation falling on the basin itself, or directed into it by sheet-flow from adjoining hills, can be counted on for replenishment of the supply stored in it. However, areas around the northern and eastern margins, where the potentially water-bearing formations are above the water table, may be included in the area of the basin for the purpose of this computation, so that the total intake area will be approximately 15 square miles. With an average annual precipitation of 14 inches, a total of about 2,500 million gallons per year will be received by the intake area, and a withdrawal of 250,000 gallons per day or 100 million gallons per year would be equivalent to about 4 per cent of this precipitation.

SUMMARY AND CONCLUSIONS

Scout drilling in the Cabbage Gum Basin by the Mines Branch, together with information obtained by the Bureau of Mineral Resources and the Water Resources Branch, has proved approximately 2,000 million cubic feet of superficial sediments and 9,000 million cubic feet of decomposed granite and gneiss below the present water table.

Analyses indicate that most of the water contained in these formations is suitable for human consumption.

The following additional work is recommended:

1. Further scout drilling to prove the extent of the decomposed granite and gneiss to the west of drill hole 190/110.
2. An attempt should also be made to recover cores of the decomposed granite and gneiss, and to measure their porosity and permeability.
3. At the same time, closely controlled pump tests should be carried out in areas where maximum thicknesses of water-bearing formations have been indicated.

The following areas would be suitable:

For the superficial sediments:

Between 10 well and 10 N bore hole.
Between 5 well, 8 well and 9 N bore hole.

For the decomposed granite and gneiss:

Between 210/105 and 210/100 drill holes.
Near drill hole 195/100.
North of No. 6 well.
Between No. 10 and 13 wells.
Around drill hole 190/110.

These tests, in addition to determining specific yields, should endeavour to ascertain whether any barriers to the free movement of water exist between the superficial sediments and the decomposed granite, or within the superficial sediments themselves. For this purpose, it will probably be necessary to seal off sections of the test holes and pump from selected intervals.

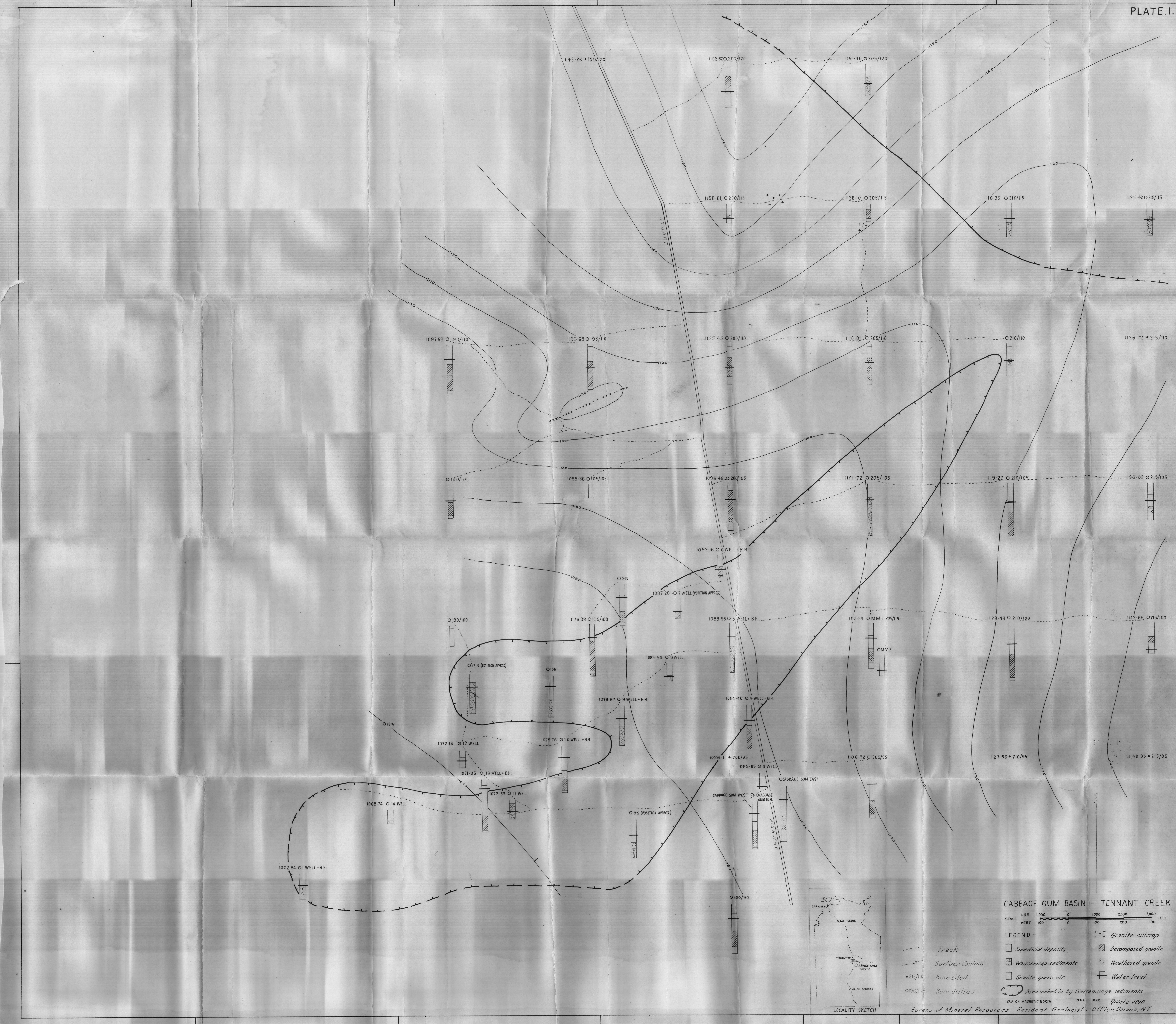
4. Regular measurements of water levels in all accessible wells and drill holes should be carried out to enable more accurate contours of the water table to be drawn and to observe seasonal fluctuations, which may assist in predicting recharge.

