DEPARTMENT OF MINES
SOUTH AUSTRALIA

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GROUNDWATER INVESTIGATION:

PORTION OF PICCADILLY VALLEY, ADELAIDE HILLS

Rept.Bk.No. 74/54
G.S. No. 5373
Hyd. No. 2628
D.M. No. 236/74

by

K.D. Wake-Dyster
Student Geologist
Hydrogeology Section

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18th February, 1974

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ABSTRACT

The survey was aimed at various aspects of hydrogeology within the Piccadilly Valley and immediate surroundings. The Piccadilly Valley is located 10 km S.E. of Adelaide in the Hundred of Onkaparinga. The extent of the area ranged from 1 km west of Summertown to Carey Gully to the east, and north-south from Uraidla to Piccadilly (See Fig.1). The main aspects in the survey were trying to relate yields from irrigation bores with both the geology and land use in the area. Following a period of field survey work involving bore location, water sample collection, and standing water level measurement, comparisons with previously recorded information were made. In interpreting the results of the comparisons, direct correlations between the geology, topography, yields from bores and land use are apparent. Few general conclusions can be made due to the lack of regularly recorded information in the past.

INTRODUCTION

For a familiarisation of the Piccadilly Valley region information was obtained from bore cards of sections relating to the survey. Geological information was obtained from both the Department's 1:63,360 Adelaide Geological Map (1951) and the 1:250,000 Adelaide Geological Map (1969) to enable comparisons between the geology and yields from bores.

The area to be specifically surveyed in the valley region extending across to Carey Gully, was chosen as to include different rock types with their distribution disrupted by the N.E. striking Crafers Fault. Generally the land is used for market gardening, orchards and natural pastures. The practice of market gardening is attributed to the excellent quality and quantity of groundwater supplies in the Piccadilly Valley. The position is markedly changed in areas where Pre Cambrian schists and gneisses are the aquifer rocks which produce good quality groundwater but in very small supplies.

PREVIOUS INVESTIGATIONS

The only previous hydrogeological investigations relating to the Piccadilly Valley region include groundwater survey reports on property inspections and on the Uraidla Township as a whole (see References). Information obtained from these reports was valuable in assessing the geology of the area and describing the factors controlling aquifer characteristics.

The main points outlined by previous reports suggest that underground water storage is due to fracture and joint systems in the sandstones, slates and schists. The degree of water storage is affected by infilling of fractures and joints by weathered products such as clays and silts. This aspect is particularly noticeable in the Pre Cambrian schists and gneisses. The underground water pumped from bores is of extremely good quality, with suitable supplies to enable market gardening activities to exist. Due to the good quality and high rainfall an adequate recharge of groundwater is implied, provided over exploitation of groundwater supplies doesnot occur.

In a report by Bleys (1963) on a groundwater survey on Section 1154 Hd. Onkaparinga it was suggested that the Crafers Fault be located further east relative to the plotted location on the 1:63,360 Adelaide Geological Map. The suggestion was purely from observation of nearby rock outcrops with sandstones occurring east of the located fault position. Further evidence from a bore log of sandstones and clays in the location proposed by Bleys (1963) for drilling supported the suggestion. The Crafers Fault line should therefore be relocated in the vicinity of Section 1154, approx. 200m east of its present located position on the 1:63,360 Adelaide geological map. This is to allow continuity with the sandstones on the western side of the fault.

METHOD OF INVESTIGATION

This involved selecting an area containing the Piccadilly Valley south of Uraidla and extending east to Carey Gully. To obtain a detailed study of the area all irrigation bores were required to be located. After a field survey requiring the recording of standing water levels and observation of land use, the collected data was recorded for correlation with the geology, topography and water supplies from bores. The correlations between data were then interpreted to draw conclusions from the overall groundwater study using previously recorded information as a comparison.

GEOLOGY AND TOPOGRAPHY

The rock units of hydrogeological importance are the slates and sandstones of the Torrensian Series, Adelaidean System on the western side of the N.E. striking Crafers Fault. Pre Cambrian crystalline rocks consisting of schists and gneisses outcrop on the eastern side of the fault and are classified as the basement rock types in the area. The Torrensian rocks which rest unconformably on the crystalline basement dip 30° towards the south-east with a change in rock type south of Carey Gully to sandstones of the same type that occur around Uraidla. Another fault further to the east exposes the schists and gneisses again. A geological map of the area studied is presented in Fig. 2. In the S.W. corner of the study area the Torrensian rocks form a minor anticline plunging S.W. Quartzites overlie the slates and sandstones towards Mt. Lofty and Mt. Bonython which form the highest part of the Adelaide Hills region.

