COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS

RECORDS:

1964/175

AN OCCURRENCE OF GROUNDWATER IN THE PETERMANN RANGES, NORTHERN TERRITORY.

by

I.P. Youles

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SUMMARY

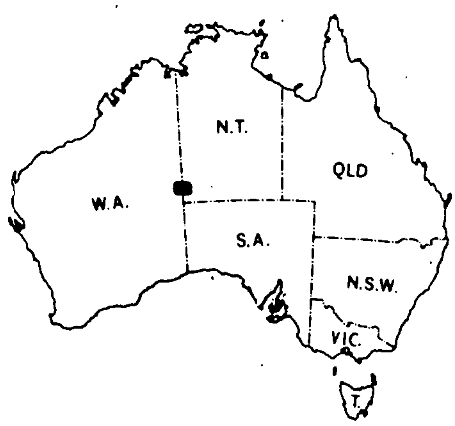
This report discusses the results of an investigation to establish a groundwater supply for a native settlement in the Petermann Ranges. The area was geologically mapped by a field party from the Bureau of Mineral Resources in 1962, but no previous hydrological investigations have been made. The investigation was confined to sediments which fill an alluvial basin.

The basin underlies an area of approximately fifty square miles and contains Quaternary sediments overlying probable Tertiary sediments, up to 205 feet thick. The latter consist of conglomerate and variously coloured sandy clays with thin sand and gravel interbeds. The sediments rest on a basement of Upper Proterozoic sedimentary rocks and metamorphic rocks.

The main aquifers are beds of sand and gravel. They contain water of three major types - bicarbonate, chloride, and sulphate-chloride. A production bore has been constructed in the area containing the bicarbonate water.