SUMMARY OF BORE DATA

Well or Bore	R.L. Surface	Depth to Water	R.L. Water Level	Depth to Basement	R.L. Basement	Thickness Decomposed Granite	Depth to Base of Decomposed Granite	R.L. Base of Decomposed Granite	Depth of Well or Bore	R.L. Bottom Well or Bore	Sediments Below W.L.	Decomposed Granite Below W.L.	Galls. p.h.	Dissolved Solids. p.p.m.
200/120	1170	100	1070	7	1163	40	75	1095	155	1015	Nil	Nil	Nil	No Inf.
205/120	1155	70	1085	41	1114	Warr.	-	-	112	1043	Nil	Warr.	Nil	No Inf.
200/115	1159	53+	Below 1106	10	1149	Nil	-	-	68	1091	Nil	Nil	Nil	No Inf.
205/115	1138	65+	Below 1073	10	1128	22	52	1086	65	1073	Nil	Nil	Nil	No Inf.
190/110	1098	54	1044	49	1049	90	160	938	175	923	Nil	90	150	520
195/110	1124	84	1040	11	1113	92	155	969	162	962	Nil	71	Trace	1010
200/110	1125	83	1042	34	1091	29	75	1050	141	984	Nil	Nil	No Inf.	No Inf.
205/110	1110	67	1043	10	1100	Nil	-	-	145	965	Nil	Nil	60	1360
210/110	(1115)	57	(1058)	11	(1104)	Nil	-	-	115	(1000)	Nil	Nil	No Inf.	No Inf.
190/105	(1095)	59	(1036)	22	(1073)	47	110	(985)	119	(976)	Nil	47	Nil	4750
195/105	1095	47+	Below 1048	8	1087	Nil	-	-	47	1048	Nil	Nil	Nil	No Inf.
200/105	1096	58	1038	18	1078	97	115	981	168	928	Nil	57	No Inf.	No Inf.
205/105	1102	55	1047	48	1054	Warr.	-	-	185	917	Nil	Warr.	No Inf.	No Inf.
210/105	1119	65	1054	60	1059	85	185	934	192	927	Nil	85	700	480
215/105	1136	64	1072	41	1095	30	105	1031	132	1004	Nil	30	Nil	No Inf.
190/100	(1076)	63	(1013)	11	(1065)	Porph.	-	-	75	(1001)	Nil	Porph.	Nil	No Inf.
195/100	1077	44	1033	55	1022	110	170	907	190	877	11	110	No Inf.	620
210/100	1123	76	1047	58	1065	89	201	922	205	918	Nil	89	Trace	1220
215/100	1143	91	1052	55	1088	10	73	1070	110	1033	Nil	Nil	No Inf.	No Inf.
205/95	1107	73	1034	85	1022	49	184	923	195	912	12	49	200	1740
200/90	(1080)	51	(1029)	30	(1050)	57	150	(930)	175	(905)	Nil	57	100	4440
1 well + B.H.	1063	39	1024	42	1021	Warr.	-	-	Well 43 B.H. 82	1020 981	3	Warr.	?800	630
3 well	1090	57	1033	No Inf.	No Inf.	No Inf.	No Inf.	No Inf.	64	1026	No Inf.	No Inf.	?500	510
4 well + B.H.	1089	51	1038	65	1024	52+	147+	Below 942	Well 70 B.H.147	1019 942	14	52+	390	630
5 well + B.H.	1090	49	1041	80	1010	Warr.	-	-	Well 64 B.H.179	1026 911	31	Warr.	2000	820
6 well + B.H.	1092	47	1045	40	1052	Warr.	-	-	Well 78 B.H. 84	1014 1008	Nil	Warr.	300	360
7 well	1087	49	1038	(49)	(1039)	Warr.	-	-	73	1014	?Nil	Warr.	300	620
8 well	1084	45	1038	(45)	(1039)	Warr.	-	-	63	1021	?Nil	Warr.	300	610
9 well + B.H.	1080	43	1036	70	1010	Warr.	-	-	Well 64 B.H.136	1016 944	27	Warr.	3400	520
10 well + B.H.	1076	41	1035	90	986	68	158	918	Well 65 B.H.185	1011 891	49	68	3400	450
11 well	1073	41	1032	15	1058	Warr.	-	-	64	1009	Nil	Warr.	240	560
12 well	1072	39	1033	20	1052	No Inf.	No Inf.	No Inf.	60	1012	Nil	No Inf.	750	540
13 well + B.H.	1072	38	1034	20	1052	62	188	884	Well 67 B.H.189	1005 883	Nil	62	2000	540
14 well	1069	No Inf.	No Inf.	(40)	(1029)	Warr.	-	-	(50)	(1019)	?Nil	Warr.	No Inf.	640
Cabbage Gum	(1086)	No Inf.	No Inf.	No Inf.	No Inf.	No Inf.	No Inf.	No Inf.	No Inf.	No Inf.	No Inf.	No Inf.	?1000	2160
C.G. East	(1091)	No Inf.	No Inf.	100	(991)	43	148	(943)	195	(896)	(55)	43	No Inf.	1010
C.G. West	(1085)	No Inf.	No Inf.	68	(1017)	62	160	(925)	169	(916)	(23)	62	No Inf.	No Inf.
MM 1	1102	(56)	(1046)	45	(1057)	51	136	966	158	944	Nil	51	No Inf.	700
MM 2	1104	59	1045	33	1071	No Inf.	No Inf.	No Inf.	70	1034	Nil	No Inf.	No Inf.	1490
9 N	1084	47	1037	95	989	40	135	949	148	936	48	40	No Inf.	900
9 S	(1074)	(44)	(1030)	76	(998)	Warr.	-	-	135	(939)	(32)	Warr.	No Inf.	570
10 N	1075	(41)	(1034)	85	990	Warr.	-	-	152	923	(44)	Warr.	No Inf.	650
12 N	(1073)	(38)	(1035)	25	(1048)	Warr.	-	-	140	(933)	Nil	Warr.	No Inf.	520
12 W	(1070)	36 +	Below 1034	32	(1038)	No Inf.	No Inf.	No Inf.	36	(1034)	Nil	No Inf.	No Inf.	No Inf.

(1085) Based on surface level calculated by interpolation.

PLATE. I.


STUART
HIGHWAY
CABBAGE GUM WEST
CABBAGE GUM EAST
CABBAGE GUM BASIN - TENNANT CREEK
SCALE
HOR. 1,000 0 1,000 2,000 3,000 FEET
VERT. 100 0 100 200 300
LEGEND -
Track
Surface Contour
215/110 Bore sited
190/105 Bore drilled
Superficial deposits
Warramunga sediments
Granite, gneiss, etc.
Area underlain by Warramunga sediments
GRID ON MAGNETIC NORTH
Granite outcrop
Decomposed granite
Weathered granite
Water level
Quartz vein
DARWIN
KATHERINE
TENNANT CK
CABBAGE GUM BASIN
ALICE SPRINGS
LOCALITY SKETCH
Bureau of Mineral Resources. Resident Geologist's Office, Darwin, N.T.

