DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT.BK. 79/18

WILLUNGA BASIN GROUNDWATER INVESTIGATION PROGRESS REPORT NO.3

VOL. I of II VOLUMES

GEOLOGICAL SURVEY

By

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Rept.Bk.No. 79/18
G.S. No. 6137
D.M. No. 1185/73
Eng. No. 79/4

APPENDICES

Figures contained in Appendix C.

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ABSTRACT

Groundwater investigations in the Willunga Basin since 1974 including the drilling of stratigraphic wells, geophysical logging, water level and salinity monitoring and surface water hydrology have enabled the geological framework of the basin and the lithofacies variations within the Tertiary sediments to be more clearly understood. The spatial distribution of the aquifer systems and the variations in water quality within them have been defined, thus establishing the framework for a basic groundwater computer model.

Groundwater monitoring has revealed declining water levels locally but there is no evidence of serious depletion of the groundwater resources. Water balance estimates suggest an average annual safe groundwater yield of the basin of approximately 4 000 megalitres. Water of irrigation quality (less than 2 000 milligrams per litre total dissolved salts) is obtainable throughout most of the Willunga Basin with the exception of the southwestern area.

INTRODUCTION

Extensive development of groundwater supplies has occurred in the Willunga Basin during the past decade. Groundwater supplies are used for domestic and agricultural purposes, principally vineyards, market gardens and orchards. This development has continued at an increasing rate and has given rise to concern for the groundwater resources of the area.

The need for a comprehensive groundwater investigation was outlined by Waterhouse in 1974, the aim of which was to formulate a suitable groundwater management policy. At that time, the hydrogeology of the basin and the limitations on groundwater development were almost entirely unknown. A hydrological investigation by Cochrane (1956), carried out at the request of the Engineering and Water Supply Department to ascertain the prospects of groundwater supplies for the towns of McLaren Vale, McLaren Flat, Kangarilla and Willunga, summarised the subsurface data. He noted that drilling practices in the area needed to be inproved to ensure greater protection of the resource and to acquire data from wells privately drilled.

The objective of this report is

- to collate all groundwater data relating to the basin.
- to interpret and assess these data.
- to determine the best course for future investigations.

Where possible, the data is presented in a manner to facilitate the compilation of a first stage computer model.

PHYSIOGRAPHY

The Willunga Basin is located approximately 30 km south of Adelaide (Figure 1). Principal towns within the basin are McLaren Vale, Willunga, Aldinga and Kangarilla, shown with the physiographic features in Figure 2. Surface elevation, 10 to 20 metres at the coast, rises in a northeasterly direction to approximately 200 metres above MSL in the vicinity of Kangarilla.

Three small ephemeral streams, Pedlar Creek, Willunga Creek and Aldinga Creek traverse the Willunga Basin and discharge at the coast. These provide the main avenues of surface water outflow from the basin and are fed principally by runoff and springs from the Willunga Range. The largest of these, Pedlar Creek, flows only for short periods after heavy rainfall. A fourth, Peter Creek, flows in a north easterly direction across the northern end of the basin and discharges into the Onkaparinga River northeast of a prominent ridge which marks the only significant groundwater divide within the basin.

Numerous ephemeral, steep sided escarpment streams, incised into the western face of the Willunga Range, debouch onto the plain and terminate within a short distance of the range in alluvial outwash fans.

The climate is of the Mediterranean type with warm, dry summers and cool, moist winters. Average annual rainfall ranges from 500 mm in the southwest to 800 mm in the northeast. The rainfall histograms of the principal towns are shown in Figure 3.

The area, commonly known as the "Southern Vales" is rural in character. The main agricultural practices are vineyards (for wine production) and almond growing, approximately 50% of Australia's almond production being obtained from the Willunga Basin. Market gardening, orchards and dairying are practiced to a lesser degree. There are no heavy industries in the Willunga Basin.

LAND USE

The land use plan as at 1958 (Fig. 4) was compiled from the earliest available aerial photographs of the Willunga Basin. The land use plan as at 1977 (Fig. 5) was compiled from the most recent photographic coverage and verified by ground surveying of land use practices.

Some increase in the acreage planted to vines and almonds is evident but the increase is not dramatic and does not reflect the increase in groundwater consumption which is known to have occurred in recent years. The conclusion to be drawn from this is that irrigation has been introduced to some vineyards and orchards which previously relied on rainfall only.

The remaining areas are given over to pasture, the growing of cereal crops, or other dry land farming practices.

GEOLOGY

The Willunga Basin is a wedge shaped embayment on the eastern flank of the St. Vincent Basin formed by reactivated Palaeozoic faults during Eocene and post Eocene times. Its main axis has a northeast-southwest orientation. The surface geology is shown in Figure 6.

The basin is bounded on its southeastern margin by the Willunga Fault and on its northern side by the onlap of sediments onto a ridge of basement rocks adjacent to the Onkaparinga River (hereinafter referred to as the "Onkaparinga Ridge"), which separates it from the Noarlunga Basin. The coast forms the western margin of the onshore part of the basin.

The maximum recorded thickness of sediments is in the southwestern corner of the basin in the vicinity of Aldinga, where 340 metres were penetrated in a stratigraphic well drilled by the Department of Mines and Energy (WLG 40 on Fig. 11). The succession thins in a northerly and northeasterly direction where it is terminated by the onlap of sediments onto Adelaidean basement rocks of Upper Proterozoic age. The sediments are generally flat lying or dip at low angles toward the coast and toward the axis of the basin. In the vicinity of the Willunga Fault however, they are sharply upturned and have undergone severe deformation (Howchin, 1911).

The oldest sediments are the Cape Jervis Beds of Permian age, (Cooper, 1977) which were intersected in wells near the coast and in the northern part of the basin between McLaren Flat and Kangarilla. They consist of clayey siltstone, fine grained sandstone and pebble conglomerate. The maximum known thickness is 160 metres in WLG 40.

Tertiary sediments range in age from mid Eocene to early Miocene and their maximum recorded thickness is 265 metres in the southwestern corner of the basin, in well WLG 38. Marine, lacustrine and paralic environments of deposition are identified within the Tertiary succession (Cooper, 1977), which consists essentially of clays, calcarenites, sands, gravels, marls and siltstones. The drilling programme has revealed complex facies changes which make correlation difficult on a purely lithological basis. Good exposures of Tertiary sediments occur in cliffs along the coast at the western end of the basin of (Reynolds, 1953, and Lindsay, 1967).

Pleistocene sediments consist principally of vari-coloured sandy clays with interbedded and lenticular sands and gravels. Alluvial sands and gravels are common adjacent to the main drainage lines and in alluvial outwash fans along the foot of the Willunga Range.

The maximum recorded thickness of these sediments is 44 metres in WLG 38 and they thin in a northeasterly direction.

HYDROGEOLOGY

Groundwater of varying quality obtained from depths ranging from 5 metres to 200 metres is used for stock, domestic and irrigation purposes.

Four aquifer systems are recognised.

- shallow Quaternary aquifers
- Port Willunga Formation
- maslin Sands
- fractured basement rocks.

The hydrogeology is presented in tabular form in Table 1.

There is undoubtedly some hydraulic connection between adjacent aquifer systems in some parts of the Willunga Basin, but the extent of such inter-connection is not known.

TABLE 1 SUMMARY OF HYDROGEOLOGY

Stratigraphic Unit	Age	Lithology	Hydrogeological characteristics	Groundwater Usage
Unnamed	Pleistocene to Recent	Clays with interbedded sands & gravels.	Confining bed over much of the basin. Thin shallow sandy & gravel unconfined & semi-confined aquifers.	Stock & domestic supplies. Best developed in vicinity of Willunga Ranges.
Port Willunga Formation	Late Eocene to Oligocene	Limestone calcarenite & sandstones.	Confined aquifer in southern half of basin. Unconfined elsewhere.	Stock, domestic & irrigation supplies.
Chinaman Gully Formation	Late Eocene	Carbonaceous silt & sand.	Aquitard.	Not known to be used for groundwater supplies.
Blanche Point Formation	Late Eocene	Marl, calcsilicate & calcarenite.	Confining bed over southern half of basin. Aquifer to aquitard elsewhere.	Some irrigation supplies in northern part of basin.
Tortachilla Limestone	Late Eocene	Limestone.	Aquitard.	Not known to be used for groundwater supplies.
Maslin Sands	Mid to Late Eocene	Carbonaceous sands & grits.	Confined aquifer over most of basin. Unconfined in northernmost part of basin.	Principal aquifer for stock, domestic & irrigation supplies throughout northern half of basin.
Cape Jervis Beds	Permian	Fluvioglacial sands & clays.	Varies from poor aquifer to aquitard.	Not known to be used for groundwater supplies.
Adelaide System	Precambrian	Phyllites and slates.	Almost entirely confined or semi-confined aquifer. Unconfined over a restricted area.	Stock, domestic & irrigation supplies in extreme northern corner of basin.

The Maslin Sands and fractured rock aquifers are interconnected in the northeastern part of the basin as there is no confining bed to separate them. The hydrographs of wells KTP 14 and KTP 15, (Fig. 15) completed in basement rocks and Maslin Sands respectively, display an almost identical seasonal pattern. In other parts of the basin, clay produced as a result of weathering of basement rocks may behave locally as a confining bed between these two aquifer systems. However, drilling has shown the absence of a confining bed in other areas within the basin and for this reason, they have been treated as one aquifer system for the purpose of constructing water table contours. Hydraulic connection is supported in some, but not all cases, by hydrochemical evidence.

Some interconnection between the Port Willunga Formation and the Maslin Sands appears likely in the central part of the Willunga Basin around McLaren Vale and McLaren Flat. In this area, the Blanche Point Formation is quite sandy and its normal role as an aquiclude, elsewhere in the Willunga and North Adelaide Plains Basins between the two aquifers is probably ineffective? To the west, however, the Blanche Point Formation becomes more silty and marly and behaves as a more effective confining bed between the two aquifers. In adjacent wells WLG 38 and WLG 39, (Figure 11) the potentiometric head of the Port Willunga Formation is an average 13 metres above that of the Maslin Sands, and while this situation prevails there may be no danger of upward leakage of highly saline water from the Maslin Sands.

The aquifer systems are discussed in more detail below

i) Shallow Aquifers

Limited irrigation supplies are obtained from shallow aquifers of Quaternary age in the Willunga Basin for stock and domestic supplies. They tend to be of limited areal extent and are commonly, either partially or wholly, separated by beds of clay. In some areas, three separate aquifers have been penetrated in vertical section within Quaternary sediments.

Yields of up to 960 kilolitres per day of good quality water (< 1000 mg/l) have been recorded in areas adjacent to the Willunga Range where Quaternary sands and gravels are well developed. Good quality groundwater is also available around McLaren Vale. In other parts of the basin, however, yields and quality are somewhat variable. In the northern and western areas, for example, windmill supplies of stock quality only are generally obtainable (> 2000 mg/l).

ii) Port Willunga Formation

The subcrop and isopach maps of the Port Willunga Formation are shown in Figures 7 and 8 respectively. This aquifer is most extensively developed for irrigation supplies in a general area bounded by McLaren Vale, McLaren Flat and Willunga where yields of up to 2400 kilolitres per day of irrigation quality water are obtainable. Yields from the Port Willunga Formation tend to be poorer in its northern and northeastern parts where it is thinner. The best quality water (< 1000 mg/l) is obtained in the eastern part of the basin in the vicinity of the Willunga Range where some of the recharge to this aquifer is believed to take place. Water quality deteriorates toward the coast where the aquifer is little exploited as salinity is generally of > 2000 mg/l.