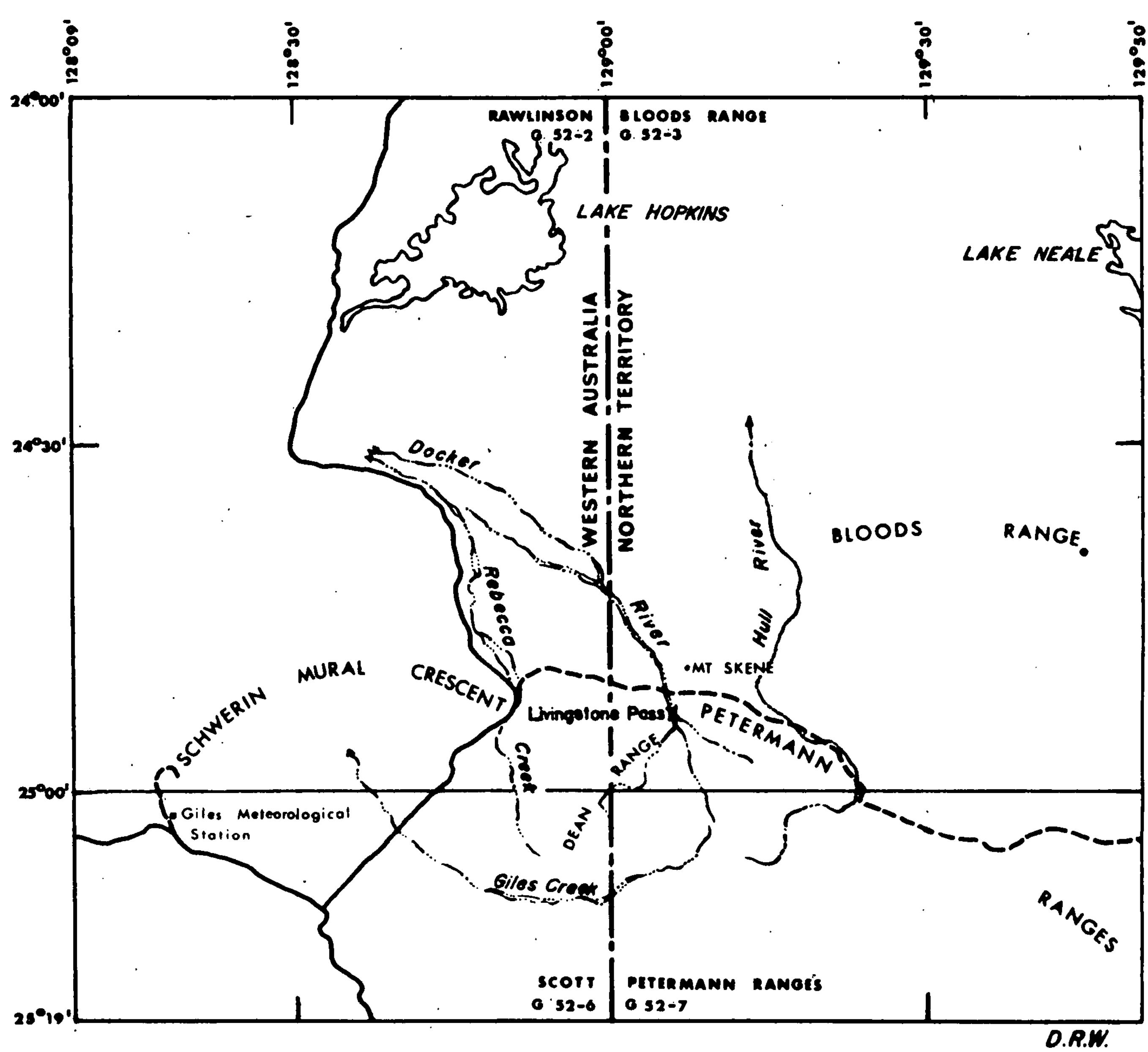
FIG. 1

LOCALITY MAP of LIVINGSTONE PASS AREA, N.T.



SCALE

0 10 20 30 40 Miles



D.R.W.

Bureau of Mineral Resources, Geology and Geophysics, February 1965

To accompany Record 1964/175

G52/A/1

INTRODUCTION

GENERAL STATEMENT

The District Engineer, Water Resources Branch, Northern Territory Administration, Alice Springs, requested geological assistance in a programme of drilling at the Petermann Ranges, to investigate the possibilities of establishing a groundwater supply suitable for a native settlement.

The area investigated is in the south-western corner of the Bloods Range 1:250,000 Sheet area, and is situated 300 miles west-south-west of Alice Springs, adjacent to the Western Australia Border (figure 1).

DRILLING RESULTS

The results of the drilling programme, which was carried out by the Water Resources Branch, Northern Territory Administration, Alice Springs, between May and August, 1963, are summarized in the following table.

TABLE 1

Bore No.	Depth	T.D.S.XX	Yield	Drawdown	Remarks
G52/3-1	208 ft.	525 ppm*	1200 gph	4.85 ft.	
G52/3-2	130 ft.	3860 ppm*	1440 gph	12.1 ft.	
G52/3-3	130 ft.	5160 ppm	not tested		
G52/3-4	130 ft.	1528 ppm	600 gph	14 ft.	
G52/3-5	205 ft.	546 ppm	not tested		100' N.E. of bore 3-10
G52/3-6	117 ft.	2832 ppm	1000 gph	18.15 ft.	
G52/3-7	155 ft.	1167 ppm	not tested		
G52/3-8	105 ft	-	not tested		100' south of bore 3-1
G52/3-9	105 ft.	-	not tested		100' north of bore 3-1
G52/3-10	120 ft.	318 ppm	1750 gph	22.5 ft.	Production bore

XX T.D.S. - Total Dissolved Salts

* - Average of several analyses

The locations of bores are given in Appendix 1, and illustrated on Plate 1.

Graphic logs of the main bores are shown in figures 2 and 3. Discussions of the results of the drilling programme, now completed, is included in subsequent sections of this report.

PREVIOUS INVESTIGATIONS

No previous investigations for groundwater supplies have been made in this area; an assessment of the groundwater potential of the area has been prepared prior to the commencement of drilling (Youles, 1963).

GEOLOGY

The regional geology of the Bloods Range 1:250,000 Sheet area is discussed by Forman (1963), and the areal distribution of the formations as mapped by Forman and Stewart in 1962 is shown on the attached map (Plate 1). Forman correlates the Dean Quartzose and Pinyinna Beds with the Heavitree Quartzite and Bitter Springs Limestone respectively. The latter two units crop out in the Alice Springs 1:250,000 Sheet area.

The Dean Quartzite and Pinyinna Beds are thrust faulted and isoclinally folded; the thrust and fold axes trend east. Subsequent erosion has produced prominent ridges of Dean Quartzite, and extensive valleys which have been filled with Quaternary and Tertiary sediments; the maximum known thickness of the Quaternary and Tertiary sediments is 205 feet. The valleys are generally underlain by Pinyinna Beds to the north of the Dean Range, and by granite, schistose quartz-feldspar porphyry and porphyroblastic schist to the south.

TERTIARY SEDIMENTS

The Tertiary sediments which have been investigated are divided into three major units. These are, in descending order:-

Light brown sandy clay unit

Cream, yellow and grey sandy clay unit

Conglomerate

The age of these sediments is unknown. The conglomerate deposits are tentatively regarded as Tertiary (Forman 1963), and a Tertiary age has been assigned to the sandy clay units by correlation with Tertiary sediments of similar lithology which occur near Alice Springs.

TABLE 2.