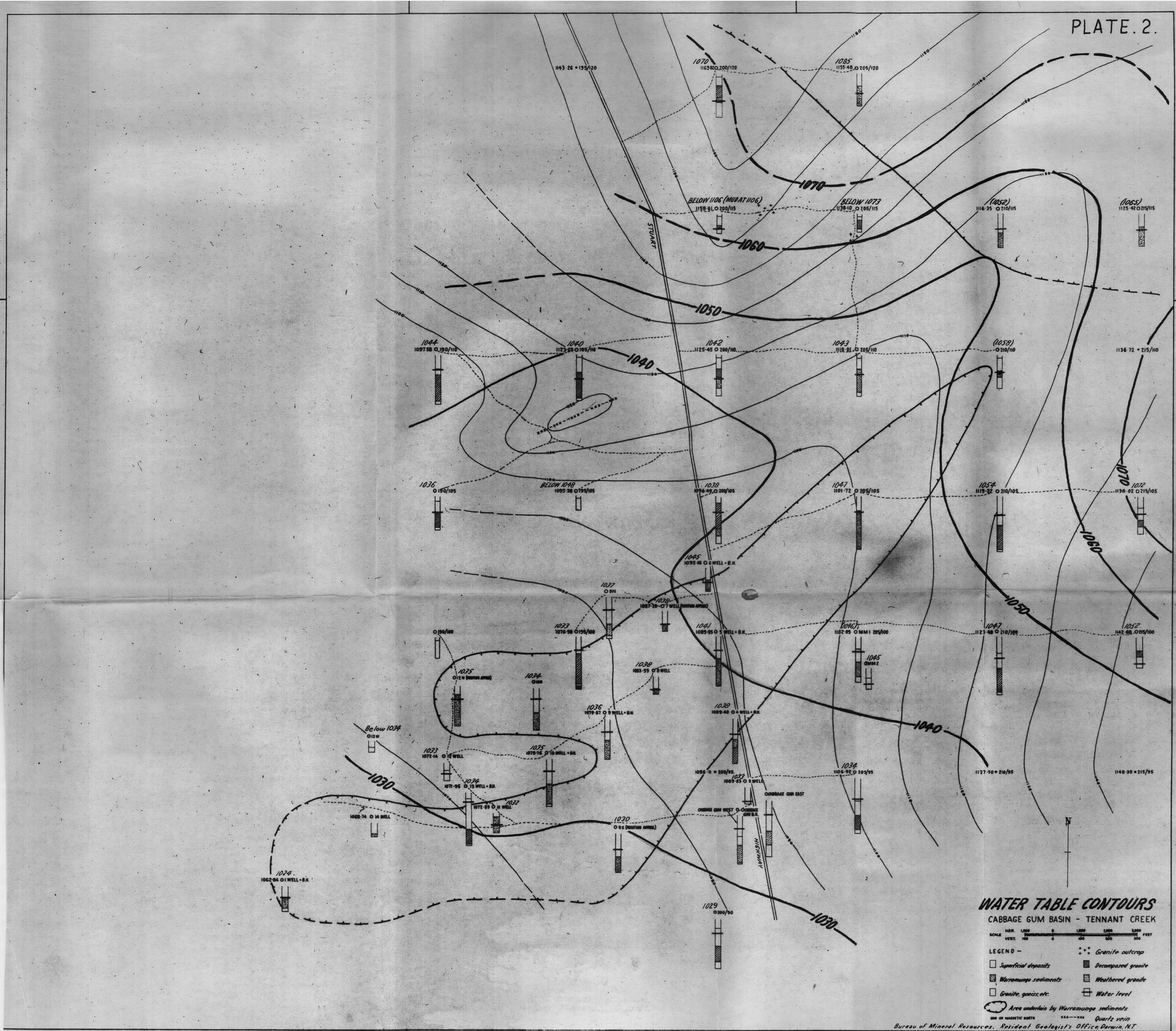
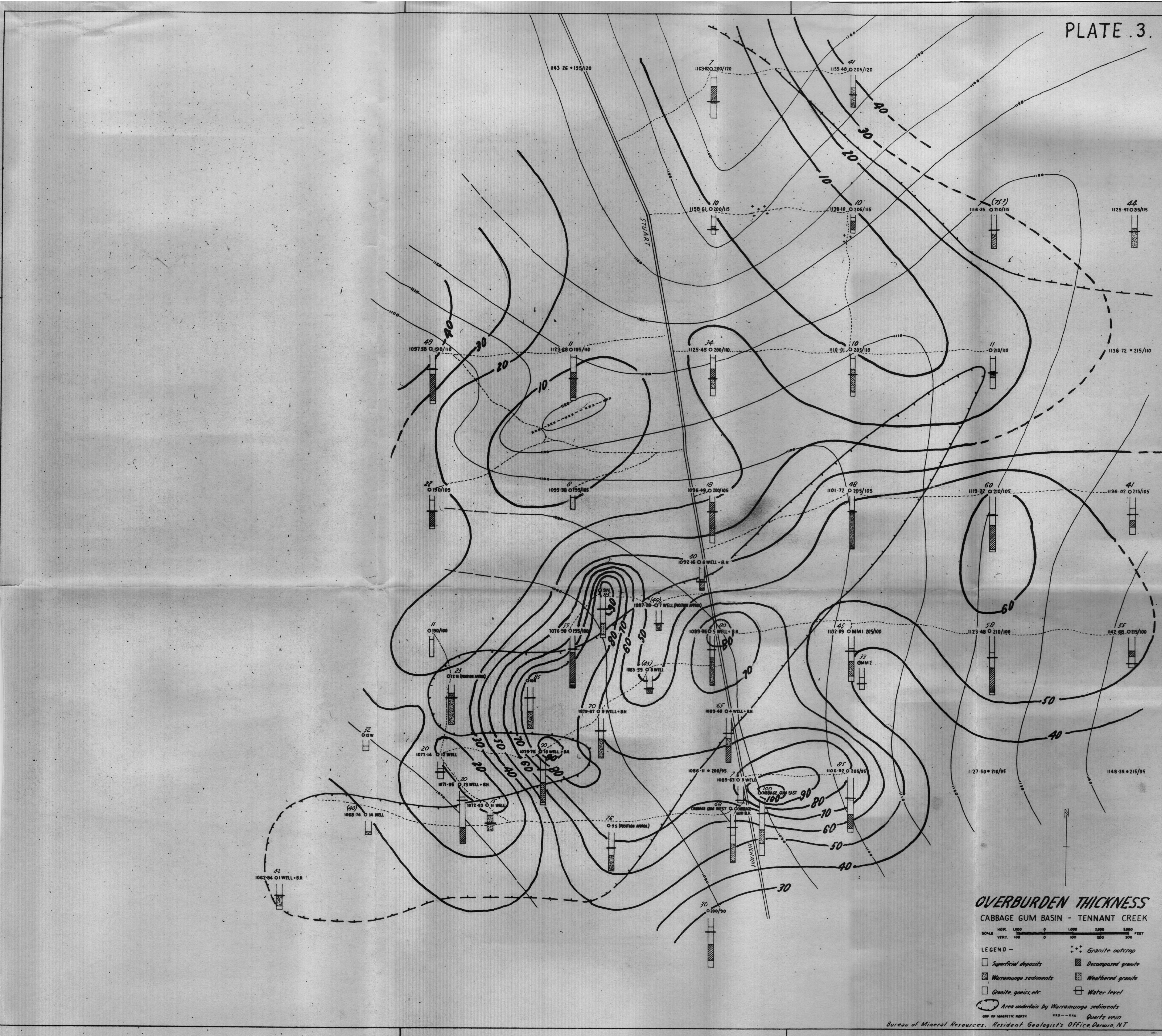