The elevation ranges from 460m to 550m (from Adelaide 1:63,360 topographic map). Surrounding the Piccadilly Valley are prominent ridges to the west and east with a small watercourse known as Cox's Creek flowing through the valley south of Uraidla.

LAND USE

The different vegetation types readily illustrate the use of land in the Paccadilly Valley area. The main types are market gardens, orchards, grazing pastures and natural scrub growth with planted pine trees.

Market Gardens:

The main vegetables grown are cabbages, cauliflowers, lettuces, onions, potatoes and sweetcorn. Areas suited for market gardening have plentiful underground water sources, with accessible terrain generally of gentle hill slopes and flood plain areas of the Piccadilly Valley.

Orchards:

Generally orchards are located in areas with a low availability of groundwater and on hillslopes. The types of orchards are apples and a variety of stone fruits including, peaches and plums.

Grazing Pastures:

In areas of poor yields of underground water (e.g. Lower

Proterozoic schists and gneisses), surface water is collected in large dams. The dam water is used to supply beef cattle and other animals with drinking water and in some cases it is used on market gardens. The grazing pastures are natural and introduced grasses, formed by the clearing of scrub vegetation.

Natural Growth and Pine Trees:

Scrub areas occur either in reserves or in environments which have no other economic purpose. Thus scrub areas are located in rugged terrains or on hill tops to prevent severe erosion of the red brown sandy topsoil.

It is important to note that besides geology, topography and water availability affecting land use in the area the ideas of the landowners and economic conditions also have an effect. During the last few years production costs have increased causing specialisation in growing only certain vegetable types with the result of decreasing production costs. Changing ownership may often result in changing land use, particularly in fringe areas of the valley and south of Carey Gully.

HYDROGEOLOGY

Rainfall

The rainfall in the Piccadilly Valley area, using figures from the nearest rainfall station located at Uraidla is 1080mm (42.67ins) annually. This appears to be an adequate source of recharge to aquifers and surface storage.

Aquifer Characteristics

According to Bleys (1969) the Aldgate Sandstone aquifer has a primary permeability which is of less importance than the secondary joint system present. The water storage in the aquifers is due to fracturing and jointing of the sandstone, slates and phyllites of the Torrensian Series and the older schists and gneisses. However, an important factor is this locality is the weathering of sandstone to sands and to a greater extent, schists to clays and silts. The weathered products infill the fractures and joints, thus effecting the permeability of underground water and water storage in the aquifer. The final result of fracture infilling is a rapid decrease in bore yields, especially in the schists and gneisses. As stated previously a change in bore yields sometimes changes the land use in an area with observed cases of market gardens being substituted for orchards.

Salinity

The salinity of underground water from bores in the study area is of a very good quality, with a maximum value of 550 p.p.m. total salts being recorded. The low total salt content and reasonable underground water yields allow intensive market gardening activities in the lower relief areas of the Piccadilly Valley.

The comparison of previous salinity results with those from the field survey indicates an apparent overall increase in the salinity of underground water extented from bores. On the average a 10% increase in salinity has occurred over the last few years, but the rise is not great enough to cause any problems at present.

Factors which could be influencing the increase in salinity are:

1. The removal of underground water supplies from aquifers for irrigation.
2. The weathering of sandstones, slates and schists causing filling of the fracture and joint systems.
3. Seasonal variations in rainfall and climate affecting recharge to the aquifer.

The first factor should have little influence on salinity as the recharge possibilities appear sufficient for replenishing the water in the aquifer. Since the salinity rise is only small, the cause is probably due to a combination of the second and third factors, especially in the schist and gneiss aquifers.

Yields

In discussion of standing water level variations in bores with landowners, the overall opinion appears to be that water levels have remained fairly constant with initiation of market gardening. On the eastern valley slopes the increase in elevation from the valley floor affects the water levels markedly. The yields are smaller with some interplay between neighbouring bores. Deepening of bores is occurring on a small scale also, but the depths of bores are only half those in the valley floor (the average depth of bores in the valley floor region is between 90m and 120m). One reason for smaller yields in valley slope regions is that land use is on a smaller scale than in the valley floor thus requiring less irrigation water.