ELEVATION OF: BORE NO.	G52/3-1	G52/3-5	G52/3-6
Collar	1902 ft.	1942 ft.	1957 ft
Base of Quaternary sediments and Top of Light Brown Sandy Clay Unit	1892	1925	1947
Top of Cream, Yellow and Grey Sandy Clay Unit		1802	1929
Bedrock - Dean Quartzite	1697	1742	1842
Top and Bottom of Sand and Gravel horizons	1830 - 1760	1880-1820	1905-1875

Datum level - mean sea level

Conglomerate

The lower portion of the dip slopes of the outcrops of quartzite are commonly covered by piedmont deposits, which form only a small portion of the total volume of sediments. Forman (1963) describes the occurrences as follows:- "The conglomerate of these deposits is angular, poorly sorted with the largest boulder sized fragments nearest the ranges or hills. Where the conglomerate dips beneath the sand it is of pebble grade and better sorted and rounded than nearer the ranges. The components are invariably derived from the more resistant rock in the adjacent ranges or hills".

Cream, Yellow and Grey Sandy Clay Unit.

This unit consists of sandy clays with thin sand and gravel interbeds.

The sandy clays consist mainly of clear and white quartz grains in cream clay (G52/3-6), or in yellow and grey clay (bore G52/3-5). The sand size varies from fine to coarse with a variable but appreciable quantity of gravel; mica is the main constituent of the silt fraction.

Sand and gravel interbeds were intersected in bore G52/3-6 only. The beds contain material from almost all grain size classes, and range texturally from silty sand to coarse gravel. Sub-angular to sub-rounded fragments of un-weathered quartz, gneiss and quartzite form the gravel fraction; the sand fraction is mainly white and clear quartz, and the silt fraction is quartz and mica.

Light Brown Sandy Clay Unit.

This unit consists of sandy clay, sand and gravel interbeds and travertine.

The major portion of the unit is light brown sandy clay, which is generally associated with a little light grey and red-brown sandy clay; rarely, there are small amounts of yellow and white sandy clays intermixed. Microscopically the light brown sandy clay consists of red-brown quartz grains in cream clay; the light grey sandy clay, however, has clear and white quartz grains, and the red-brown variety has red-brown quartz grains and clay. The sand size varies from fine to coarse with a variable but appreciable quantity of gravel; mica is the main constituent of the silt fraction.

The sand and gravel interbeds within this unit contain material from almost all grain size classes, and range texturally from silty sand to coarse gravel. Sub-angular to sub-rounded fragments of unweathered and strongly weathered gneiss, quartz, and quartzite form the gravel fraction; the sand fraction is mainly red-brown quartz, and the silt fraction is quartz and mica.

Little is known of the physical dimensions of the individual sand and gravel bodies; the thicknesses of individual bodies vary between three and twenty feet, and the bodies probably anastomose both vertically and horizontally through the sediments (figure 2).

Two varieties of travertine are associated with the light brown sandy clay unit; they are referred to as white and brown travertine.

White travertine occurs as small white fragments of calcite distributed randomly in the sandy clays. It is found at shallow depths (less than 80 feet) in areas of low permeability. Bores G52/3-2,3,4, and 6 intersected portions containing white travertine, which formed a maximum of 5% in individual bore samples.

Brown travertine consists of red-brown and clear quartz grains and nodular relics of brown sandy clay cemented by calcite. It occurs in bores G52/3-2 and G52/3-3 only, from 60 feet below surface to total depth of drilling, 130 feet. Within this zone the travertine is unevenly distributed, the amount per 5 feet sample varying from nil to 100%.