PLATE. 2.
STUART
HIGHWAY
1070
1060
1050
1040
1030
CABBAGE GUM WEST
CABBAGE GUM EAST
N
WATER TABLE CONTOURS
CABBAGE GUM BASIN - TENNANT CREEK
SCALE HOR. 1,000 0 1,000 2,000 3,000 FEET
VERT. 100 0 100 200 300
LEGEND -
Superficial deposits
Warramunga sediments
Granite, gneiss, etc.
Granite outcrop
Decomposed granite
Weathered granite
Water level
Area underlain by Warramunga sediments
GRID ON MAGNETIC NORTH
Quartz vein
Bureau of Mineral Resources, Resident Geologist's Office, Darwin, N.T.

PLATE .3.



OVERBURDEN THICKNESS
CABBAGE GUM BASIN - TENNANT CREEK
STUART
HIGHWAY
LEGEND -
Superficial deposits
Warramunga sediments
Granite, gneiss, etc.
Granite outcrop
Decomposed granite
Weathered granite
Water level
Area underlain by Warramunga sediments
Quartz vein
Bureau of Mineral Resources, Resident Geologist's Office, Darwin, N.T.

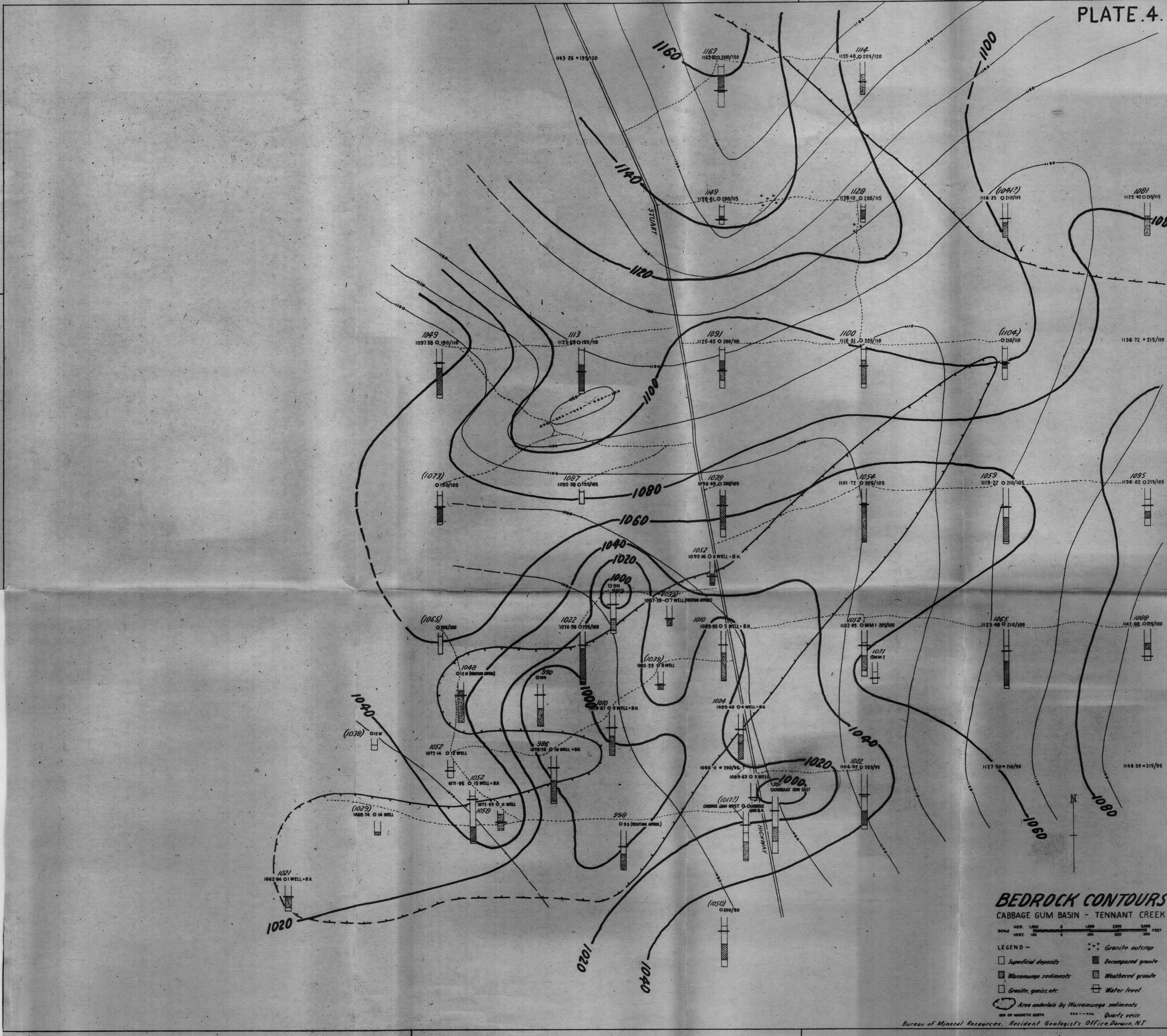
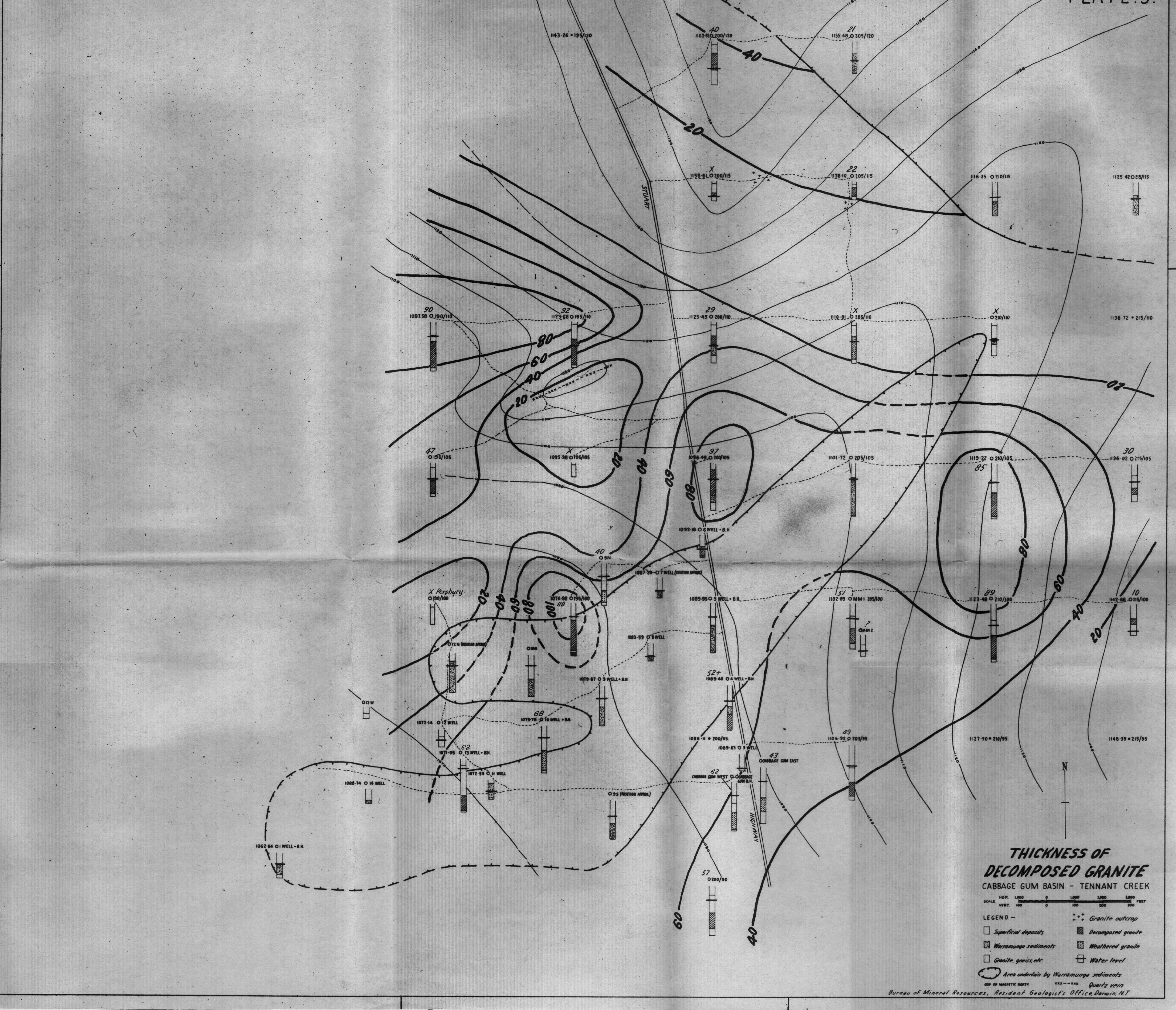