The Port Willunga Formation behaves as a confined aquifer in the southern half of the basin. The maximum recorded potentiometric head is in WLG 39 where the water level rises to approximately 40 metres above the top of the aquifer. No artesian flows have been reported.

iii) Maslin sands

This aquifer extends over the entire Willunga Basin; subcrop and isopach maps are shown in Figures 9 and 10. Supplies of up to 1700 kilolitres per day of good quality water are obtained from the Maslin Sands for the irrigation of vines, orchards and pasture in the northern part of the basin. The best yields are obtainable in an area bounded approximately by McLaren Flat, Blewitt Springs and Kangarilla. Along the northern margin of the basin, supplies and quality are variable and range from marginal to poor (Fig. 20).

The aquifer is exploited little south of McLaren Vale because of the availability of suitable supplies at a shallower depth and where it is of poorer quality.

The best quality groundwater is obtainable in the northern part of the basin but it deteriorates toward the coast where the Maslin Sands are subartesian. In WLG 38, a salinity of approximately 137 000 mg/l was recorded, indicating that in the southwestern part of the Willunga Basin, this aquifer contains connate water derived from an evaporative environment.

The decline in water level in the Port Willunga Formation in this area may be a cause for concern. A reversal in the head difference between that aquifer and the Maslin Sands would allow an upward migration of highly saline water.

iv) Fractured Basement Rocks

Water supplies are obtained from fractured basement rocks largely in the marginal areas of the basin. Supplies of up to 2200 kilolitres per day of good quality groundwater are obtained from in the Kangarilla area for the irrigation of pasture, orchards and vines. Many wells are completed in basement rocks on the upthrown side of the Willunga Fault. Along the northern margin of the Willunga Basin, water quality is mediocre to poor. This applies also to the Maslin Sands in this part of the basin, suggesting that runoff from the "Onkaparinga Ridge" does not make a significant contribution to recharge to groundwater in the basin.

Basement rocks were tested in well WLG 37, between McLaren Vale and McLaren Flat and found to have a yield of approximately 2200 kilolitres per day, of fair quality water (1 600 mg/l). This suggests that fractured basement rocks may constitute an alternative source of groundwater in those areas where yields from shallower aquifers are poor. Between Kangarilla and Blewitt Springs some wells have been drilled through the Maslin Sands and completed in basement rocks. This is probably because yields in the Maslin Sands have been found to be inadequate, either because of poor completion practices or because it has a low permeability. Basement rocks may also provide for some groundwater flow within the basin.

Springs which emanate from basement rocks at the foot of the Willunga Range provide useful water supplies, locally.

DRILLING

Prior to the recent drilling programme, the stratigraphy of the basin was known from coastal sections (Reynolds, 1953), from WB1, a deep well drilled for the E. & W.S. Department (Cochrane, 1956 and Lindsay, 1966), and from a limited amount of palaeontological work carried out on a few wells within the basin (Ludbrook, 1961a and 1961b).

The selection of sites for recent stratigraphic drilling was based upon four considerations:

a) Records of wells in the Willunga Basin were examined to compile available stratigraphic information as an aid in choosing well sites.

b) Interesting or anomalous features revealed in the composite water table contours constructed from the initial observation network.

c) Advice tended by Mr. J.M. Lindsay of the Biostratigraphy Division.

d) Areas of heavy consumption of groundwater.

Two objectives for the drilling programme were defined:

1) To determine the spatial distribution of the aquifer systems of the basin by correlation from areas of known stratigraphy (coastal sections and WB1) and to trace their lithofacies variations.

2) To investigate the hydrologic and hydrochemical characteristics of each of the aquifers by means of careful sampling and measurement of static water levels and, thereby, determine what hydraulic connection if any exists.

To date 13 wells have been drilled by the Department of Mines & Energy in the Willunga Basin, in the period January 1974 to September 1976 for an aggregate of 1698 metres, as indicated in Figure 11.

The drilling programme was divided into two stages:

Stage 1: Two wells, WLG 44 and WLG 40 were located near the coast to enable correlation with the coastal sections. Five wells WLG 37, 38, 41 and 43 and KTP 14 were drilled along the deep axis of the basin, from the southern end near Sellicks Beach where the stratigraphy was better known, and extending to the northeast apex at Kangarilla. This enabled correlation to be made from the areas of known stratigraphy to the inland part of the basin where it was unknown.

Stage 2: Six wells were drilled on a rectilinear grid pattern, approximately parallel to the deep axis of the basin, to investigate changes in facies towards basin margins.

From the point of view of determining the subsurface geology and stratigraphy of the basin, both of which were previously largely unknown, the drilling programme has been eminently successful.

Because of rapid lithofacies variations correlation on the basis of lithology alone has not been easy, except over short distances of two kilometres or less. Wireline geophysical logs tend to show significant and often marked differences in character for the same strata over relatively short distances. These facts attest to the rapid lateral variations in depositional environments throughout the Eocene to Miocene sedimentary history of the Willunga Basin.

Thus, the author has had to rely to a considerable degree on the palaeontological interpretations, carried out by Dr. B.J. Cooper of the Biostratigraphy Division, for correlation of stratigraphic units. This work has greatly facilitated the objectives of the drilling programme and has in turn, proved invaluable in determining formation tops from sample descriptions of privately drilled wells which previously were almost meaningless. In addition, it has improved the interpretation of geophysical borehole logs.

Drilling has provided a basis for defining the physical parameters of all aquifers and useful advice may now be given to landowners with regard to target depths and recommended completion practices. The gross thickness of all water bearing sediments from which useful supplies can be obtained, will be used to compile an initial mathematical model.

A summary of the drilling details is given in Table 2.

TABLE 2

SUMMARY OF DRILLING DETAILS

Well No.	Depth Drilled (m)	Depth Completed (m)	Completed Interval	Aquifer Completed	Water Cut (m)	SWL (m) + (as at July 1978)
WLG 23	46.5	46.5	44.5-46.5	basement	23	18.7
24	26	26	20-26	"	11,26	9.7
37	127	42	40-42	Blanche Point Marl	10,17, 37,56	
38	309	309	299-300	North Maslin Sand	-*	18.6
39	56	56	47.3-56	Pt. Willunga Fm.	-*	8.05
40	340	164	162-164	N. Maslin Sand	22 & 163	19.15
41	90	18	16-18	Blanche Pt. Formation	7,11,14 41 & 69	4.2
42	163	140	139-140	N. Maslin Sand	-*	31.2
43	185	86.5	84.5-86.5	N. Maslin Sand	26,37 & 78	32.1
44	105	70	68-70	S. Maslin Sand	50,68,73 75 & 79	39.8
45	176	suspended		To Blanche Pt. Fm to date	18,60 & 90	
KTP 14	50	49	44-49	basement	9 & 19	0.4
15	24			Maslin Sands		0.7

+ below top of casing
*drilled by rotary drilling plant-no water cuts available

All wells listed above been incorporated into the groundwater observation network. The lithological descriptions of sediments penetrated in each of these wells are contained in Appendix A which also includes, in tabulated form, all formation tops. The author is indebted to Dr. B.J. Cooper for much of the data relating to formation tops.

GEOPHYSICAL WELL LOGGING

Wireline geophysical logging was carried out in all departmental wells and in 23 additional private wells in an attempt to correlate strata that undergo rapid facies changes throughout the basin. The details of the geophysical logging programme and some comments pertaining to it are contained in Appendix B.

This programme was only partially successful because many of the private wells logged did not penetrate the main aquifers. Many of the wells logged are completed within shallow aquifers of limited areal extent.

Unfortunately, many wells that could have provided useful geophysical data, were sealed in such a way that access to them with a geophysical logging tool was extremely difficult or impossible. The locations of all geophysically logged private wells are shown on Figure 12. A longitudinal section through the Willunga Basin, based upon geophysical wireline log correlation, is shown on Figure 13 and on section A-A' in Figure 12.

GROUNDWATER MONITORING

A groundwater observation network established in 1973 upon completion of water well surveys in the hundred of Willunga and the relevant portion of the hundred of Kuitpo consisted of 28 private wells. The first water level readings were recorded in September 1973. The locations of these wells are shown on Figure 14.

a) Water Level Observations

Water table contours could be constructed only for the upper northeastern part of the basin as it was not known at that time (1973) into which aquifer each observation well was completed. As Departmental wells were completed they were added to the observation network. The earlier water table contour plans represented composite piezometric or static water levels of the various aquifer systems.

A summary of the details of the observation wells as shown in Table 3, shows that the observation well network monitors a variety of aquifer systems. As the recent drilling programme progressed, it became apparent that earlier potentiometric contour plans presented a composite picture and did not reflect the behaviour of groundwater within each aquifer system or the degree of hydraulic connection between them. For this reason, the water level observation network needs to be made more comprehensive and must be designed to observe the water table and potentiometric surfaces in the individual aquifer systems. Further field work is planned to examine existing wells for their suitability as observation wells.

The present observation network is divided basically into two parts:

i) A network consisting of 13 Departmental wells for which the stratigraphy is well documented. Water levels in these wells are read fortnightly and hydrographs are plotted to determine seasonal fluctuations and to detect the influence of pumping.

ii) A network consisting of 28 private, mostly abandoned, wells read at three monthly intervals. These are designed to

TABLE 3

DETAILS OF WILLUNGA BASIN OBSERVATION WELLS

Observation No.	State No.	Depth (m)	Aquifer Monitored	Periodicity
WLG 1	697 000203	219.5	basement	3 monthly
2	697 068701	54.5	Maslin Sand	"
3	697 003101	24	Blanche Pt. Fm.	"
4	697 001102		Maslin Sand ?	"
5	697 051702	162	basement	"
6	697 049802	20	Pt. Willunga Fm.	"
7	697 051001	12	Quaternary	"
8	697 048703	14	Blanche Pt. Fm ?	"
9	697 050603	23	"	"
10	697 006401		basement	"
11	697 012402	35	Maslin Sand	"
12	697 013201	44.5	"	"
13	697 030002	82	Quaternary	"
14	697 014805		Maslin Sand ?	"
15	697 046002	62	Pt. Willunga Fm.	"
16	697 046302	47	"	"
17	697 025804			"
18	697 022802	61	Quaternary	"
19	697 017901			"
20	697 024701			"
21	697 070501	53	Pt. Willunga Fm.	"
22	697 034901	3.5	Quaternary	"
23	697 010601	46.5	basement	fortnightly
24	697 058101	26	basement	"
37	697 047707	42	Blanche Pt. Fm.	"
38	697 061002	309	Nth. Maslin Sand	"
39	697 061001	56	Pt. Willunga Fm.	"
40	697 041201	164	Nth. Maslin Sand	"
41	697 001406	18	Blanche Pt. Fm.	"
42	697 017402	140	Nt. Maslin Sand	"
43	697 000806	86.5	"	"
44	697 038802	70	Sth. Maslin Sand	"
45	697 049902	176	Blanche Pt. Fm.	"
KTP 1	446 000602	27	Maslin Sand	3 monthly
2	446 046701	37	"	"
3	446 001902	95	basement	"
4	446 082501	39	"	"
5	446 081601	61	"	"
6	446 087301		Maslin Sand	"
7	446 163802		basement	"
14	446 085401	49	basement	fortnightly
15	446 085402	24	Maslin Sand	"

detect long term trends in groundwater storage.