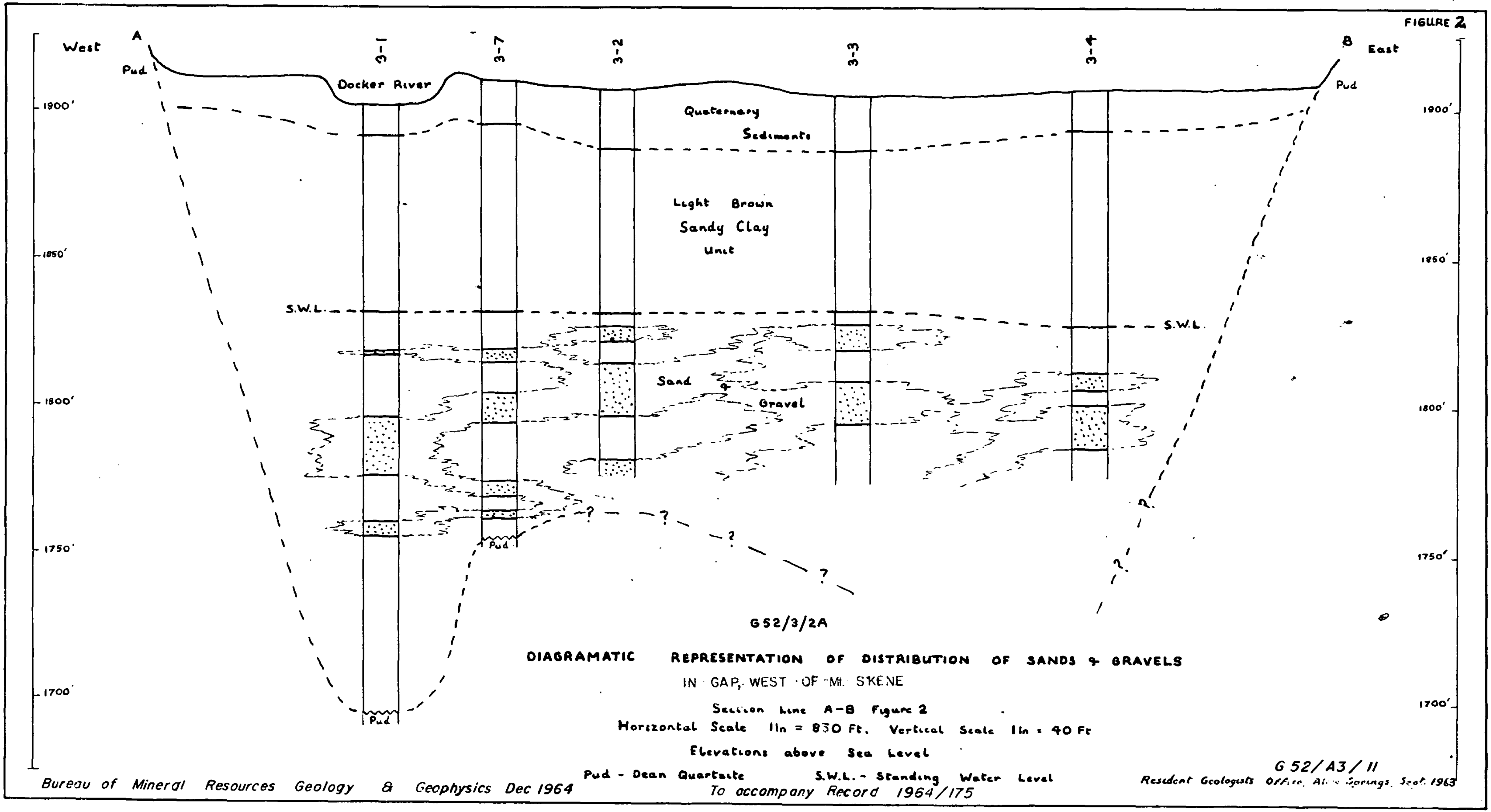
Quaternary Sediments

Red-brown silty sands of aeolian origin and the surface alluvium associated with the rivers (Plate 1) form a thin capping over the Tertiary sediments, and are of Quaternary age. The maximum thickness intersected was 20 feet in bore G52/3-2.

GEOMORPHIC DEVELOPMENT OF THE BASIN

Very little information is available on the form of bedrock contours; bedrock profile in the gap west of Mt. Skene (figure 2) indicates that the basin was formed by fluvial erosion. Degradation was controlled by a local base level of erosion in that gap approximately 1690 feet above sea level. Secondary base levels of erosion exist upstream; one is 1½ miles north of Livingstone Pass, approximately 1740 feet above sea level, and another is at Livingstone Pass, approximately 1840 feet above sea level.

The texture of the Tertiary sediments and the spatial distribution of the lithological types suggest that the sediments were deposited by stream flow. No detailed sequence of events can be postulated as there is insufficient evidence.



DIAGRAMATIC REPRESENTATION OF DISTRIBUTION OF SANDS & GRAVELS IN GAP, WEST OF Mt. SKENE

Section Line A-B Figure 2

Horizontal Scale 1In = 830 Ft. Vertical Scale 1In = 40 Ft

Elevations above Sea Level

Pud - Dean Quartzite S.W.L. - Standing Water Level

HYDROLOGY

Groundwater is stored in the Tertiary sediments of the basin. It is lost from the basin by natural sub-surface flow through the gap west of Mt. Skene, and is recharged mainly by run-off from the ridges. The Docker River provides some recharge by infiltration through the river bed for short periods following infrequent floods.

AVAILABILITY OF GROUNDWATER

Granite, Schistose Porphyry and Porphyroblastic Schist.

The permeability and porosity of these rocks is low. A small quantity of groundwater may move into the sediments in the Learmonth Park area through joints or fracture zones, but these rocks are unlikely to provide substantial quantities of groundwater.