PLATE.4.
BEDROCK CONTOURS
CABBAGE GUM BASIN - TENNANT CREEK
LEGEND -
Superficial deposits
Warramunga sediments
Granite, gneiss, etc.
Granite outcrop
Decomposed granite
Weathered granite
Water level
Area underlain by Warramunga sediments
Quartz vein
STUART
HIGHWAY
CABBAGE GUM EAST
CABBAGE GUM WEST
1160
1140
1120
1100
1080
1060
1040
1020
1000
Bureau of Mineral Resources, Resident Geologist's Office, Darwin, N.T.

PLATE. 5.



THICKNESS OF DECOMPOSED GRANITE
CABBAGE GUM BASIN - TENNANT CREEK
SCALE HOR. 1,000 0 1,000 2,000 3,000 FEET
VERT. 100 0 100 200 300
LEGEND -
Granite outcrop
Superficial deposits
Decomposed granite
Warramunga sediments
Weathered granite
Granite, gneiss, etc.
Water level
Area underlain by Warramunga sediments
GRID ON MAGNETIC NORTH
Quartz vein
STUART HIGHWAY
X Porphyry
CABBAGE GUM EAST
CABBAGE GUM WEST
N
Bureau of Mineral Resources, Resident Geologist's Office, Darwin, N.T.