The fortnightly hydrographs of the nine longest operational observation wells are shown on Figure 15. They have been averaged out to a certain extent and,as shown, are diagrammatic to illustrate trends rather than precise fluctuations. The hydrographs show the varying patterns of water level and potentiometric level behaviour throughout the Basin. Wells KTP 14 and 15, located in the northeastern corner of the basin, where volumes of groundwater storage are relatively small, show a regular seasonal response to recharge and pumping.

As one proceeds further into the basin, towards the coast, seasonal fluctuations become more muted, as illustrated by WLG 40, 41 and 42. Wells WLG 23 and 24 show that water levels are declining slowly in the northern part of the basin.

WLG 39 has shown a general decline in potentiometric level until late 1977, followed by a marked decline since that time. The reason for this is obscure because this well was completed in the Port Willunga Formation in the southwestern corner of the basin where there is little withdrawal of groundwater because of high salinity (approx. 5 500 mg/l). The water level is approximately 10 metres above sea level and there is no danger of intrusion from the sea. However, the situation in this well will continue to be monitored. Water table contours for the combined aquifer system of the Maslin Sand and fractured basement rocks are shown on Figures 16 and 17 for March 1976 and July 1978, respectively; the southwesterly direction of groundwater movement is obvious.

TABLE 3

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2	697 068701	54.5	Maslin Sand	"
3	697 003101	24	Blanche Pt. Fm.	"
4	697 001102		Maslin Sand ?	"
5	697 051702	162	basement	"
6	697 049802	20	Pt. Willunga Fm.	"
7	697 051001	12	Quaternary	"
8	697 048703	14	Blanche Pt. Fm ?	"
9	697 050603	23	"	"
10	697 006401		basement	"
11	697 012402	35	Maslin Sand	"
12	697 013201	44.5	"	"
13	697 030002	82	Quaternary	"
14	697 014805		Maslin Sand ?	"
15	697 046002	62	Pt. Willunga Fm.	"
16	697 046302	47	"	"
17	697 025804			"
18	697 022802	61	Quaternary	"
19	697 017901			"
20	697 024701			"
21	697 070501	53	Pt. Willunga Fm.	"
22	697 034901	3.5	Quaternary	"
23	697 010601	46.5	basement	fortnightly
24	697 058101	26	basement	"
37	697 047707	42	Blanche Pt. Fm.	"
38	697 061002	309	Nth. Maslin Sand	"
39	697 061001	56	Pt. Willunga Fm.	"
40	697 041201	164	Nth. Maslin Sand	"
41	697 001406	18	Blanche Pt. Fm.	"
42	697 017402	140	Nt. Maslin Sand	"
43	697 000806	86.5	"	"
44	697 038802	70	Sth. Maslin Sand	"
45	697 049902	176	Blanche Pt. Fm.	"
KTP 1	446 000602	27	Maslin Sand	3 monthly
2	446 046701	37	"	"
3	446 001902	95	basement	"
4	446 082501	39	"	"
5	446 081601	61	"	"
6	446 087301		Maslin Sand	"
7	446 163802		basement	"
14	446 085401	49	basement	fortnightly
15	446 085402	24	Maslin Sand	"

The contours indicate a significant contribution to recharge water from the high country around the northeastern part of the basin and in particular, around the boundary between the hundreds of Willunga and Kuitpo. The contour lines are curved in the vicinity of the Willunga Range to reflect the presumed recharge from this area.

A comparison of Figures 16 and 17 shows that significant changes in groundwater storage occur only in the northeastern corner of the basin and remain virtually unchanged below McLaren Flat. This is due to pumping from the Maslin Sands aquifer which is almost entirely practiced in that area above McLaren Flat.

As might be expected, water levels are higher at the end of winter than at the end of summer.

Only four observation wells were completed in the Port Willunga Formation and no attempt has been made to construct potentiometric and water table contours.

Further work is required to extend the observation network to enable water table contours to be drawn for this aquifer and thereby determine the degree of hydraulic interconnection between it and the Maslin Sands aquifer. At the one locality where adjacent wells were completed in the two aquifers, (WLG 38 and WLG 39) the potentiometric head of the Port Willunga Formation is an average 13 metres above that of the Maslin Sands. However, WLG 38, completed in the Maslin Sand aquifer, contains highly saline water of greater density than that in WLG 39. The difference in potentiometric heads between the two aquifers therefore, will not be as great as suggested by the difference in water levels in the two wells.

b) Groundwater Quality

Routine sampling of observation wells was discontinued in 1975 because it was not known in many cases from which aquifer a water sample was being obtained. Further, the sampling method left much to be desired, since samples were obtained by bailer. Private wells in the observation network are all either abandoned or very infrequently used, such wells being chosen because of convenience. Operational wells are usually sealed and access to them is very difficult, if not impossible.

Samples obtained from abandoned wells represent water which has been resident within corroded casing, possibly for many years and bears little relation to formation water from the aquifer itself.

In some cases, the depth of an observation well is unknown and the aquifer into which it was completed is purely conjectural. In other cases, although the depth of an observation well is known, the depth to which it is cased is unknown and one can only speculate on the condition of the casing.

For all its shortcomings, the first observation well network, established before the drilling programme commenced, is probably the best that could have been chosen at the time and indicates how little the geology of the Willunga Basin was known.

The salinity data for the different aquifer systems has been compiled from existing bore record data and from the results of the recently completed drilling programme.

Generalised salinity zones are shown for three aquifer systems:

1) Shallow aquifers (Fig. 18)
2) Port Willunga Formation (Fig. 19)
3) Maslin Sands/Basement (Fig. 20)

All three aquifer systems contain good quality groundwater in the vicinity of the Willunga Range, reflecting recharge from it. In addition, they show the general deterioration in groundwater quality toward the coast and in the southwestern part of the basin.

The zones of good quality groundwater in the Port Willunga Formation reflect the main avenues of recharge to it. On the downthrown side of the Willunga Fault, the Port Willunga Formation is overlain by a considerable thickness of Hindmarsh Clay (20 to 40 metres) and it appears that the fault plays a significant role in recharging the Port Willunga Formation, largely by movement of water down the fault plane and possibly also by the lateral movement of water from fractured basement rocks, across the fault zone and into this aquifer. In addition, recharge in the vicinity of the fault scarp must occur quite considerably by leakage from the scarp streams which terminate within short distances of it (generally 1 to 2 kilometres) in outwash fans. This water enters the Port Willunga Formation via shallow sandy aquifers. High salinity (approximately 6 000 mg/l) in the southwestern corner of the basin indicates poor recharge in this area.

Recharge in the vicinity of McLaren Vale and McLaren Flat is more likely to occur by direct downward infiltration of rainfall, stream losses and/or leakage from shallow aquifers because of the shallow depth of the Port Willunga Formation in this area. The Maslin Sands contain good quality groundwater over an extensive area from Kangarilla almost to Willunga. It is possible that the Willunga Fault is an avenue for some recharge to the Maslin Sands.

In the area around McLaren Flat, where good quality groundwater occurs in all three aquifer systems, it appears that water enters the Maslin Sands aquifer by downward leakage from shallow aquifers, through the Port Willunga Formation. This is supported by hydrochemical data. The Blanche Point Formation in this area is quite sandy and is unlikely to behave as an aquiclude between the two lower aquifer systems.

High salinity groundwater in the Maslin Sands in the southwestern part of the basin indicates no recharge in this area.

HYDROCHEMISTRY

Full chemical analyses were carried out on water samples from nine of the investigation wells drilled by the Department of Mines and Energy as shown in Appendix C. The cation and anion were plotted on Piper trilinear diagrams, also shown in Appendix C.

The water analyses are grouped into three separate diagrams which are related to the localities of the wells from which the samples were obtained, as follows:

Northern area (Figure 1)	WLG 41
	WLG 43
	KTP 14
Central area (Figure 2)	WLG 23
	WLG 24
	WLG 37
Coastal area (Figure 3)	WLG 38
	WLG 40
	WLG 44

An attempt has been made to use the hydrochemical data as evidence of the degree of mixing of waters between adjacent aquifer systems within the northern, central and coastal areas of the Willunga Basin.

Although hydraulic connection is believed to exist between the Maslin Sands and basement rocks this is not supported by the hydrochemical data from KTP 14 where waters from these two aquifers show different characteristics. The cation ratios from WLG 43, however, show a grouping of waters from the Blanche Point Formation, Maslin Sands and basement rocks, suggesting a mixing of waters in this area (Figure 1, Appendix C).

The anion ratios from wells in the northern part of the basin show a rather vague grouping. There is some evidence to support connection between the Blanche Point Formation and Maslin Sands.

In the central part of the basin, there is a similarity between waters of the shallow aquifers, Blanche Point Formation, Maslin Sands and basement in well WLG 37, suggesting a direct downward movement of groundwater. This is shown in the cation and anion ratios for this well shown in Figure 2 of Appendix C.

Hydrochemical data from the coastal area of the Willunga Basin shows some interesting features (Figure 3, Appendix C). In well WLG 38 significant differences exist between waters from the upper and lower parts of the Port Willunga Formation. There is a marked decrease in calcium, magnesium and bicarbonate ion ratios below 79 metres. The approximate total salts analyses show an increase from 4 000 to 21 000 milligrams per litre between 99 and 101 metres. No significant change in this unit is apparent on the lithological log at this depth and it is probable that this represents the fresh water/sea water interface. It is possible also, that much of the water contained within the lower part of the Port Willunga Formation is connate water.

Here again, in the coastal area, cation and anion ratios show evidence of hydraulic connection between the Maslin Sands and basement. There is no apparent connection between shallow aquifers and the Port Willunga Formation in this part of the basin.

SURFACE WATER MONITORING

Surface water salinity sampling points were established at fifteen localities in the Willunga Basin and are shown on Figure 21. Sampling was carried out over a two year period from February 1975 to January 1977. In January 1977, the decision was made that all surface water investigations would be carried out by the Water Resources Branch of the Engineering and Water Supply Department, and the surface water monitoring programme carried out by the Department of Mines and Energy was terminated. The surface water salinity data was to be used as part of the determination of the salt balance of the basin. A brief summary of the surface water salinity data is shown in Table 4.