Pinyinna Beds and Dean Quartzite

Because of the similarity of the Pinyinna Beds to the Bitter Springs Limestone, it is possible that aquifers exist in the Pinyinna Beds. This possibility has not been investigated.

The Dean Quartzite is unlikely to yield substantial quantities of groundwater because the formation consists of hard silicified sandstone with very low interstitial porosity; joint permeability may be present. The unit has not been tested.

Sand and Gravel

Thin beds of sand and gravel within the Tertiary sediments are the main aquifers of the basin. Their bulk permeability and porosity are both good. Although individual bodies are generally of small extent, they are, apparently, interconnected. Substantial quantities of groundwater will be available from these sediments, the majority of which are below the piezometric surface.

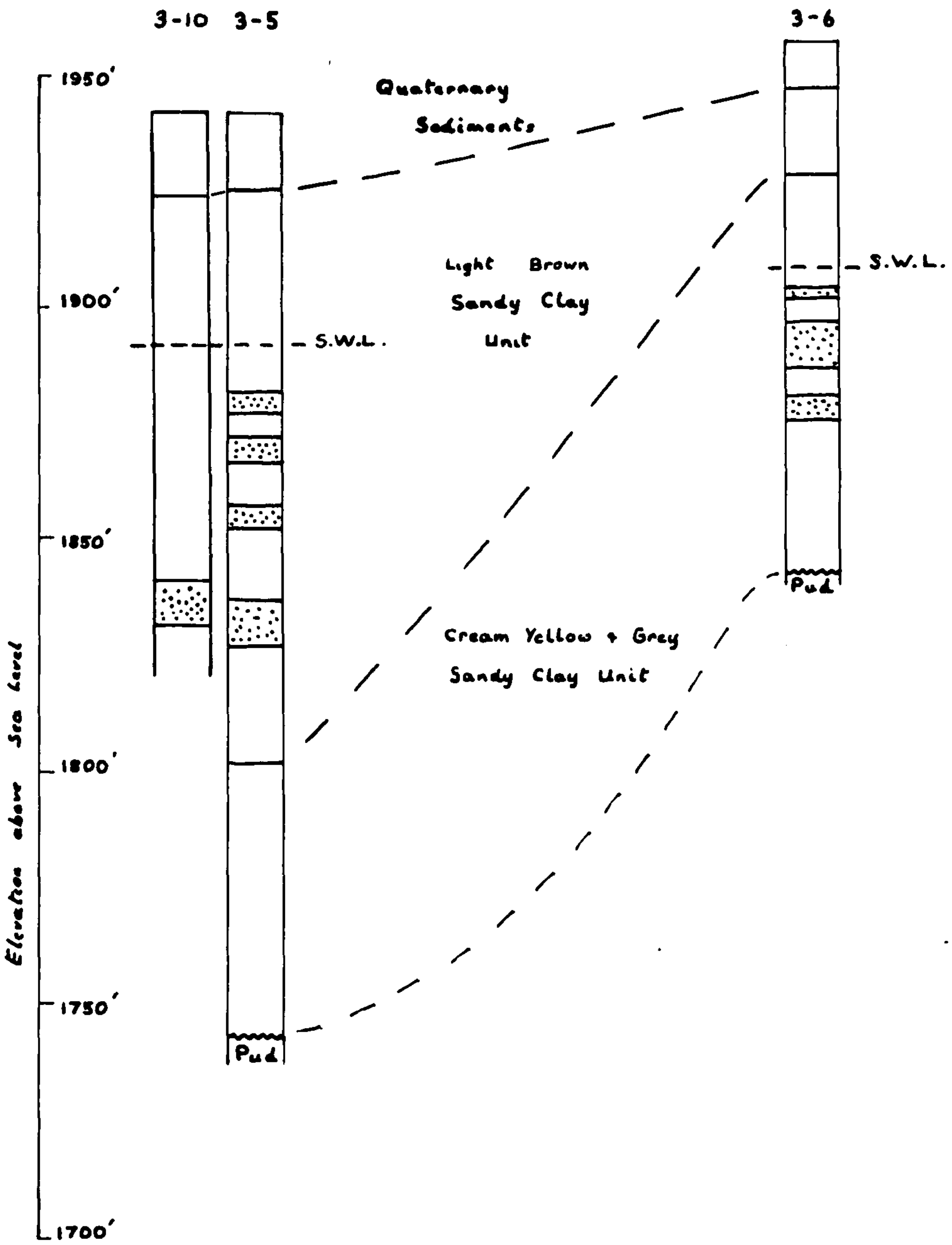
Sandy Clays

The sandy clays generally have a low permeability and a moderate porosity. Significant quantities of water may be obtained indirectly from these sediments by long term drainage into the more permeable sand and gravel beds.