Several bores penetrating the Aldgate Sandstone near Cox's Creek south of Uraidla overflow in winter, and some all the year round. Similarly circumstances occur near creeks south of Carey Gully. All overflowing bores are situated in locations suited for maximum recharge and in areas of lowest elevation near water courses.

Of the bores surveyed only 10% were accessible for obtaining a standing water level reading. The majority of bores are capped by Pomona turbine pumps or metal caps in the case of submersible pumps being fitted. In comparing previously recorded standing water levels with the survey results the levels appear to be falling slightly. However the cause maybe due only to seasonal fluctuations with comparison of results in different seasons.

An interesting point that developed in discussions with landowners was the effect of tectonic activities in the area on groundwater supplies. In the early 1950's earthquake activities affected existing bores in different ways. Cases exist where yields were completely lost and other of supplies being increased in quantity and quality. The earthquake from the above cases had the effect of both displacing rocks and blocking boreholes and increasing the fracture and joint systems in the aquifers. An increase in fracturing and jointing of rocks would cause an increase in permeability and water storage, in turn increasing the quantity and quality of groundwater.

Recharge Characteristics

The following calculations give an idea of recharge quantities in the Piccadilly Valley area:

The quantity of water available from rainfall per annum

$= 11.7 \times 1.08 \times 10^9$ litres

$= \underline{12.7 \times 10^9 \text{ litres}}$ (2.8×10^9 gall)

The mean annual rainfall for Uraidla is 1080mm (42.67ins). Assuming the intake zone for aquifers is in the Piccadilly Valley or nearby Mt. Lofty Ranges, the total quantity of water available for recharge from rainfall can be calculated.

A selected area containing bores with known supplies was 11.7 km^2 (4.5 sq. ml).

Assuming that all pumps in the area selected operate a third of the year at 12 hrs/day giving 1440 hrs. operation.

The total yield from bores = 315.64 l/sec (250,000 gall/hr)

The quantity of water withdrawn from underground supplies per annum

$= \underline{16.4 \times 10^8 \text{ litres}}$ (3.6×10^8 gallons)

From the calculations, for non-depletion of the aquifers a minimum recharge of 15% of water available from rainfall is required. Depending on the permeability of the aquifer and location of the recharge zone the 15% recharge value maybe too low for minimum recharge. Little information about the permeability of the aquifers and recharge zones could be found in previous reports. However considering the above factors there appears to be adequate recharge with no drastic changes in standing water levels in bores in the Piccadilly Valley.

DISCUSSION

In the preliminary plotting of water supplies from bore cards and comparing with the geology of the area, an apparent correlation exists between them. This may suggest an indirect technique of locating structural features such as faults by contouring water supplies from bores. By comparing Fig. 2 and Fig. 3 the technique is observable by the direct correlations appearing. For the method to be successful a large number of bores are required. A possible use of the method could be in refining geological maps, with the use of bore logs to give subsurface geological information.

SUMMARY AND CONCLUSIONS

The groundwater study of the Piccadilly Valley region involved collecting and comparing information on geology, topography, hydrogeology and agriculture of the area. The purpose of correlating the factors above was to obtain a better understanding of the inter-relationship between them.

The main conclusions arising from the study are based entirely on observable correlations between information which can be obtained by perusing the maps at the rear of the report.

A direct correlation exists between the geology of the Piccadilly Valley region and the groundwater yields, with the greatest supplies being obtained from the Aldgate Sandstone. The influence of the Crafers Fault is as a boundary between the Aldgate Sandstone and older schists and gneisses. The schists and gneisses are poor aquifers due to infilling of fractures and joints with silts and clays to a greater extent than in the Aldgate Sandstones. The existence of Aldgate Sandstone south of Carey Gully is demonstrated on the contour map of groundwater supplies with an increase in yields in that region. The vegetation map in comparison with the other maps suggests that land use is influenced by groundwater availability, relief and the geology of the area.

Providing over exploitation of the underground water resources in the Aldgate Sandstone does not occur, the standing water levels in bores should remain relatively constant.

However, a major study of the region should be carried out to accurately define the aquifer characteristics. The drilling of observation bores to measure any changes in standing water levels with time is recommended. Several landowners have recently been asked to carry out voluntary water level measurements but details have not been finalised.

ACKNOWLEDGEMENTS

I would like to thank members of the Hydrogeology Section for the helpful assistance offered throughout the project and useful experience gained personally from the project.