TABLE 4

SUMMARY OF SURFACE WATER SALINITY DATA

Sampling Point	A	B	C	D
WLG 25	2 500	550	2 000	1 300
26	1 500	250	dry	700
28	2 000	480	1 500	1 300
29	1 900	250	1 000	600
30	2 200	420	1 450	700
32	1 820	750	dry	1 500
33	1 900	700	1 400	1 050
34	1 700	720	1 250	1 000
35	17 000	550	dry	1 100
36	1 100	300	dry	700
KTP 11	2 800	450	1 700	1 000
12	1 800	320	1 700	650
13	2 700	300	1 500	650

A. Maximum recorded salinity
B. Minimum recorded salinity
C. Average salinity - end of summer
D. Average salinity - end of winter

Two sampling points, WLG 27 and WLG 31, were usually dry and did not contribute useful surface water salinity data.

Stream gauging was initially proposed in the investigation programme as part of the groundwater recharge studies of the basin. The main contribution to surface water inflow appears to be from the numerous ephemeral escarpment streams incised into the western face of the Willunga Range. Two gauging stations were to be established to measure runoff from two representative catchments on the western side of the range.

Two perennial streams fed by springs in the Willunga Range were to be gauged to determine their contribution to surface water inflow.

Gauging stations were also to be established on Pedlar Creek and Aldinga Creek which are the two main avenues of surface water outflow at the coast.

All gauging sites were selected after consultation with officers of the Water Resources Branch of the E. & W.S. Department, who agreed to investigate the surface water and its relation to recharge to groundwater in the Willunga Basin.

It became clear, however, as the investigation progressed that the measurement of surface water flows would not be of value to the recharge investigation, as it would be impossible to set up a hydrographic model of the basin which would be of sufficient accuracy, or have sufficient data input, to enable a reliable estimate of recharge to be made.

On the basis of this conclusion, it was recommended that no surface water gauging stations be installed and recharge investigations have therefore, been abandoned. It is intended that an attempt be made to estimate recharge by indirect means at a later stage with the aid of computer modelling.

An estimate of groundwater recharge has been made from a consideration of rainfall on the Willunga Basin and the total surface catchment area that contributes runoff to it. This is shown in the section dealing with the water balance.

GROUNDWATER CONSUMPTION SURVEY

Each landowner within the Willunga Basin was forwarded, by mail, a request to furnish an estimate of his annual groundwater consumption. A total of 74 replies were received and the total withdrawal indicated by this means is approximately 2 700 megalitres per year.

This estimate is undoubtedly too low for three reasons:

i) the amount of irrigation practiced in the basin indicates a higher consumption

ii) replies were not received from all landowners

iii) landowners tend to be conservative by nature and suspicious of government enquiries regarding groundwater consumption.

It is considered that a follow up to the written survey should be conducted in the field. This will entail an assessment of well discharge rates, pump capacities, power ratings of pump motors, areas and types of crop irrigated.

WATER BALANCE

A simple water balance equation, for a groundwater basin as a whole, can be written as:

$$\text{INFLOW} = \text{OUTFLOW} + \text{CHANGE IN STORAGE}$$

At this stage of the investigation it is premature to attempt to determine a water balance for each of the four aquifer systems individually in the Willunga Basin, because the amount of groundwater withdrawals from each is unknown and the extent of hydraulic connection between the aquifers has not been defined.

However, because it is known that pumpage takes place from all aquifers and that some hydraulic connection occurs it may not be necessary to determine the water balance for each individual aquifer, but simply for the whole basin as a single entity, for the purposes of an approximate estimate.

The three components of the above equation will be estimated separately.

1. Inflow

Inflow to the Willunga Basin is derived from:

(i) surface runoff from catchments outside the basin,

(ii) groundwater underflow,

(iii) stream losses within the basin,

(iv) direct downward infiltration of rainfall within the basin.

Since no stream gauging has been carried out in the Willunga Basin the contributions made to groundwater recharge by items (i) and (iii) are unknown.

No aquifer testing has yet been carried out in the Willunga Basin and although approximate hydraulic gradients can be estimated in the vicinity of the basin margins, no transmissivity values are available to determine item (ii). However, an attempt is made here to estimate groundwater inflow.

Information supplied by Professor John Holmes of the Flinders University (pers. comm.) suggests that during years of average rainfall, there is no surplus of rainfall over evapotranspiration and soil moisture deficit requirements, to provide for groundwater recharge within much of the plains area of the Willunga Basin.

Item (iv) therefore, makes only a minor contribution if any, to recharge.

During very wet years, however, a significant contribution to recharge may be made by direct downward infiltration once the soil moisture deficit and evapotranspiration requirements have been satisfied.

A simpler approach to the problem is to consider the rainfall over the entire basin and its catchments as being the total inflow component. On the advice of Mr. E.B. Collingham of the Engineering and Water Supply Department, the total area was divided into eight representative rainfall areas, based upon the mean annual rainfall isohysets and topography.

Three of these representative catchment areas are within the sedimentary basin and any recharge contributed by these is internally derived.

The other five representative areas are scarp catchments, outside the sedimentary basin and these contribute to groundwater recharge in two ways:

i) by surface flow into the basin via the ephemeral escarpment streams which cross the Willunga Fault, and

ii) by groundwater inflow from hardrock aquifers into sedimentary aquifers.

The representative rainfall areas (catchments) are shown in Figure 22.

The rainfall on each catchment was estimated from the isohyets. The monthly rainfall distributions for those catchments above the town of Willunga were chosen as being the same as for Willunga itself. For catchments above Kangarilla, the distribution of the Meadows rainfall station was chosen.

Water balance computations were carried out for each catchment area using the monthly mean rainfalls and subtracting the evapotranspiration and soil moisture deficit values supplied by Professor John Holmes based upon CSIRO studies. The inflow contributions for the catchment areas are given in Table 5 below:

TABLE 5

INFLOW CONTRIBUTIONS BY CATCHMENTS

Catchment (Fig. 22)	Area (km^2)	Rainfall (mm/yr.)	Excess (mm/yr.)	Recharge (Ml/yr.)
1	17	600	50	850
2	14	690	100	1 400
3	13	750	110	1 430
4	9	790	130	1 170
5	31.5	830	150	4 725
6	17	659	57	970
7	16	790	130	2 080
8		516*	0	

*Average of McLaren Vale (502 mm) and Aldinga (530 mm) weather stations.

This gives a total volume of water available for recharge of 12 625 Ml per annum. This figure is adopted for inflow to the Willunga Basin. It is an estimate only, based upon the best data available and is possibly slightly too low because it does not include recharge that would occur in the outer plains area (area 8) during years of high rainfall. Such recharge does not show up when average figures are considered.

2. Outflow

Outflow from the Willunga Basin is comprised of three components. These are:

(i) surface runoff via streams at the coast and into the Onkaparinga River.

(ii) groundwater underflow at the coast.

(iii) groundwater withdrawals for irrigation.

(i) Four small ephemeral streams, Pedlar Creek, Willunga Creek Aldinga Creek and Maslins Creek traverse the basin and discharge at the coast. The largest of these, Pedlar Creek, has been observed by the author to flow at the coast only during years of above average rainfall or following periods of heavy or sustained rainfall. A flood was recorded on Pedlar Creek in 1973.

This creek is fed by a spring from basement rocks approximately 1 kilometre to the east of the old South Road. The flow, presumed to be the base flow, has been estimated by the author at approximately 50 kilolitres per day. It disappears into reed beds at Moana and does not reach the coast. An annual average outflow of 1 000 Ml is assumed.

The three remaining streams are assumed to contribute 1 000 Ml per year to the total outflow figure. It should be stressed that these values are very approximate estimates at best, as no flow measurements have been recorded on any of the coastal streams.

A fourth creek, Peter Creek, flows in a north easterly direction across the top end of the basin and discharges into the Onkaparinga River. A gauging station has been erected on this creek by the Engineering and Water Supply Department at Baker Gully. The average outflow of Peter Creek has been determined at 6 000 Ml per year.

The total surface water outflow from the Willunga Basin is estimated to be approximately 8 000 Ml per year.

(ii) No accurate determination of groundwater underflow at the coast can yet be obtained since no aquifer parameters have been determined. However, an estimate can be made, since thicknesses and approximate hydraulic gradients for the two main aquifer systems, the Port Willunga Formation and the Maslin Sands, are known.

For the Port Willunga Formation, an average thickness of 100 metres is assumed (see figure 8). No water table contours are available since only four observation wells are known to be completed in this aquifer. However, an approximate gradient can be estimated; this value is 1 in 350 or 0.003.

In the Adelaide Plains basin, transmissivity values have been determined from production tests of wells completed in the Port Willunga Formation. In cases where this aquifer has a thickness of approximately 100 metres, (e.g. at Regency Park golf course) transmissivity values average approximately 100 m^3/day/m (Griffin, 1976). This value is assumed for the Port Willunga Formation in the Willunga Basin since there are geological similarities between this and the Adelaide Plains basin.

Groundwater underflow can be calculated simply from the equation: $Q = T.I.L.$

where Q = volume of underflow/unit time
T = transmissivity
I = hydraulic gradient
L = width of flow path (approx. 7 kilometres in this case).

Using this equation:

$$Q = 100 \times 0.003 \times 7\ 000\ m^3/day$$
$$= 0.3 \times 7\ 000 \times 365\ m^3/yr$$
$$= 767\ Ml/year$$
$$= 800\ Ml/year\ (approx.)$$

For the Maslin Sands aquifer, an average thickness of 50 metres is assumed (see Figure 10). The only transmissivity values available for sandstone aquifers of comparable age and lithology within the St. Vincent Basin are those from dewatering investigations at the Inkerman coalfield where aquifers of similar thickness give transmissivity values averaging 30 m^3/day/m (Bowering, 1976).

The hydraulic gradient within this aquifer is approximately 1 in 500 or 0.002 (see Figure 17). Highly saline water in the Maslin Sands aquifer recorded in well WLG 38 (137 000 mg/l) suggests that no outflow occurs from it in the southwestern part of the basin, and for this reason, the width of the groundwater flow path is assumed to be approximately 5 kilometres at the coast.

Using the same equation for groundwater flow, the underflow from the Maslin Sands aquifer is estimated to be 110 Ml per year (say 100).

This gives a total groundwater outflow from the Willunga Basin of 900 Ml per year for the two principal aquifers at the coast. This estimate is possibly on the low side because it does not include groundwater movement through other sedimentary units (viz Blanche Point Formation, Chinaman's Gully Beds and Tortachilla Limestone) which, although presumed to have low transmissivities at the coast, will make a minor contribution to outflow. Groundwater movement through basement rocks has been ignored, since this is unknown and is presumed to be quite low.

(iii) A groundwater consumption survey, carried out during 1977 indicated an annual average groundwater withdrawal of 2 700 megalitres. This figure may be low but for the purpose of computing a water balance for the Willunga Basin, 3 000 megalitres is assumed. The water outflow from the Willunga Basin is thus:

surface outflow:	8 000	Ml/year
groundwater underflow:	900	"
groundwater withdrawal:	3 000	"
Total	11 900	"

3. Change in Storage

Hydrographs of nine operational wells in the Willunga Basin are shown in Figure 15. Four wells WLG 23, WLG 38, KTP 14, and KTP 15 show virtually no change in storage. The remainder show a decrease in storage, with the exception of WLG 42 which shows an increase.