Quaternary Sediments

These sediments cannot yield groundwater as they are invariably above the piezometric surface.

FIGURE 3



G52/3/3A

GRAPHIC LOGS OF BORES G52-3-5 , 3-6 + 3-10
PETERMANN RANGES

Vertical Scale 1in = 40ft

Pud - Dean Quartzite S.W.L. - Standing Water Level

- Sand + Gravel Horizons

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To accompany Record 1964/175

Resident Geologists Office Alice Springs Oct 1963

G52/A3/1

SALINITY AND MOVEMENT OF GROUNDWATER.

Samples of water from the aquifers intersected were analysed by the Animal Industry Branch, Northern Territory Administration, Alice Springs. The results of these analyses have been plotted on a triangular diagram (Plate 2). It is apparent from the anion triangular diagram that the basin contains three major types of water; these are a bicarbonate water (bores G52/3-5 and G52/3-10), a chloride water (bore G52/3-6) and a sulphate-chloride water (bores G52/3-2 and G52/3-2).

The bicarbonate water occurs in the portion of the light brown sandy clay unit beneath the valley to the north-west of the Dean Range; the surface area of this valley underlain by the unit is estimated to be 10 square miles (Plate 1). The percentage of rainfall that becomes run-off on the Dean Range can be expected to be high. A portion of this run-off will have a ready path for access to groundwater storage through coarse material in alluvial fans at the foot of the Dean Range. The chemical character of the water obtained from bore G52/3-1 indicates that groundwater from this area is discharged through the western side of the gap west of Mt. Skene (Plate 1 and figure 2).

The chloride water occurs in the cream, yellow and grey sandy clay unit, which is thought to underlie most of the Learmonth Park area; the high chloride content indicates that recharge and permeability are both poor. This water discharges mainly through the central and eastern parts of the gap west of Mt. Skene.

The sulphate-chloride water also occurs in the light brown sandy clay unit, in the gap west of Mt. Skene. It is probable that this water comes mainly from the Learmonth Park area, and that the high sulphate content is associated with the brown travertine.

CONCLUSIONS

A groundwater supply of 1000 g.p.h. and of suitable quality for human consumption is available from bore G52/3-10. Although larger supplies are available, pumping rates in excess of 1000 g.p.h. may cause encroachment of chloride water from the Learmonth Park area.

As the surface area of the portion of the basin containing bicarbonate water is approximately 10 square miles, the yield and quality of water available from bore G52/3-10 should remain constant during long periods of drought.