K.D. Wake-Dyster
Student Geologist
Hydrogeology Section

K.D.W-D:J.L.
18th February, 1974

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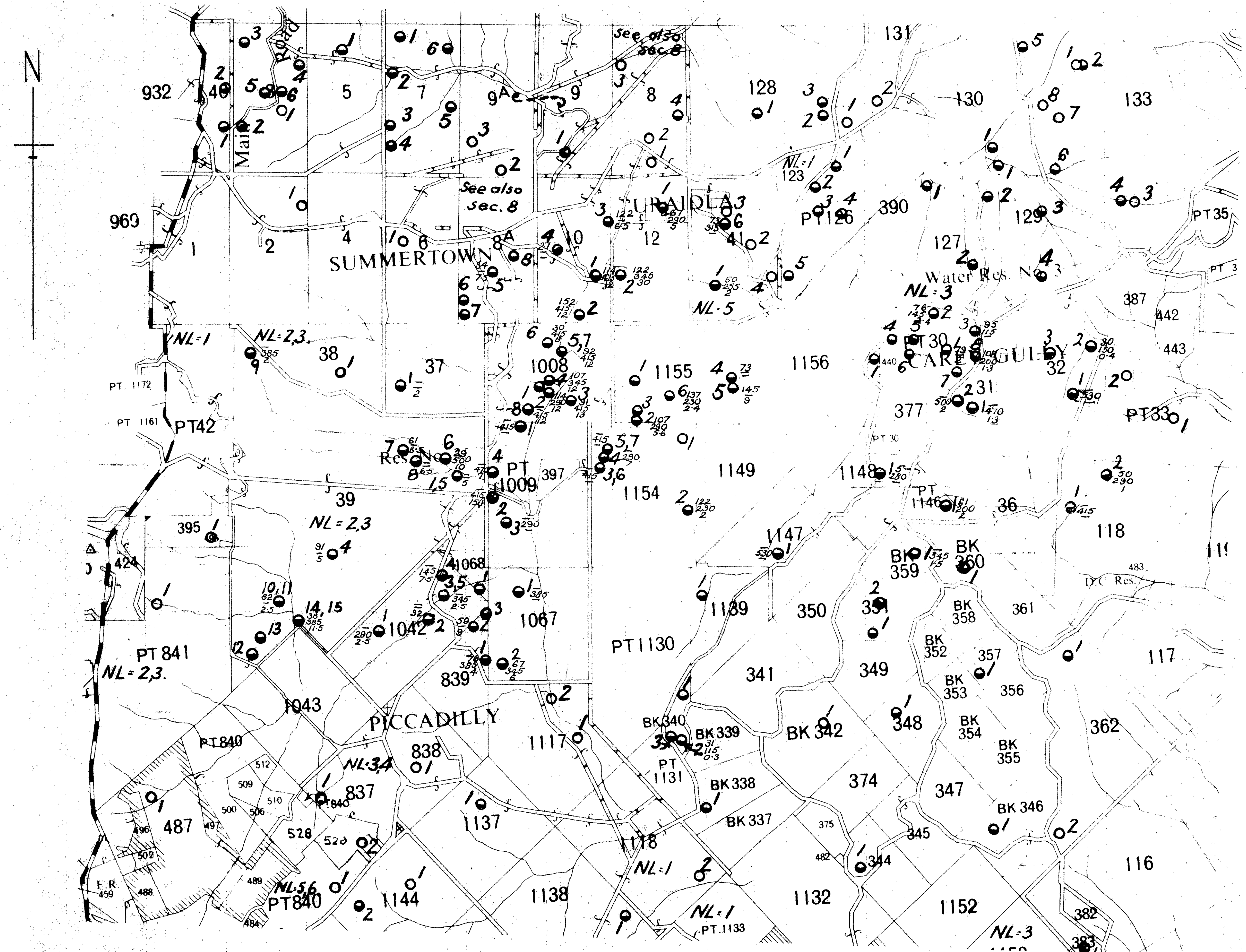

FIG. 1

LEGEND

- ● .... Photograph located borehole.
- ○ .... Located borehole
- 1 .... Borehole number in section
  - 50 .. Depth in metres
  - 415 .. Salinity in milligrams per litre
  - 8 .. Supply in litres per second