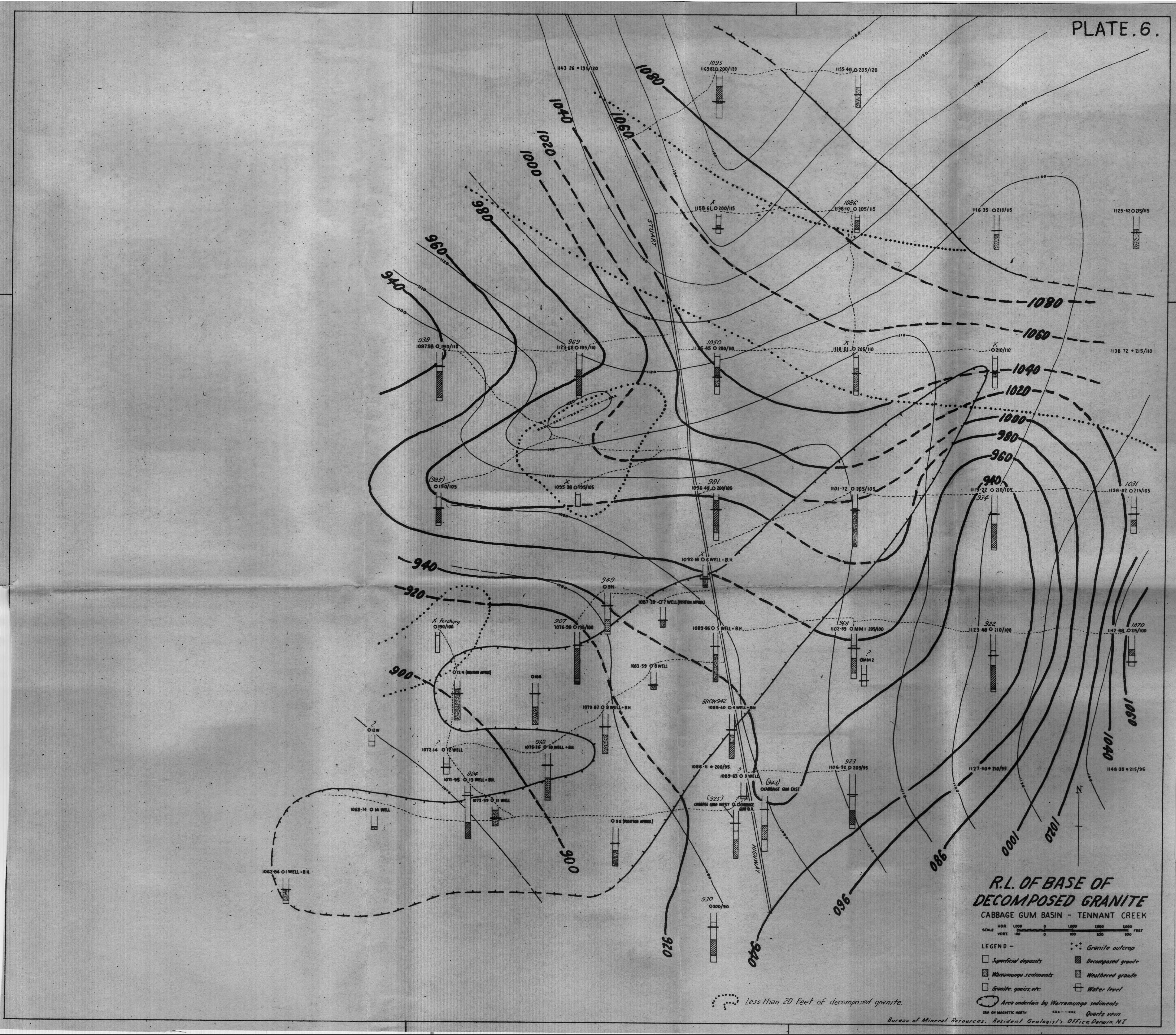


PLATE. 6.
R.L. OF BASE OF DECOMPOSED GRANITE
CABBAGE GUM BASIN - TENNANT CREEK
SCALE HOR. 1,000 0 1,000 2,000 3,000 FEET
VERT. 100 0 100 200 300
LEGEND -
Superficial deposits
Warramunga sediments
Granite, gneiss, etc.
Granite outcrop
Decomposed granite
Weathered granite
Water level
Area underlain by Warramunga sediments
GRID ON MAGNETIC NORTH
Quartz vein
Less than 20 feet of decomposed granite.
Bureau of Mineral Resources. Resident Geologist's Office, Darwin, N.T.
STUART
HIGHWAY
CABBAGE GUM EAST
CABBAGE GUM WEST
X Porphyry
N
1080
1060
1040
1020
1000
980
960
940
920
900

PLATE. 7.