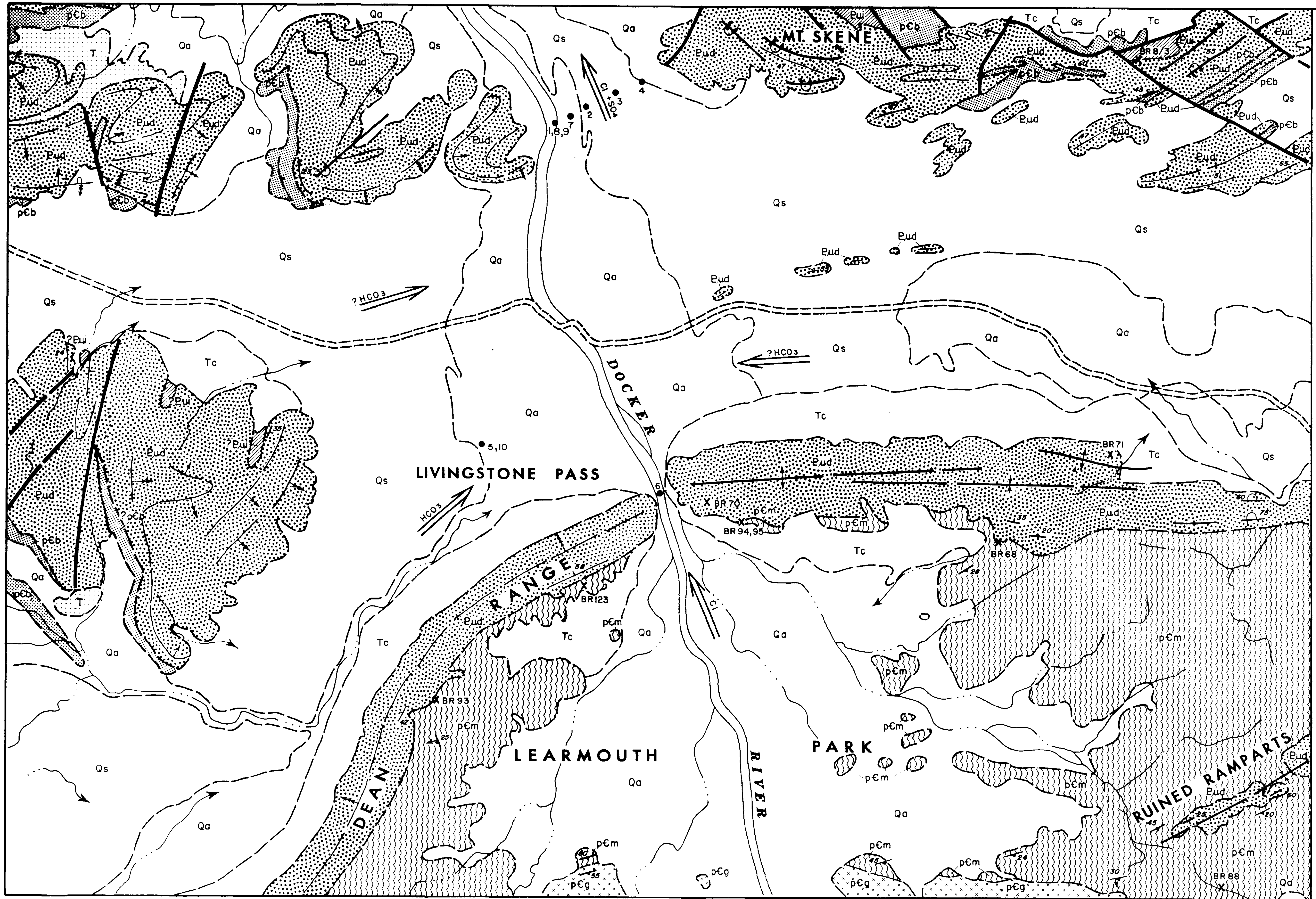
REFERENCES

FORMAN, D.J., 1963 - Regional Geology of the Bloods Range Sheet, South-west Amadeus Basin. Bur.Min.Res.Aust.Rec. 1963/47 (unpubl.).

YOULES, I.P., 1963 - Availability of Groundwater in the Petermann Ranges. Resident Geol. Office, N.T.A., Alice Springs. (unpubl.).

APPENDIX 1.

Bore No.	Latitude	Longitude	Remarks
G52/3-1	24° 49' 55"	129° 05' 50"	
G52/3-2	24° 49' 49"	129° 06' 10"	
G52/3-3	24° 49' 43"	129° 06' 30"	
G52/3-4	24° 49' 36"	129° 16' 50"	
G52/3-5	24° 52' 57"	129° 05' 05"	100' N.E. of bore 3-10
G52/3-6	24° 53' 14"	129° 17' 10"	
G52/3-7	24° 49' 52"	129° 06' 00"	
G52/3-8	24° 49' 55"	129° 05' 50"	100' south of bore 3-1
G52/3-9	24° 49' 55"	129° 05' 50"	100' north of bore 3-1
G52/3-10	24° 52' 57"	129° 05' 05"	



GEOLOGY OF LIVINGSTONE PASS AREA PETERMANN RANGES N.T.

Showing also directions of groundwater movement.

REFERENCE

CAINOZOIC	QUATERNARY		Qs	*Sand*
			Qa	*Alluvium*
	TERTIARY ?		Tc	*Conglomerate*
			T	*White sandstone, pipe rock, conglomerate*
PRECAMBRIAN	UPPER PROTEROZOIC	Pinyinna Beds	Ꝑui	*Dolomite and siltstone. Algal stromatolites*
		Dean Quartzite	Ꝑud	*Quartzite and conglomeratic quartzite, sandstone*
	UNDIFFERENTIATED		p€g	*Coarse porphyritic granite*
			p€m	*Porphyroblastic schists, quartz-feldspar porphyry*
		Bloods Range Beds	p€b	*Sandstone, arkose, tuff, agglomerate, basalt and acid porphyry*

Geological boundary
Syncline
Syncline, overturned
Anticline
Anticline, overturned
Fault
Strike and dip of strata (25)
Vertical strata
Overturned strata (75)
Dip < 15° } *air-photo interpretation*
Dip 15°–45° } *air-photo interpretation*
Dip > 45° } *air-photo interpretation*
Trend lines } *air-photo interpretation*
Strike and dip of foliation (24)
Strike and dip of foliation and plunge of lineation (30)
Reference number of specimen locality (BR 93)
Water bore and reference number (● 7)
Direction of movement of groundwater and its chemical character (HCO3)

N

APPROXIMATE SCALE

1 0 1 2 MILES

Geology, 1962 by D.J. Forman, A.J. Stewart. Compiled, 1962 by D.J. Forman, A.J. Stewart.