SCALE IN KILOMETRES: 0 — 1 — 2

SCALE IN MILE: ·25 — 0 — ·25 — ·5 — ·75 — 1 — 1·25

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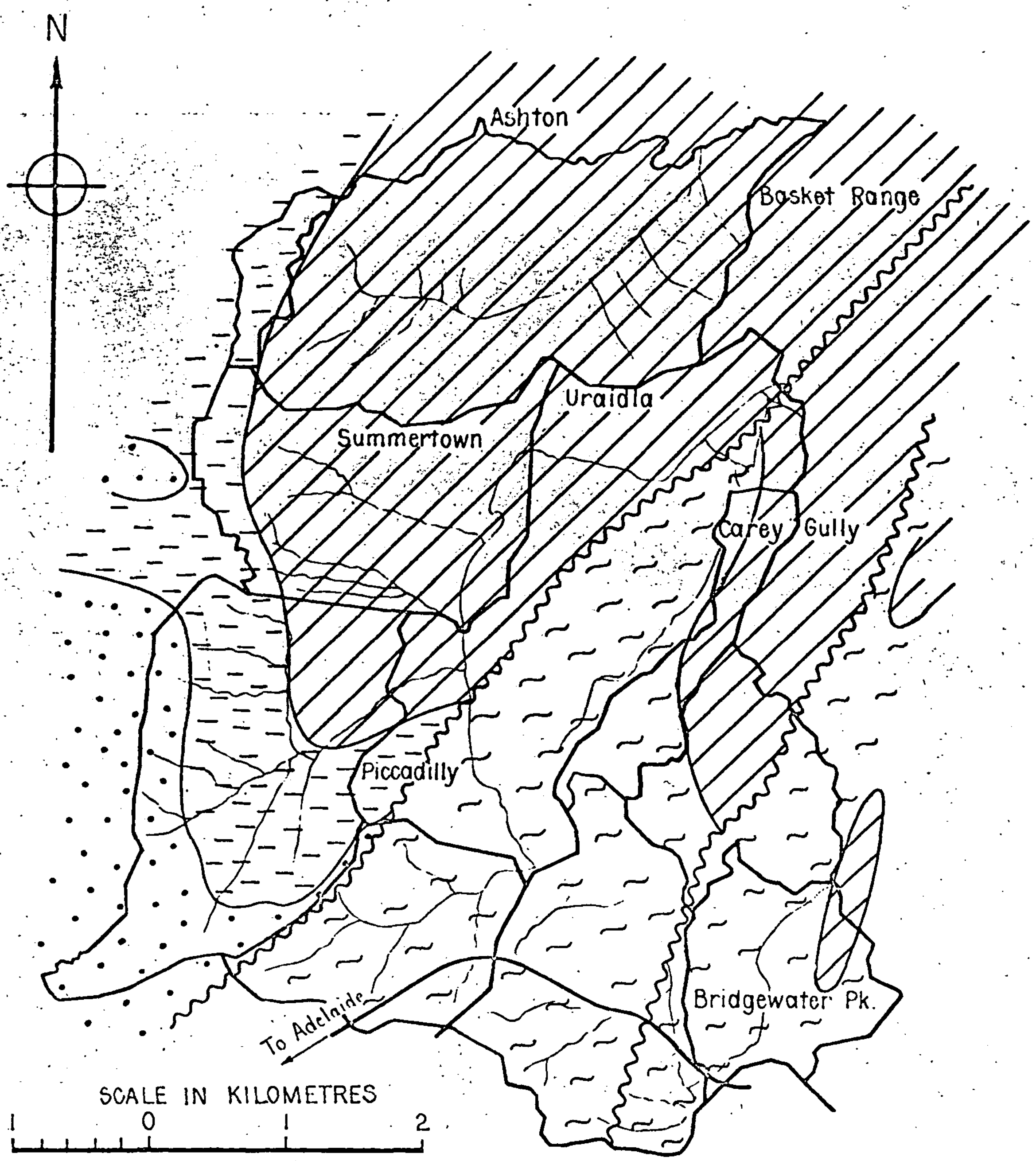
PICCADILLY VALLEY GROUNDWATER STUDY HUNDRED ONKAPARINGA BORE DATA PLAN			
		DRN.	SCALE: 1:15840
		TCD.	74-93 Ha 7
		CKD.	
DIRECTOR OF MINES		EXD.	DATE: FEBRUARY 1974.



LEGEND

PROTEROZOIC

Torrensian

- Flaggy feldspathic STONEYFELL QUARTZITE, includes unnamed siltstone members.
- WOOLSHED FLAT SHALE : Grey laminated siltstone, minor quartzite member.
- ALDGATE SANDSTONE : Feldspathic fine to coarse grained sandstone and arkose.