For each well, a representative area of influence was determined to which was ascribed a change in groundwater storage related to that well. The method used and the calculations involved are shown in Appendix D and Figure 23 which show an estimated decrease in groundwater storage of approximately 1 300 megalitres per year.

The water balance equation therefore becomes:

INFLOW = OUTLFOW + CHANGE IN STORAGE

12 625 11 900 1 300

The discrepancy of 575 megalitres results from the numerous assumptions that have been made.

11,900
1300
12,200
- 12,625
171

Another reason for the discrepancy is that the inflow side of the water balance equation is based upon average annual rainfall data. The observed changes in water level, however, (from which the change in storage component of the equation is derived) have been affected by three years of below average rainfall i.e. 1975 to 1977 inclusive. Thus the change in groundwater storage is larger than would be the case during a year of average rainfall.

Despite the discrepancy, it is considered that the components of the water balance equation are of the correct order of magnitude. They are not presented here as a basis for the formulation of a water resources management policy for the Willunga Basin. Much more investigation work is required in the area to refine the water balance.

CONCLUSIONS

1. There is no evidence to indicate that serious depletion of the groundwater resource of the Willunga Basin is occurring. Some decline in water levels is apparent and it is considered that this may be a function of the three years of below average rainfall from 1975 to 1977 inclusive and the attendant increase in groundwater demand. It is likely that water levels will be restored following seasons of average or above average rainfall. This is by no means certain and the situation will need to be monitored carefully.
2. There is no evidence of declining water quality in the Willunga Basin. However, the variation in groundwater salinity with time is unknown. Because of the extent of hydraulic connection between aquifers, it is likely that groundwater quality will be of greater importance in the management of the resource. Hydraulic connection

will allow the movement of salts between aquifers under the influence of pumping.

3. Any water resource management policy devised for the Willunga Basin, must consider the basin as a single entity. Groundwater abstraction from and recharge to any individual aquifer, cannot be regarded as influencing that aquifer alone.
4. Disposal of effluent into the aquifers is safe only in the southwestern corner of the basin south of Aldinga Beach, where groundwater quality is too poor for domestic use.

RECOMMENDATIONS

The following recommendations relate to further work that is considered necessary to complete the groundwater investigations to a stage where aquifer parameters and the water and salt balances in the Willunga Basin can be suitably defined for modelling purposes.

A. Groundwater Monitoring

1. It is recommended that an examination of all wells completed in the Port Willunga Formation be carried out in the field to assess their suitability for incorporation into an observation well network.
   This will involve measuring the depth of each well and the depth to which it is cased.
2. A comprehensive network, designed to enable water table contours to be constructed for each aquifer system, should initially be read at three monthly intervals for approximately three years at the end of which the results should be reviewed. A few representative wells in each aquifer system (no more than four or five) should be monitored fortnightly for the compilation of hydrographs.

3. Sampling of wells, both departmental and private, must be carried out by means of a portable pump or downhole conductivity meter if the salinity monitoring programme is to have any meaning. Where possible, the co-operation of landowners should be sought in obtaining samples during pumping.

B. Further Investigations

1. Drilling

The highest priority for drilling is along the foot of the Willunga Range to examine the aquifers and sedimentary section in the deepest part of the Willunga Basin. It is recommended that wells be drilled at four localities between Kangarilla and 5 kilometres south of Willunga, and that they be completed to monitor the recharge to the basin from the Willunga Range. Dual completions will be required at three localities to observe changes in storage in the Port Willunga Formation and Maslin Sands aquifers.

A dual completion at one other locality is also recommended, to examine the potentiometric heads in these two aquifers and their changes with time. The suggested locality is midway between Aldinga and Willunga.

2. Geophysics

It is recommended that gamma ray and neutron logging be carried out in selected deep wells to determine total aquifer thicknesses and thus the volume of usable groundwater in storage in the Basin.

Resistivity surveying should be carried out in the coastal area along traverse lines normal to the coast line. The data from such a survey can be used as a reference to detect future groundwater salinity changes at the coast and thereby detect any landward movement of the groundwater/seawater interface.

3. Aquifer Testing

No aquifer testing has yet been carried out in the Willunga Basin. Initially, it is recommended that at least ten aquifer tests be conducted, principally to determine transmissivities in the recharge areas of the basin and the volume of groundwater underflow along the coast. Storage coefficients of the aquifers must be determined to enable changes in depths of the water table and potentiometric head to be related to changes in groundwater storage.

A minimum of four aquifer tests are required for the Port Willunga Formation and six for the Maslin Sands. In each case, if possible, water level observations must be taken in aquifers other than that which is being pumped, to determine the level of hydraulic connection.

The aquifer testing programme should be carried out over a two year period, at the end of which the need for additional testing in the Port Willunga Formation and Maslin Sands should be considered. Consideration must also be given to aquifer testing in the shallow aquifers, particularly in the vicinity of the Willunga Range where these are most heavily exploited.

4. Stream Gauging

It is recommended that stream gauging be carried out during periods of flow on Pedlar and Aldinga creeks to measure leakage from them and so determine their contribution to groundwater recharge. This will refine the estimate of groundwater safe yield. A gauging station is already established on Peter Creek and no additional work is required on that stream.

5. Local Recharge

It is recommended that the contribution made to groundwater recharge by direct downward infiltration of rainfall be estimated by determination of the tritium content of water in the unsaturated zone in selected localities.

6. Groundwater Usage

It is recommended that a comprehensive survey of groundwater consumption throughout the Willunga Basin be made and a correlation between groundwater withdrawals and water table and potentiometric level fluctuations be established.

It will be necessary to examine irrigation practices and the distribution of crop types to interpret the real meaning of the hydrographs.

All aspects of a groundwater basin investigation outlined above are necessary to arrive at a meaningful management policy, using computer modelling as the means to determine such a policy. In this manner, data derived from a mathematical model can be realistically related to land use practices.

OJWB:ZV

O.J.W. BOWERING

REFERENCES

Bowering, O.J.W., 1976. Inkerman Coalfield Dewatering Investigation Report No. 2. S. Aust. Dept. Mines Rept. Bk. No. 76/73 (unpublished).

Campana, B. and Wilson, R.B., 1954. Yankalilla map sheet, Geological Atlas of South Australia, 1:63 360 series. Geol. Surv. S. Aust.

Cochrane, G.W., 1956. The Geology and Hydrology of the Willunga Basin. Rept. Invest. Geol. Surv. S. Aust. No. 8.

Cooper, B.J., 1977a. New and revised stratigraphic nomenclature in the Willunga Embayment. Q. Geol. notes., Geol. Surv. S. Aust. No. 61.

Cooper, B.J., 1977b. Eocene to Miocene stratigraphy of the Willunga Embayment. Geol. Surv. S. Aust. Rept. Bk.No. 77/123.

Daily, B., Firman, J.B., Forbes, B.G. and Lindsay, J.M., 1976. Geology. In: Twidale, C.R., Tyler, M.J. and Webb, B.P. (Eds.), Natural History of the Adelaide Region. Roy. Soc. S. Aust., Adelaide, pp. 5-42.

Firman, J.B., 1976. Limestone at the base of the Pleistocene sequence in South Australia. Q. Geol. notes, Geol. Surv. S. Aust., No. 58.

Griffin, G.K.P., 1976. Regency Park Recreation Centre Water Well Completion Report. S. Aust. Dept. Mines Rept. Bk. No. 76/157 (unpublished).

Harris, W.K., 1966. New and Redefined Names in South Australian Lower Tertiary Stratigraphy. Q. Geol. notes, Geol. Surv. S. Aust., No. 20.

Howchin, W., 1911. Description of a disturbed area of Cainozoic rocks in South Australia with remarks on its geological significance. Trans. Roy. Soc. S. Aust., 35.

Howchin, W., 1929. The Geology of South Australia.

Lindsay, J.M., 1966. Stratigraphy and Micropalaeontology of the Willunga Bore WB-1, a re-examination. S. Aust. Dept. Mines. Rept. No. 8/66 (unpublished).

Lindsay, J.M., 1967. Foraminifera and stratigraphy of the type section of Port Willunga Beds, Aldinga Bay, South Australia. Trans. Roy. Soc. S. Aust. No. 91.

Lindsay, J.M., 1969. Cainozoic Foraminifera and stratigraphy of the Adelaide Plains Sub-basin, South Australia. Bull. Geol. Surv. S. Aust. No 42.

Lindsay, J.M., 1970. Port Willunga Beds in the Port Noarlunga - Seaford Area. Q. Geol. notes, Geol. Surv. S. Aust. No. 35.

Ludbrook, N.H., 1961a. Examination of three water bores near McLaren Flat, Hd. of Willunga. S. Aust. Dept. Mines Rept. No. 53/50 (unpublished).

Ludbrook, N.H., 1961b. Palaeontological Examination of material from the hundreds of Noarlunga and Willunga. S. Aust. Dept. Mines Rept. No. 53/119 (unpublished).

Ludbrook, N.H., 1963. Correlation of the Tertiary Rocks of South Australia. Trans. Roy. Soc. S. Aust. No. 87.

Ludbrook, N.H., 1969. The Tertiary Period. In: Parkin, L.W. (Ed.), Handbook of South Australian Geology. Geol. Surv. S. Aust., Govt. Printer, Adelaide, pp. 172-203.

Ludbrook, N.H. and Lindsay, J.M., 1966. The Aldinga Stage. Q. Geol. notes, Geol. Surv. S. Aust. No. 19.

Mawson, D., 1952. The Willunga Basin, Introductory and Historical Notes. Trans. Roy. Soc. S. Aust. No. 76.

Olliver, J.G. and Reed, J.A., 1975. Construction Sand Resources, Maslin Beach, Hd. Willunga, Co. Adelaide. S. Aust. Dept. Mines Rept. No. 796 (unpublished).

Reynolds, M.A., 1953. The Cainozoic succession of Maslin and Aldinga Bays, South Australia. Trans. Roy. Soc. S. Aust. No. 76.

Sprigg, R.C. and Wilson, R.S., 1954. Echunga map sheet, Geological Atlas of South Australia, 1:63 360 series. Geol. Surv. S. Aust.

Stuart, W.J., 1969. Stratigraphy and structural Development of the St. Vincent Tertiary Basin, South Australia. Ph.D. Thesis, Department of Geology, University of Adelaide (unpublished).

Tucker, N.P., 1975. Willunga Basin Groundwater Investigation Progress Report No. 2 - Borehole Surveys to August 1975. S. Aust. Dept. Mines Rept. Bk.No. 75/117 (unpublished).

Twidale, C.R., 1976. Geomorphological Evolution. In: Twidale, C.R., Tyler, M.J. and Webb, B.P. (Eds.), Natural History of the Adelaide Region. Roy. Soc. S. Aust. Adelaide, pp. 43-59.

Waterhouse, J.D. and Barnett, S.R., 1974. Willunga Basin Investigation Progress Report No. 1 - A Summary of Work to December 1973 and Proposed Future Investigations. S. Aust. Dept. Mines Rept. Bk. No. 74/2 (unpublished).