G52/A3/9 JK

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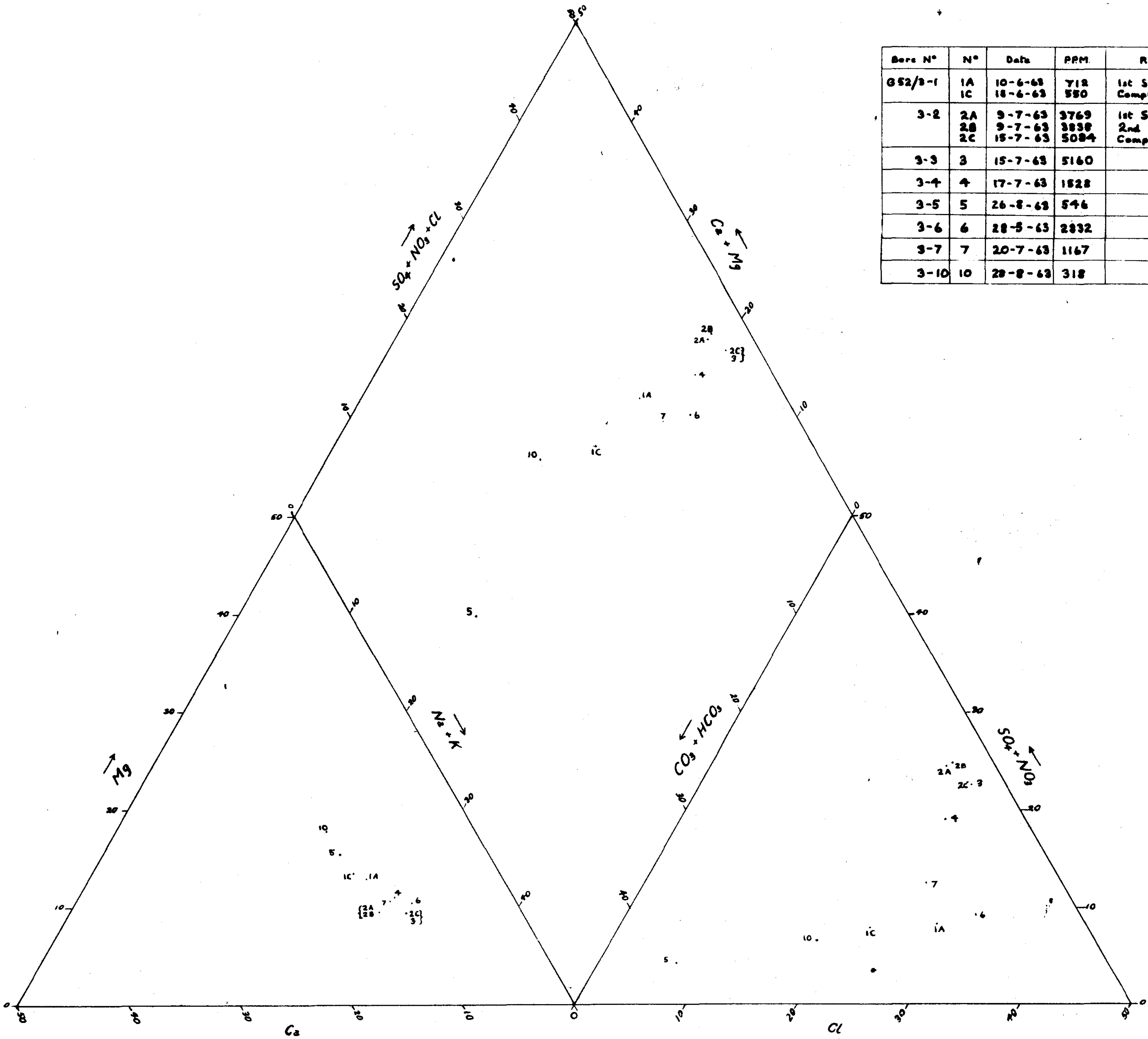
PLATE 2

G 52/3/4A

WATER-ANALYSIS DIAGRAM

PETERMAN RANGES N.T.

Bore N°	N°	Date	P.P.M.	Remarks
G52/3-1	1A 1C	10-6-63 18-6-63	712 550	1st Supply - 82' Completion of bore
3-2	2A 2B 2C	9-7-63 9-7-63 15-7-63	3769 3838 5084	1st Supply - 82' 2nd " - 110' Completion of bore
3-3	3	15-7-63	5160	
3-4	4	17-7-63	1528	
3-5	5	26-8-63	546	
3-6	6	28-5-63	2832	
3-7	7	20-7-63	1167	
3-10	10	28-8-63	318	



Percentage Reacting Values

G 52/A3/10

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Resident Geologists Office, Alice Springs, Sept 1963