UNCONFORMITY

Lower Proterozoic or Carpentarian

- Mica – quartz schist and granitic gneiss

FIG. 2

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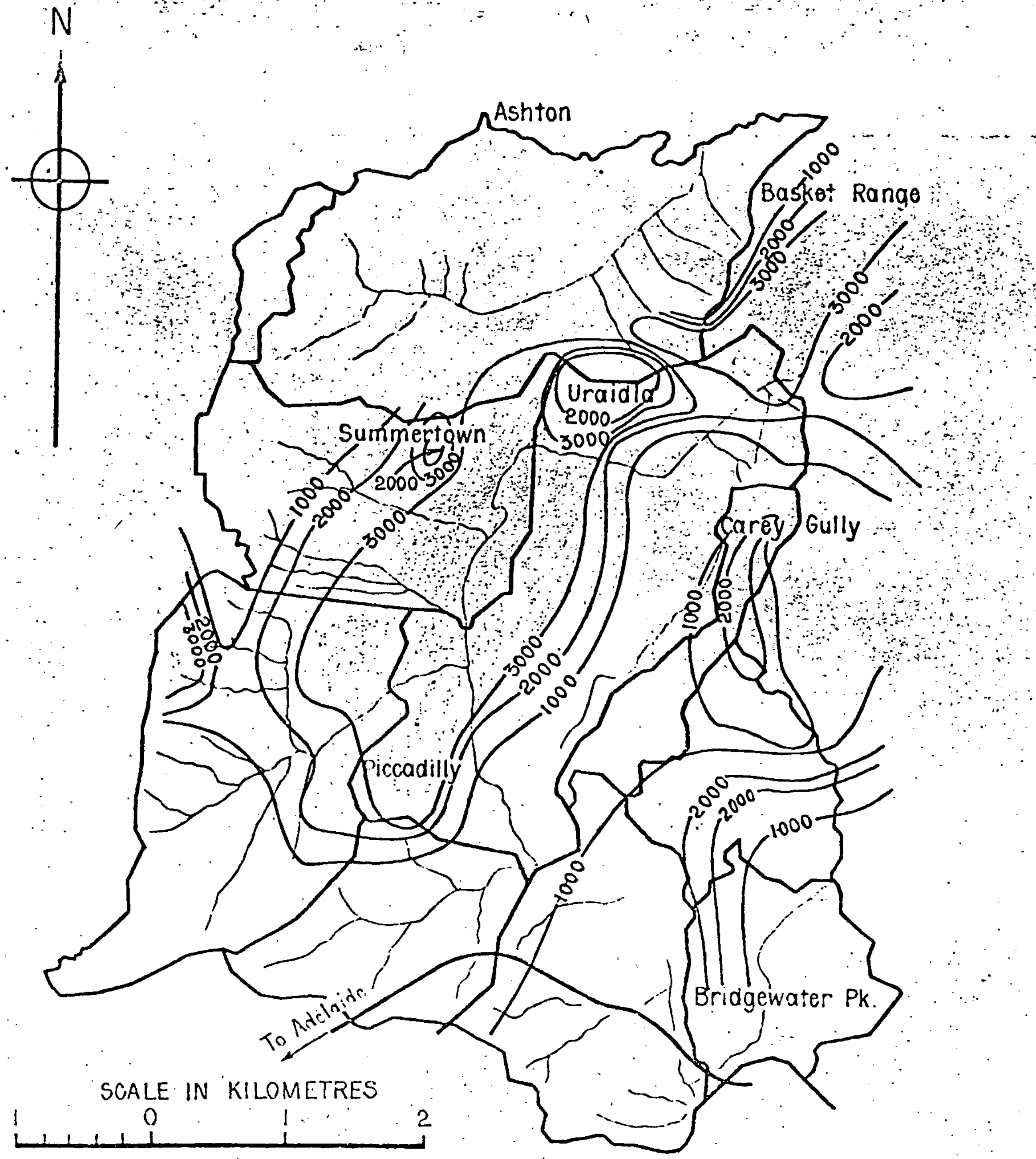
HYDROGEOLOGY SECTION	Drn. KWD	PICCADILLY VALLEY REGION	SCALE: 1 : 50 000
	Tcd. BDW		S10718
	Ckd.	REGIONAL GEOLOGY	
	Exd.		DATE: 18 FEB 1974