APPENDIX A

BOREHOLE LITHOLOGS
AND WATER ANALYSIS SUMMARIES
WILLUNGA BASIN DRILLING PROGRAMME

TABLE I

Formation Intervals-Willunga Basin Investigation Wells

Well No.	Quaternary	Port Willunga Formation	Chinaman Gully Beds	Blanche Pt. Formation	Tortachilla Limestone	South Maslin Sand	North Maslin Sand	Permian	Basement
WLG23	0-9					9-14	14-40		40
WLG24	0-11	-	-						11
WLG37		0-39		39-83	83-89	89-92	92-111		111
WLG38	0-44	44-199		199-243	243-245	245-256	256-301		301
WLG40	0-21	21-74.5	74.5-79	79-120	120-121.5	121.5-131	131-180	180-200+	
WLG41	0-14			14-22		22-41	41-57		57
WLG42		0-68	68-75	75-114	114-117.5	117.5-118	118-149		149
WLG43	0-32			32-50		50-70	70-90	184.5	184.5
WLG44	0-17.5	17.5-26	26-28.5	28.5-55.5	55.5-60	60-102.5			102.5
WLG45	0-36	36-150	150-159	159-176+					
KTP14									
WB1	0-34	34-121	121-130	130-185	185-188	188-205+			

DEPARTMENT OF MINES SOUTH AUSTRALIA

HYDROGEOLOGY SECTION

BORE LOG

HIRER *Department of Mines.*

Drill type *Cable Tool*
Circulation *Water*
Driller *A. Sturak*
Start *8-4-74*
Finish *18-4-74*

Logged by *J.D. Waterhouse*
Date logged *24-4-74*
Bore Diameter *6"*
DEPTH *46·5*

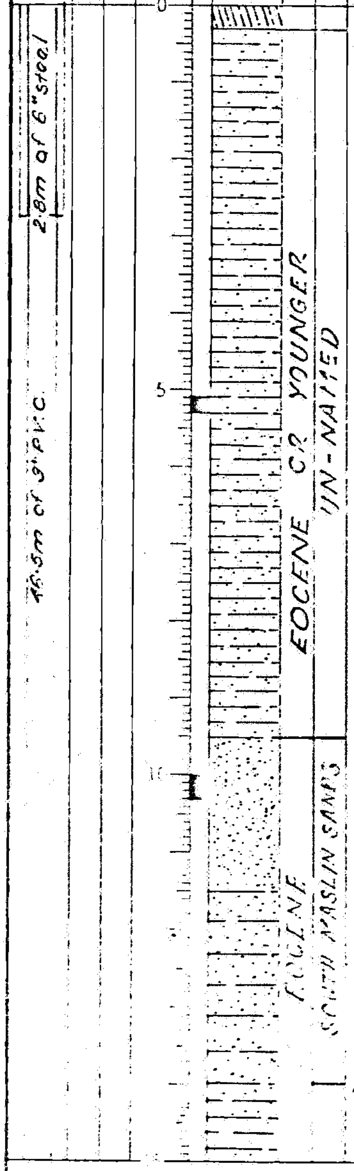
A.M.G. Zone
Coords. E
" N
Datum Elev.
(m) Ref. Pt. Elev.
Surface Elev.

HUNDRED *WILLUNGA*
SECTION *Adj 106*
STATE No. *69701060l*
Project No. *WLG 23*
Docket No. *1185/73*
Bore Serial No. *192/74*

Depth to Water cut m	Depth to standing water m	SUPPLY litres/sec	SUPPLY Method of test	TOTAL DISSOLVED SOLIDS Milligrammes/litre	TOTAL DISSOLVED SOLIDS Analysis W No
		SEE ATTACHED SHEET.			

REMARKS *Willunga Basin Investigation Stratigraphic bore. Completed as an Observation bore in North Maslin sands. WLG 23.*

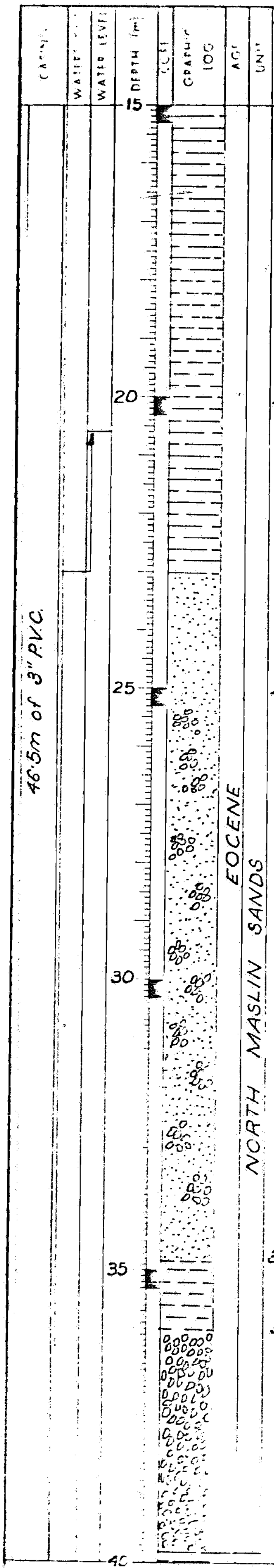
CASING | WATERS CUT | WATER LEVEL | DEPTH (m) | CORE | GRAPHIC LOG | AGE | UNIT



DEPTH (m) from	to	DESCRIPTION
0	0·3	SOIL:- Dark brown, slightly calcareous, clayey, silt.
0·3	9·5	LUTITE:- Moderately calcareous. Pink/fawn with minor pink-brown. 10% quartz, silt size to 0·5mm, colourless, angular to rounded. 4·3-5·3m; slightly calcareous, pink/brown with minor grey/fawn and red/brown mottling. 20% quartz, silt size to 0·5mm., colourless and milky, angular to subrounded. 5·3-7·3m; slightly calcareous, silty. Red/brown and grey mottled. 30% quartz as above. 7·3-9·5m; slightly calcareous. Red/brown and grey mottled. 20-30% quartz, silt size to 1·5mm., colourless and milky subangular to subrounded. Rarely milky, angular to 5mm., rare black, well cemented, rounded grains to 3mm.
9·5	11·5	SANDSTONE:- Moderately cemented. Quartz grains, colourless, rounded, 0·2-0·7mm., most 0·5mm. 30-50% of grains stained yellow/brown.
11·5	14·0	LUTITE-ARENITE:- 50% silty lutite, brown with minor grey mottling. 50% quartz arenite, angular to rounded, silt size to 2mm, colourless, milky and brown stained. A few angular, well cemented brown/black fragments of ferruginous sandstone to 1cm. Rare angular red/brown stained quartz to 1cm Common fine white mica.
14·0	16·0	LUTITE:- slightly calcareous, silty. Minor fine white mica, off white from 16-18m. Rare ferruginous grains to 1·5mm. Common fine white mica. grey.

GJT	1	5
Feb '75		

DEPARTMENT OF MINES — SOUTH AUSTRALIA



DEPTH m from	to	DESCRIPTION
18·0	20·0	SILT:- Very fine. Common fine white mica. Off-white – grey.
20·0	23·0	LUTITE:- Silty. Minor fine white mica. Off-white with minor pink brown
23·0	25·0	ARENITE:- Poorly sorted quartz, subangular to rounded, from silt size to 1mm. Most colourless, some milky. Common white mica to 0·5mm.
25·0	34·8	ARENITE-RUDITE:- As above, but grains to 6mm. 27–29m; 10% pale yellow quartz. 29–34·8m; Rare blue/green rock fragments.
34·8	36·0	SILT:- Quartz, colourless, rarely to 0·5mm. Common fine white mica to 1mm.
36·0	39·8	RUDITE:- White, angular quartz from silt size to 5cm. Common brown subangular, translucent grains to 3mm. Minor grey, rounded slate fragments to 3mm. Common fine white mica 38·5–39·8m, quartz from 1–7mm grading to silt size. Angular to subrounded, colourless to milky to yellow with minor red/brown staining. Minor orange brown translucent grains as above. Common fine white mica to 2mm

Borehole Serial No 697010601

GJT 2 8

Feb '75

Pl Nº S10537a ME

DEPARTMENT OF MINES — SOUTH AUSTRALIA

CASING	WATER CUT	WATER LEVEL	DEPTH (m)	CORE	GRAPHIC LOG	AGE	UNIT	DEPTH m from	to	DESCRIPTION
46·5m of 3" PVC			40			PROTEROZOIC	UNDIFFERENTIATED	39·8	42·8	LUTITE:- Very weathered, kaolinitic, slatey meta-siltstone. Brown layered, with weak cleavage.
								42·8	46·5	SILT:- Clayey, grey/blue. Weathered slate/meta-siltstone.
			45							
										END OF HOLE 46·5m.
			50							

Borehole State No 6970/C6C0/

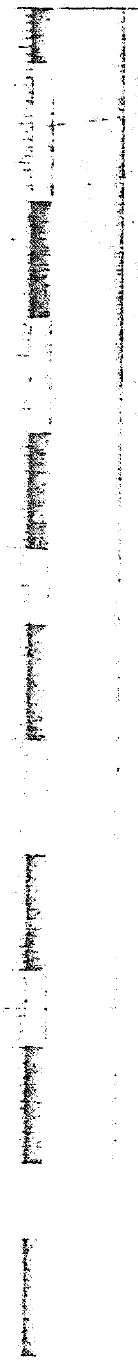
Log GJT Sheet 3 of 5

Date Feb '75 Bore Report No.

RE No SKE 37a MH

DEPARTMENT OF MINES — SOUTH AUSTRALIA

CORE DESCRIPTION (J.D.W. & W.K.H.)