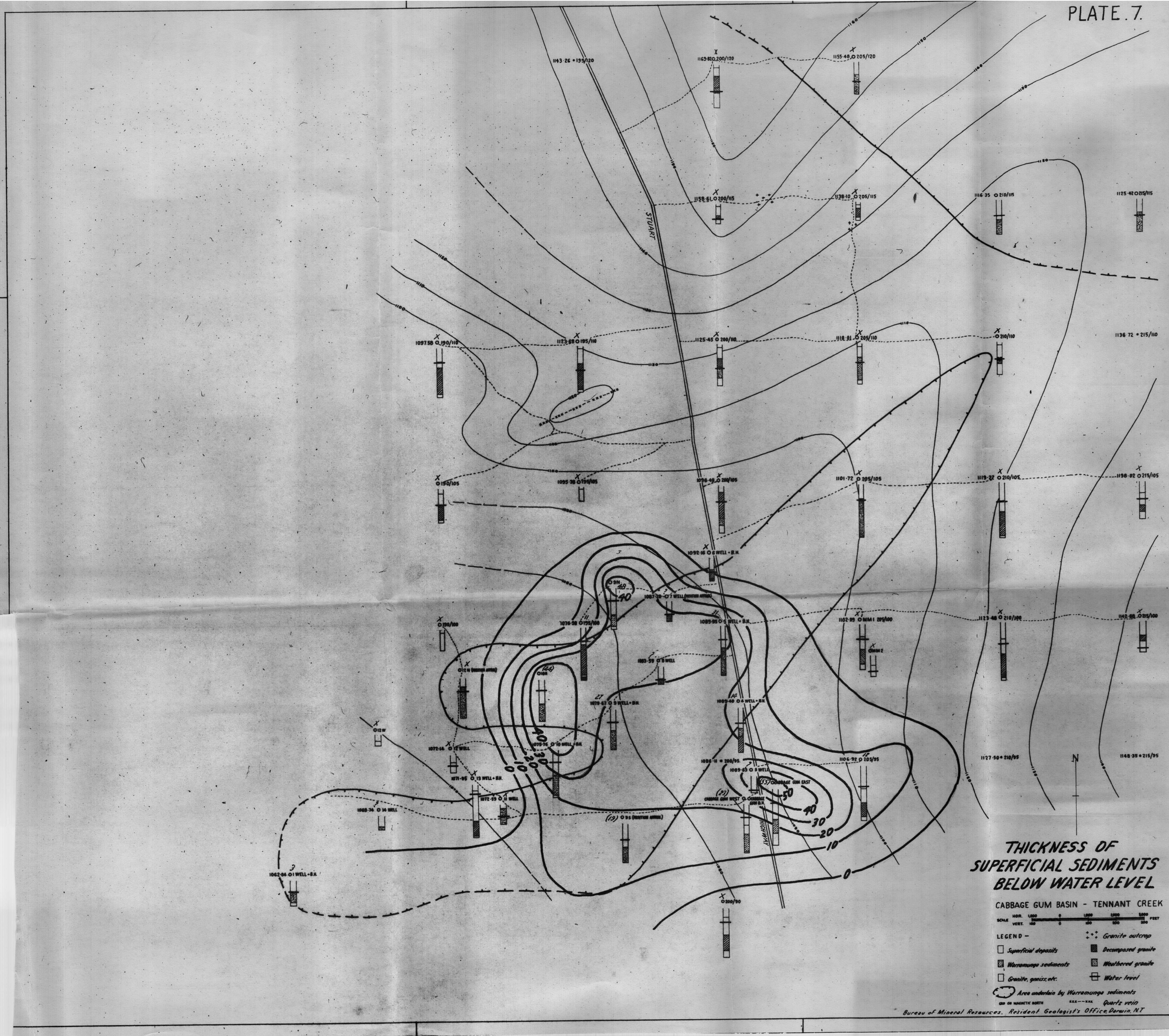

THICKNESS OF SUPERFICIAL SEDIMENTS BELOW WATER LEVEL
CABBAGE GUM BASIN - TENNANT CREEK
SCALE HOR. 1,000 0 1,000 2,000 3,000 FEET
VERT. 100 0 100 200 300
LEGEND -
Superficial deposits
Warramunga sediments
Granite, gneiss, etc.
Granite outcrop
Decomposed granite
Weathered granite
Water level
Area underlain by Warramunga sediments
GRID ON MAGNETIC NORTH
Quartz vein
STUART
HIGHWAY
CABBAGE GUM EAST
CABBAGE GUM WEST
0
10
20
30
40
50
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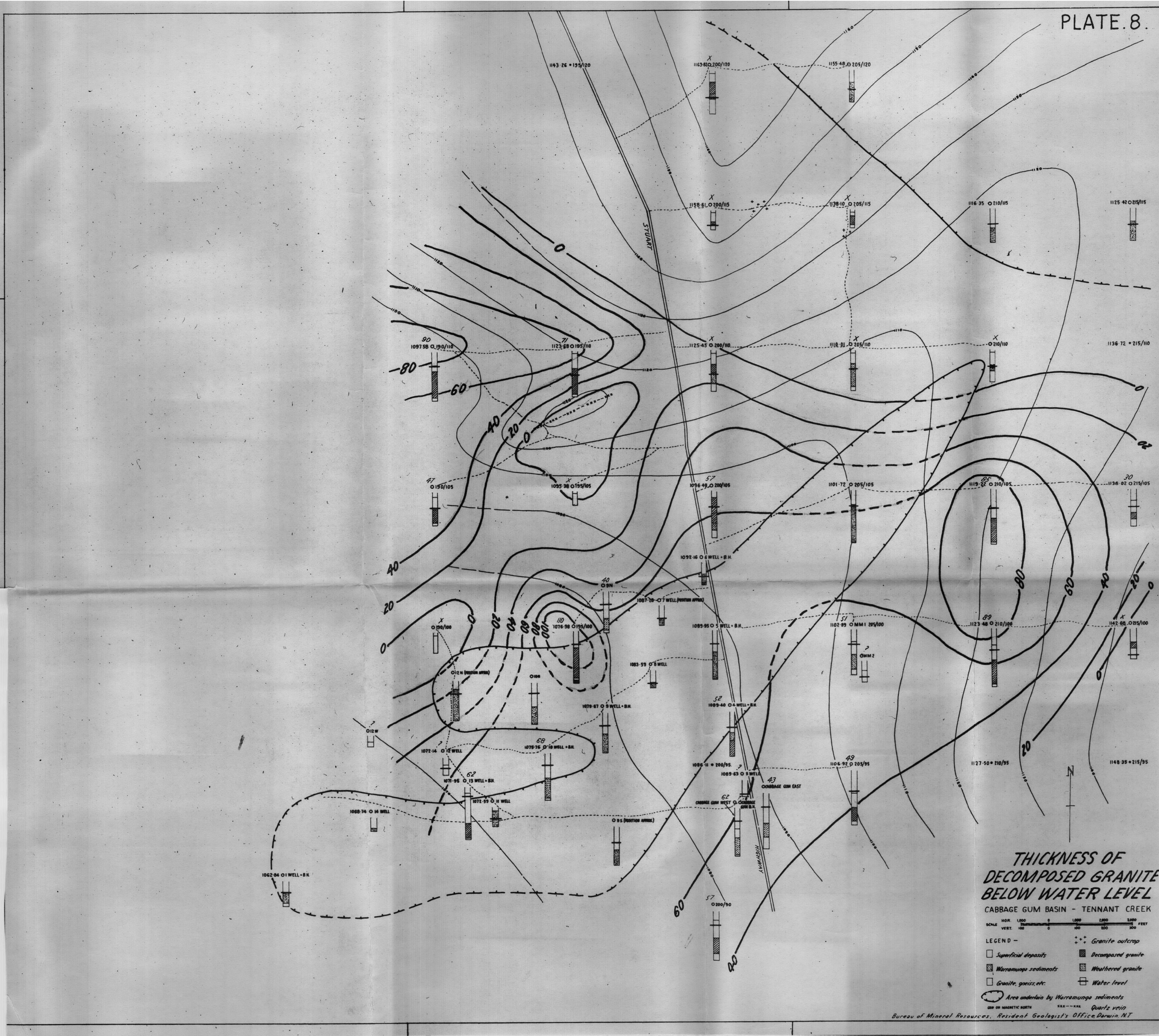
PLATE. 8.