LEGEND

Galls/ Hr.	Litres/sec.
1000	1·3
2000	2·5
3000	4·0

Flow (Galls./Hr)

- 0 — 1000
- 1000–2000
- 2000–3000
- 3000 +

2000 Flow in galls/Hr.

FIG. 3

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HYDROGEOLOGY SECTION	Drn. KWD	PICCADILLY VALLEY REGION	SCALE: 1 : 50.000
	Tcd. BDW	UNDERGROUND WATER SUPPLY	S10721
	Ckd.	CONTOUR PLAN	
	Exd.		DATE: 18 FEB. 1974

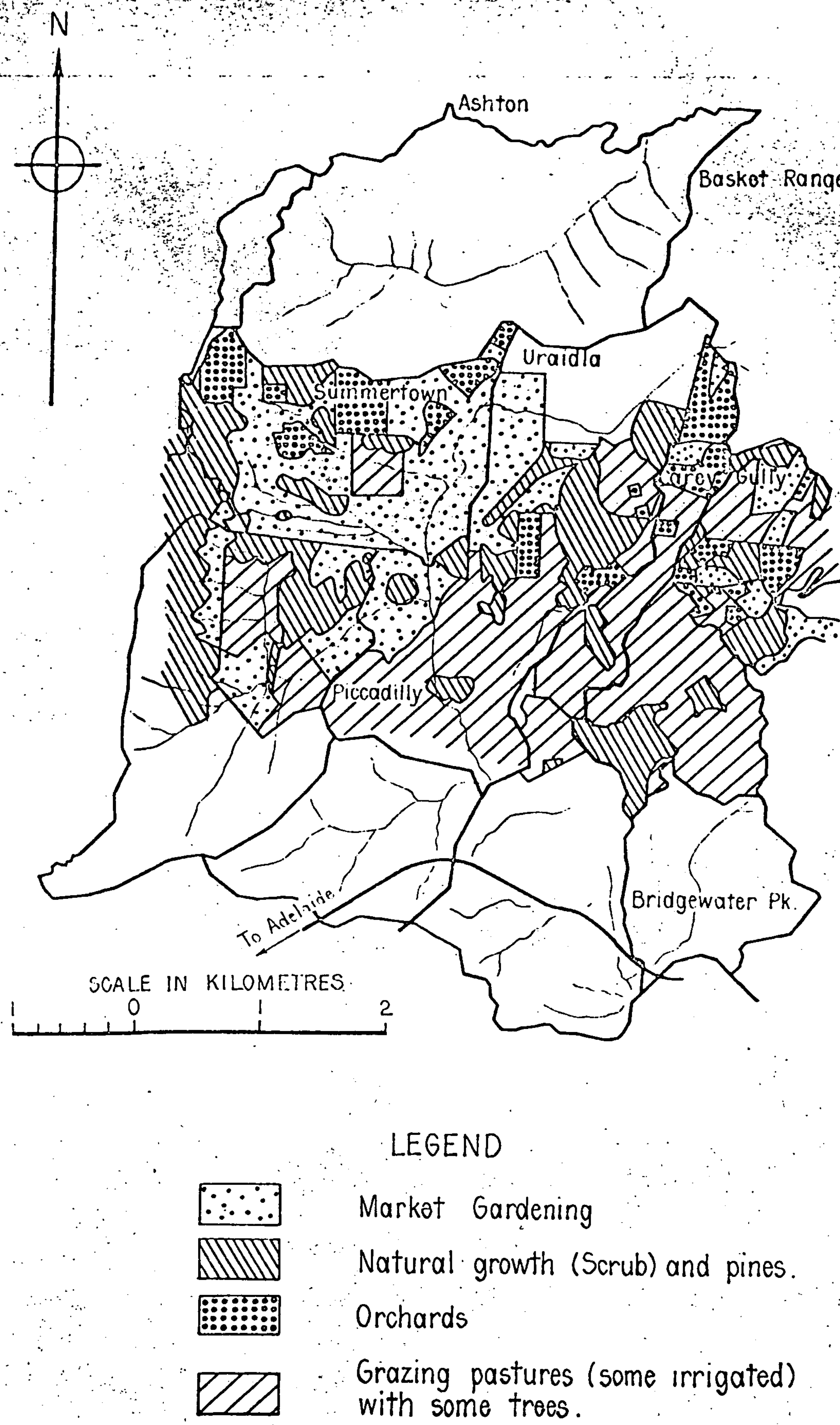

FIG.4