5·15–5·30m.	ARENITE:- Quartz, silt size to 0·5–1mm. Most well rounded, colourless. 30–40% lutite, grey/red, mottled
10·0–10·3m	SANDSTONE:- Moderately cemented, quartz grains rounded, 0·2–0·7mm, most 0·5mm, colourless. 30–50% of grains stained yellow brown.
15·0–15·3m.	ARENITE:- Quartz, angular to subangular, rarely rounded, colourless, fine to medium grained. Rare heavy minerals. Grey overall.
20·0–20·3m.	SILTITE:- Quartz, colourless. Minor kaolinitic lutite, fine white mica and heavy minerals. Bottom 5cm light brown, finely laminated lutite.
25·0–25·3m.	ARENITE:- Quartz, medium grained, rounded to well rounded. Occasional mica flakes. 2-3% lutite. Colourless. Overall white.
30·0–30·3m	ARENITE:- Quartz, dominantly coarse grained, angular to rounded, colourless. Occasionally yellow, milky and pink.
35·0–35·3m	ARENITE:- Quartz, medium grained, angular to subrounded, colourless. Occasional mica flakes

[illegible]

SUMMARY OF WATER ANALYSES

Progressive depth of bore (m)	Sampling depth (m)	Water level (m)	Total dissolved solids (Milligrammes/litre)	Analysis W. No.	Remarks
27·00	27·00	24·40	960	2401/74	
29·00	29·00	24·00	935	2402/74	
31·00	31·00	20·60	990	2403/74	
33·00	33·00	20·60	880	2404/74	
37·00	37·00	20·60	767	2405/74	
39·00	39·00	20·60	774	2406/74	Full analysis

[illegible] State No. 697010601

GJT 5 5

Feb '75

RF No. S10539 MH

S.A. Dept of Mines

Drill type Cable Tool
Circulation Water
Driller A. Sturak
Start 22·4·74
Finish 24·4·74

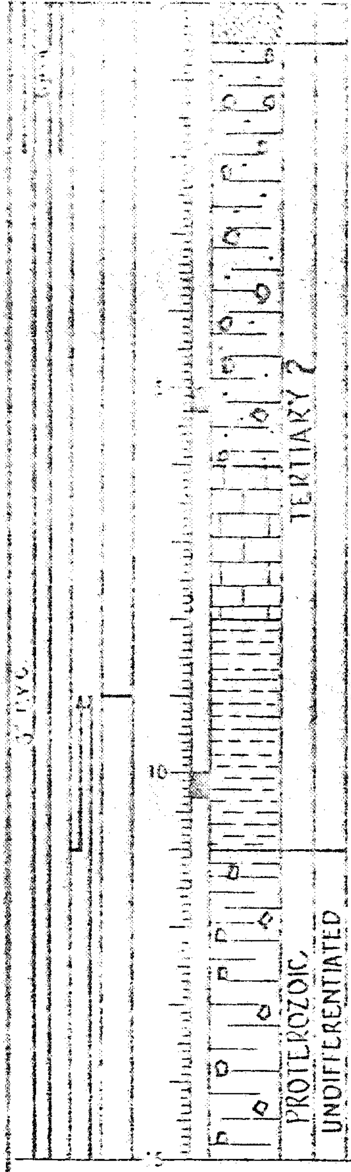
Logged by J. Waterhouse
Date logged 25·7·74
Bore Diameter 6 inch
DEPTH 26m

A.M.G. Zone
Coords E
N
Datum Elev.
Ref. Pt. Elev.
Surface Elev.

HUNDRED Willunga
SECTION 581
STATE No 6527058102
Project No. WLG·24
Docket No. 1185/73
Bore Serial No 194/74

Depth to water cut (m)	Depth to standing water (m)	Supply litres/sec.	Method of test	Total dissolved solids	
11·00	9·00	–	Not tested	See separate sheet	
17·50	9·00	–	Not tested		

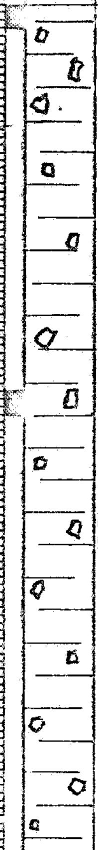
REMARKS Willunga Basin Stratigraphic bore – completed for water observation.
Obs. bore Nº WLG 24



DEPTH (m)		DESCRIPTION
0	0·50	ARENITE Colourless and milky quartz, angular to subrounded, from silt size to 2mm (most less than 1mm). Common rounded ferruginous lumps to 2cm, variable cementation, red/brown internally, some weathered to clay.
0·50	6·00	LUTITE Very stiff, grey, grading to red and yellow/brown, varying proportions (always less than 30%) of quartz arenite, from silt size to 0·5m, subrounded to angular, generally colourless, 50% stained red/brown. 2·00 to 4·00 Calcareous Orange/brown 20% arenite-rudite. Most colourless and red/brown quartz, mainly 0·2 to 0·3mm, some to 3mm, subangular to subrounded. Minor black/brown grains from silt size to 3mm. Rare subangular grains, buff, fossiliferous, quartzose calcarenite to 5mm. 4·00 to 6·00 As above, 30% arenite rudite with equal proportions quartz and red/brown grains as above. Calcarenite as above to 2cm.
6·00	8·00	CALCARENITE Well cemented, massive, grey fragments with minor grey calcisiltite-calcilutite and colourless subrounded quartz from silt size to 1mm. Rare off white bryozoal fragments.
8·00	11·00	SILT Slightly calcareous. 25% Lutite. Rare white calcareous grains to 1mm. Grey with yellow/brown mottling. 10·00 to 11·00 Slightly calcareous. Grey with yellow/brown mottling 25% lutite. Minor grey, moderately cemented calcarenite fragments slightly fossiliferous, to 2cm. Minor colourless quartz from silt size to 0·5mm, subangular to subrounded.
11·00	17·50	LUTITE Brown. Rare white calcareous grains. Minor colourless quartz from silt size to 0·4mm. Rare dark brown, angular to subangular fragments to 3mm. 13·00 to 15·00 Red/brown and grey mottled with minor silt-arenite in two forms ① Subrounded quartz, silt size to 0·5mm ② Red/brown opaques, even grained ~0·5mm.

Dr. R.H. Sheet 1 of 2
Date Aug '75

FT Nº 610537 MH



WATER	WATER	DEPTH	GRAPHIC LOG	AGE	UNIT	DEPTH m from	to	DESCRIPTION
		15						15·00 to 17·00 Stiff, grey
								17·00 to 17·50 Brown, 10% angular quartz to 1cm, colourless to milky with red staining
				PROTEROZOIC	UNDIFFERENTIATED	17·50	26·00	QUARTZ Fragments of vein quartz of variable size, with no slate at 17·50m but grading to 50% blue/grey weathered slate at base.
		20						
		25						
								END OF HOLE

Borehole State No. 697058102

Dr. R.K. | Sheet 2 of 2

Date Aug'75 | Bore Folder No. [illegible]

PF Nº 510537o MH

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

PROJECT:

CORE DESCRIPTION

HOLE NO

UNIT/STATE NO:

CORE Dia.	DEPTH m	GRAPHIC LOG	GEOLOGICAL DESCRIPTION OF CORE

5.00-5.30 CONGLOMERATE Calcareous sandy with minor clay, Arkosic quartzite clasts to 10cm. Red brown

10.00-10.30 LUTITE, arenaceous (rounded to well rounded frosted colourless quartz), silty kaolinitic. Occasional pebbles of weathered arkosic quartzite to 1cm. Grey brown

15.00-15.30 LUTITE Weathered shale/slate. Weak inclined cleavage, rare slickensided joints. Brown

20.00-20.30 LUTITE As above Quartzite at base

Borehole State No. 697058102 WLG 24
PF No. S10749

SHEET 3 OF 4

DEPARTMENT OF MINES SOUTH AUSTRALIA

HYDROGEOLOGY SECTION

BORE LOG

HIRER S.A. Dept of Mines and Energy

Drill type Cable Tool
Circulation Water
Driller W.H. James
Start 31·7·74
Finish 20·9·74

Logged by J.D. Waterhouse
Date logged During Drilling
Bore Diameter
DEPTH 127m

A.M.G. Zone
Coords. E
" N
Datum Elev.
(m) Ref. Pt. Elev.
Surface. Elev.

HUNDRED WILLUNGA
SECTION 477
STATE No. 6970 47707
Project No. WLG 37
Docket No. 1185/73
Bore Serial No. 109/75

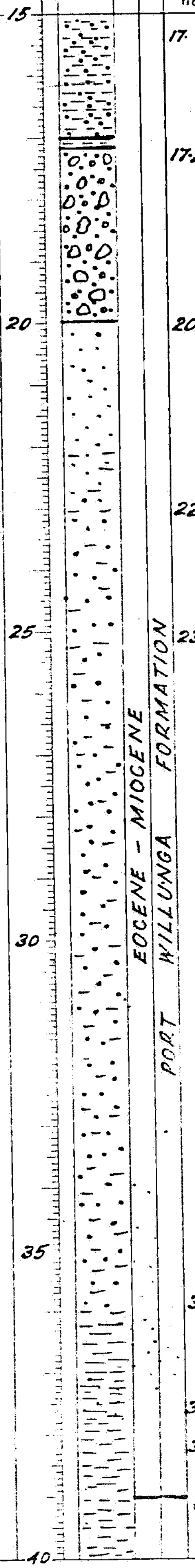
Depth to Water cut (m)	Depth to standing water (m)	SUPPLY		TOTAL DISSOLVED SOLIDS	
		litres/sec.	Method of test	Milligrammes/litre	Analysis W No
	SEE	ATTACHED	SHEET		

REMARKS Willunga Basin Stratigraphic Bore. Completed as observation bore WLG 37 in unconfined Quaternary aquifer.

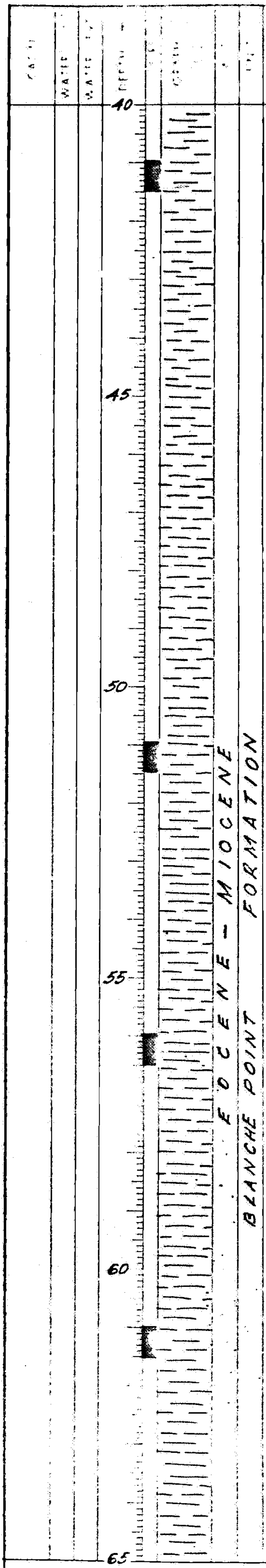
CASING	WATERS CUT	WATER LEVEL	DEPTH (m)	CORE	GRAPHIC LOG	AGE	UNIT	DEPTH (m) from	to	DESCRIPTION
3" P.V.C. to 42m			0 5 10 15			EOCENE - MIOCENE	PORT WILLUNGA FORMATION	0	1	ARENITE Quartz, silt size to 0·5mm, most 0·3 - 0·5mm, subangular to subrounded, colourless with some brown staining. Minor white to buff, angular to subangular calcareous grains to 2mm. Minor fawn lutite, black-brown opaques, subrounded to angular, from silt size to 2·5mm.
								1	17	ARENITE-SILTITE Quartz, colourless-milky-yellow, some brown stained, subangular-subrounded, most 0·1 - 0·3mm, rarely to 3mm and angular. Minor fawn lutite and fine white mica to 0·5 mm. 1-3m. Rare grey, angular, massive, calcareous fragments to 4mm. Rare subrounded, red-brown ferruginous grains to 3mm. Rare white-fawn subangular calcareous grains less than 1mm. 5-6mm. Most quartz 0·1 - 0·5 mm. 12-13m. Bit sample. Arenite-siltite as above, with 20% lutite matrix - fawn and pale grey-brown 3 mm bands. Plastic. 13-14m. Rare brown, moderately cemented ferruginous sandstone (quartz grains AA), some grey lutite blobs.