THICKNESS OF DECOMPOSED GRANITE BELOW WATER LEVEL

CABBAGE GUM BASIN – TENNANT CREEK

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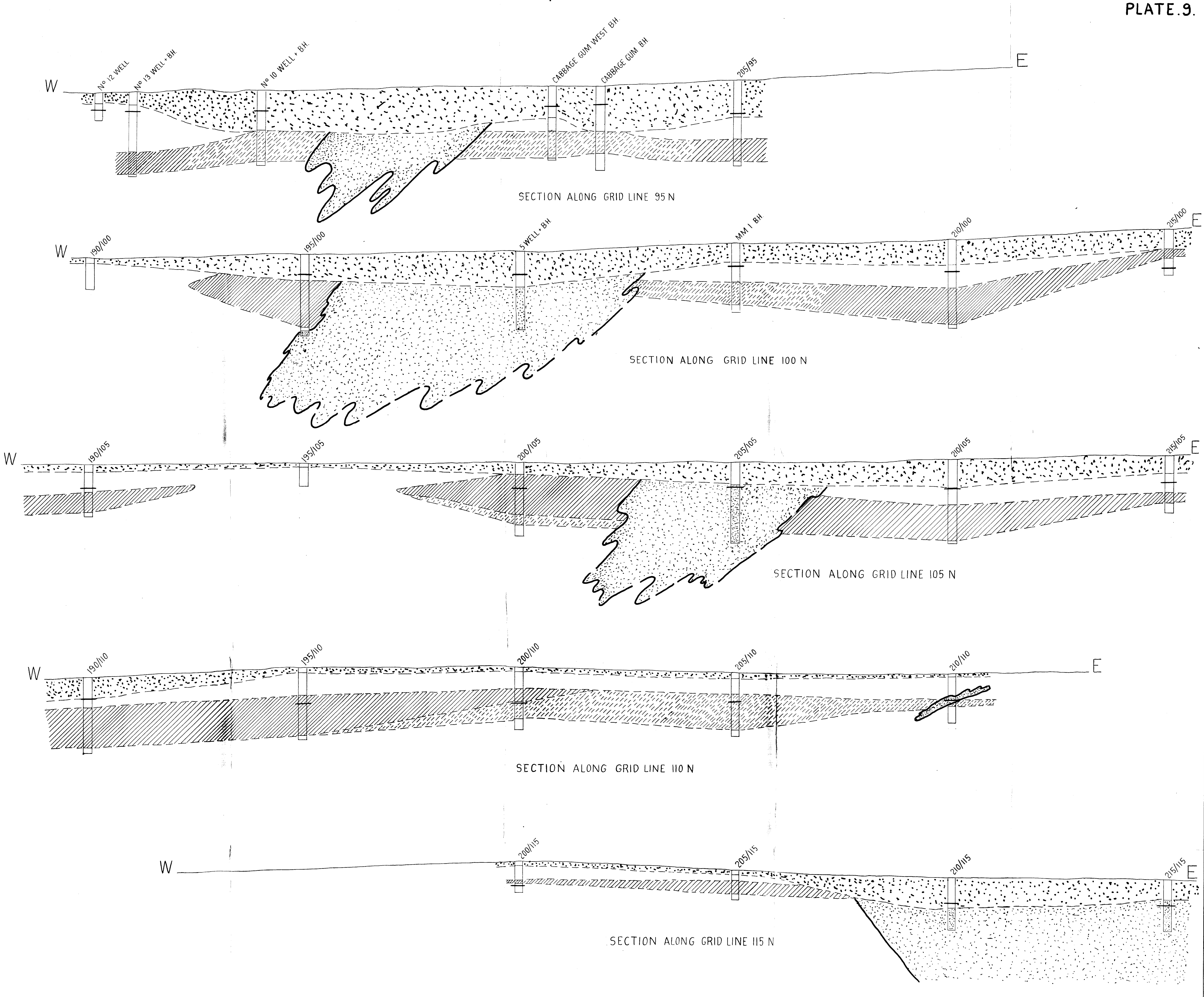
PLATE. 9.



EAST-WEST SECTIONS

CABBAGE GUM BASIN - TENNANT CREEK

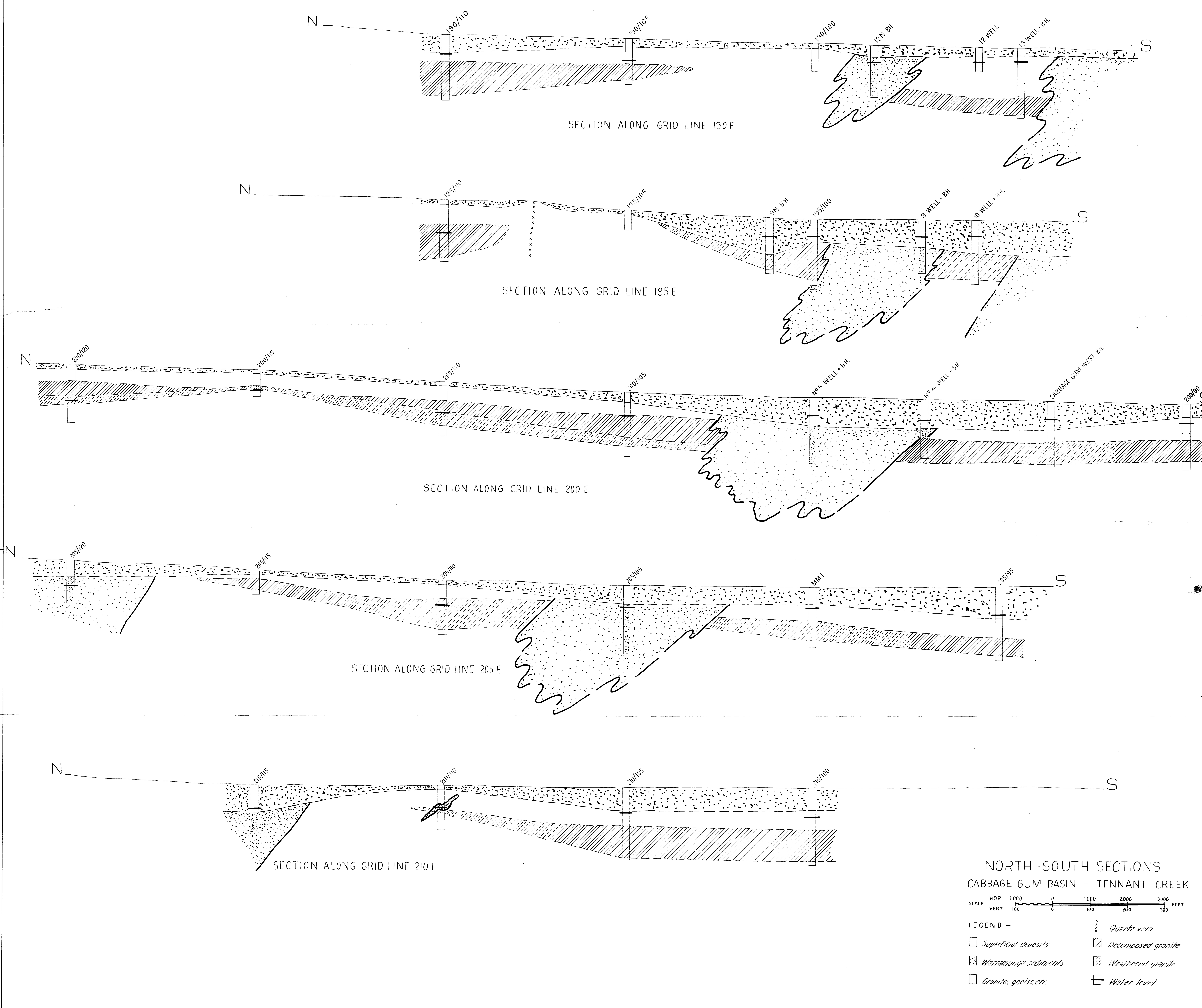
SCALE HOR. 1,000 0 1,000 2,000 3,000 FEET
VERT. 100 0 100 200 300

LEGEND -

- *Superficial deposits*
- *Warramunga sediments*
- *Granite, gneiss, etc.*
- *Decomposed granite*
- *Weathered granite*
- *Water level*

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

PLATE. 10.



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