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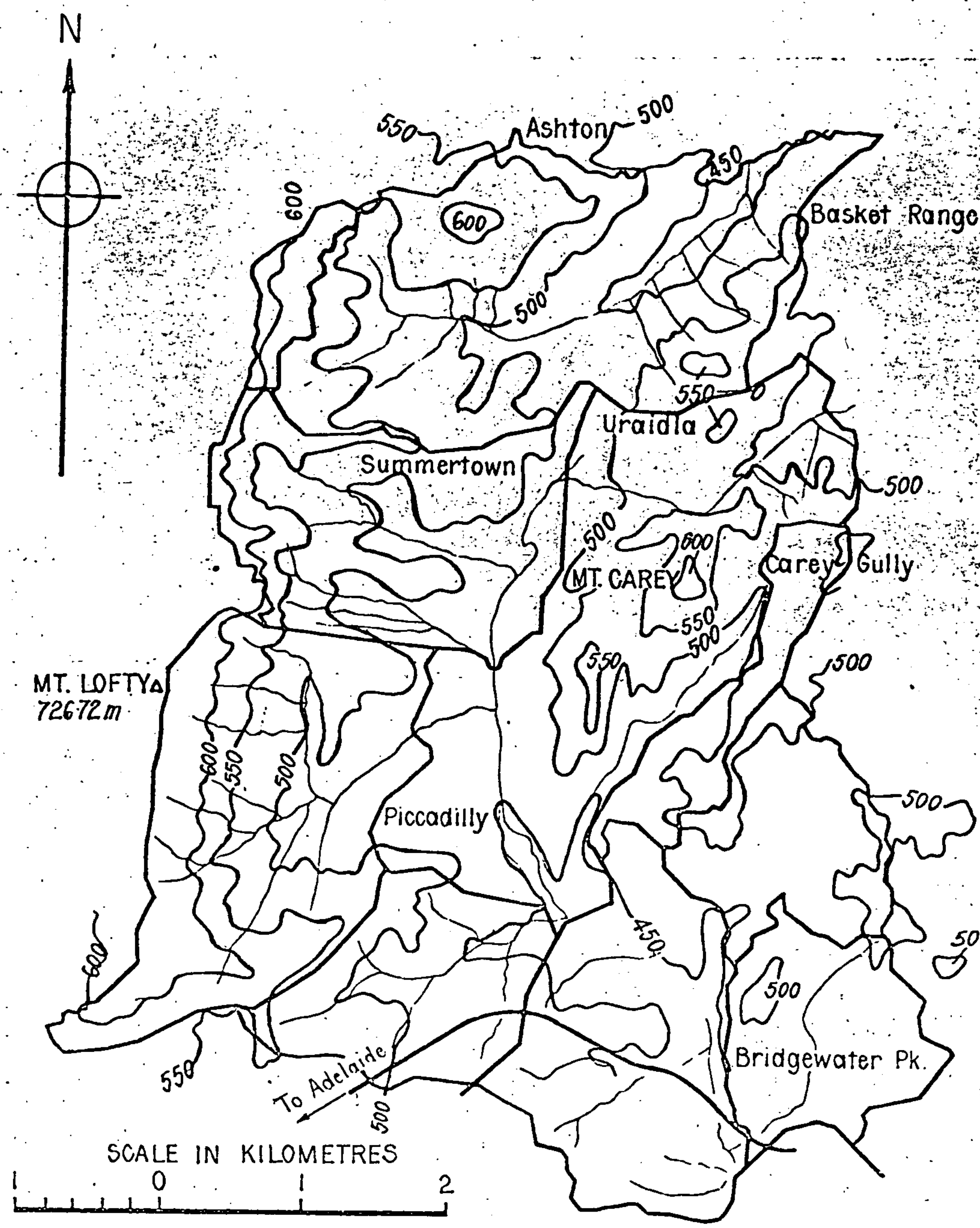
HYDROGEOLOGY SECTION	Drn. KWD	PICCADILLY VALLEY REGION	SCALE : 1 : 50 000
	Tcd. BDW		S10720
	Ckd.	A D USE	



LEGEND

500 — Topographic contours (in metres) Datum M.S.L

FIG. 5

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HYDROGEOLOGY SECTION	Drn. KWD Tcd. BDW	PICCADILLY VALLEY REGION	SCALE: 1 : 50 000 S10719