	Date	Sheet 1 of 7
	Date	Bore Record N.

PE Nº 510537 MH



DEPTH m from	to	DESCRIPTION
17	17·20	SILT Quartz, colourless, subangular to subrounded, to 0·2 - 0·3 mm. 10% Quartz arenite to 1mm most 0·5 - 1mm, colourless and rarely milky, rounded. Minor moderately cemented orange and purple siltstone fragments, fine white mica & brown lutite.
17·20	20	ARENITE - RUDITE. Poorly sorted quartz, silt size to 4mm, most 0·3 - 1mm, rounded, colourless, large grains milky - orange, subangular quartz. Some weakly cemented. Minor light brown lutite, fine white mica. 18-20m Minor orange-brown lutite.
20	22	SANDSTONE. Moderately to well cemented ferruginous sandstone - quartz, poorly sorted from silt size to 1·5mm. Red/purple with sharp boundary to outer orange brown (1cm) rim of fragments up to 10cm. Minor quartz arenite, silt size to 2mm, subrounded to rounded, colourless to milky.
22	23·50	ARENITE Quartz, silt size to 3mm (rarely), most less than 1mm. subrounded to rounded (larger grains subangular), colourless, some milky, orange stained. Common white mica to 1mm. 23-23·50m 30% light grey lutite.
23·50	36	ARENITE Quartz, from silt size to 1mm, subangular to rounded, most colourless, some milky, orange and red stained. Rare fine white mica, minor lutite. 35-36m 30% fine silt and lutite - grey with red/brown mottling.
36	37	ARENITE Quartz, from silt size to 3mm, most rounded, some subrounded. 30% silt - lutite matrix, weakly cemented in places. Grey and red/brown.
37		LUTITE, grey and red-brown. 50% silt with minor quartz arenite - rudite to 4mm, rounded-subrounded
37	38	SILT Quartz to 0·2mm, angular to subangular, colourless. Common white mica to 0·5mm.
38	42	SILT Quartz, mainly less than 0·2mm, subangular to subrounded, most colourless, some red and brown. Minor subrounded quartz arenite to 0·8mm. Common rounded glauconite pellets to 1mm - some within fragments of well cemented light and dark brown siltstone. 10-20% dark brown lutite. Rare angular quartz to 4mm, white to fawn.



DEPTH m from	to	DESCRIPTION
42 -	72	<u>SILT</u>, dark brown, very fine with up to 30% lutite. Slightly calcareous, 5% pink brown fossil fragments to 4mm.

<u>42-48m</u>. Common, rounded, glauconite grains to 0.5mm. 5% quartz, arenite, silt size to 1mm angular to subrounded. Minor, brown, well cemented pyritic siltstone. Minor fine white mica.

44-48m. Rare colourless spicules to 1.5mm.

<u>48-72m</u>. 5% colourless silica spicules to 2mm. (Most < 1mm). Minor quartz silt.

<u>48-56m</u>. 5% glauconite, rounded, most 0.5-1mm.

<u>54-56m</u> Rare subangular quartz to 0.4mm.

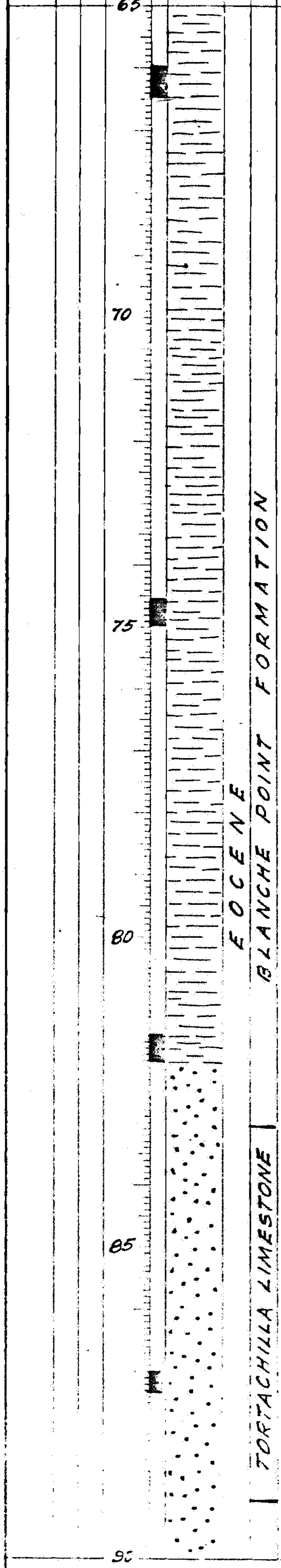
<u>56-64m</u>. Lutite minor. Minor glauconite, rounded, most 0.5-1mm.

<u>64-72m</u>. 50% glauconite, rounded, most 0.5-1mm.

Borehole State No 697047707

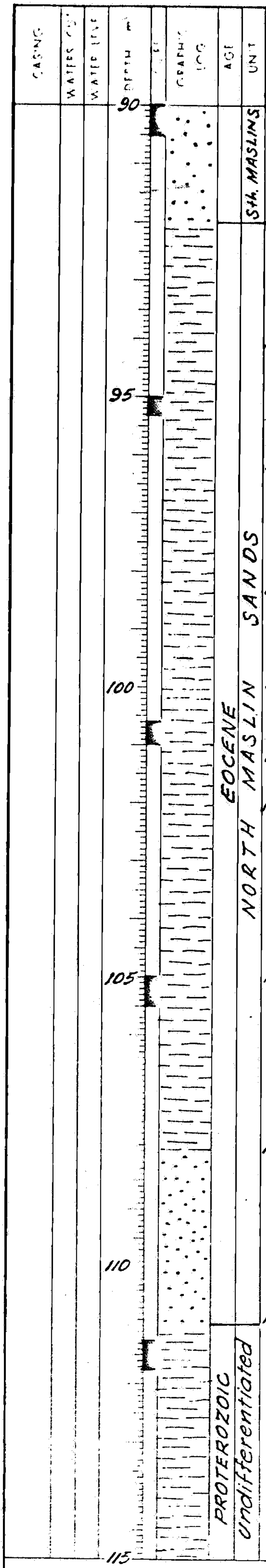
Bore Folder No

PE Nº 510537a MH



DEPTH m from	to	DESCRIPTION
		68-70m 50% of sample moderately cemented.
72	80	SILTITE, slightly calcareous, moderately cemented grey brown fragments to 5mm. Less than 5% quartz silt, colourless, subangular to max. 0·2mm. Minor rounded glauconite grains to 1·5mm. Minor pink/brown fossil fragments to 3mm. Rare sponge spicules to 1mm. 74-76m. Poorly cemented, 5% lutite. 76-78m. A few well cemented fragments. 78-80m. Glouconite 10% of sample.
80	82	SILTITE, Browns. 10% glauconite grains, rounded and angular to 2mm. 5% pink brown fossil fragments to 3mm. Minor quartz, colourless, subangular, to 1·5mm.
82	90	ARENITE, quartz, from silt size to 3mm, angular to rounded. Equal proportions of colourless and brown translucent grains. 20% fine silt matrix, slightly calcareous, green/brown. 20% metasiltstone fragments from silt size to 6mm (max. 3mm 84-90m). Common light brown shell fragments to 4mm. 82-84m. 20% glauconite, some as hard grains, most as pale green-dark green-black weakly cemented silt. 84-90m 5% glauconite, as above.

DEPARTMENT OF MINES — SOUTH AUSTRALIA



DEPTH m from	to	DESCRIPTION
90	92	**ARENITE** Quartz, silt size to 2mm, most < 1mm, angular to rounded. Colourless and brown translucent fragments 10-20% Lutite, silty, black as matrix
92	94	5-10% Rock fragments, rounded, to 2mm, brown 5-10% Angular pyrite to 4mm, some cementing quartz grains. Common green glauconite grains, subrounded to rounded, to 2mm.
94	96	Common fine white mica. Rare white quartz, angular to subangular to 2mm. **LUTITE**, black/brown. 30% Arenite as above to 4mm. Rare fossil fragments as above to 2mm.
96	98	**LUTITE**, black-brown. 30% - 50% quartz arenite, silt size to 0·5mm, rarely to 1·5mm, angular to rounded, colourless and milky. Common fine white mica. Rare glauconite, pyrite grains (angular) to 2mm.
98	100	**LUTITE**, as above, with 5% arenite as above.
100	100·3	**ARENITE** Quartz, silt size to 1mm, angular to rounded, colourless and milky. Common muscovite flakes to 4mm. 5% pyrite to 3mm, angular.
100·3	102	**LUTITE**, dark brown, silty, lignitic (common wood fragments to 4mm. 5% pyrite, angular to 3mm.
102	104	Minor arenite, quartz, silt size to 0·5mm. angular to rounded rarely to 1·5m, colourless and milky. **LUTITE** as above - lignite rare. 5-10% Arenite as above, most 0·2 - 0·4mm, rarely to 3mm.
106	108	**LUTITE**, silty, dark brown. 20% Arenite, quartz, silt size to 1mm, most < 0·5mm, angular to rounded. Rare quartz grains to 3mm, rounded. Minor fine white mica.
108	111	**ARENITE** Quartz, as above. Common white mica flakes to 1mm. Minor pyrite grains to 1·5mm. Minor lutite/siltite, brown.
111	127	**LUTITE** silty grey/blue, grading to blue/grey fractured slate by 127m.

Borehole State No 697047407

Sheet 5 of 7

Bore Folder No.

DEPARTMENT OF MINES — SOUTH AUSTRALIA

CASING	WATERS CUT	WATER LEVEL	DEPTH (m)	CORE	GRAPHIC LOG	AGE	UNIT	DEPTH (m) from	to	DESCRIPTION
			115							
			120			PROTEROZOIC	Undifferentiated			
			125							
										END OF HOLE

Borehole State No 697047407

[illegible] Sheet 6 of 7

[illegible] Bore Record No

DEPARTMENT OF MINES — SOUTH AUSTRALIA

SUMMARY OF WATER ANALYSES WLG 37

Progressive depth of bore (m)	Sampling depth (m)	Water level (m)	Total dissolved solids (Milligrammes/litre)	Analysis W No.	Remarks
10.00	10.00	10.00	880	4038/74	
17.00	17.00	7.50	825	4039/74	
19.00	17.00	7.50	782	4040/74	
23.00	19.00	6.73	700	4041/74	
25.00	23.00	7.00	410	4042/74	
31.00	12.00	10.60		4043/74	Full analysis
37.00	35.00	8.00	715	4289/74	
40.00	38.00	6.77	760	4290/74	
43.00	40.00	17.10	825	4291/74	
45.00	33.00	32.00	880	4292/74	
48.00	46.00	40.00		4293/74	Full analysis
	50.00	45.00	1480	4635/74	
	54.00	48.00	1540	4636/74	
	40.00	51.33	1510	4637/74	
	65.00		1540	4638/74	
	68.00			4639/74	Full analysis
	68.00	63.00	1600	4640/74	
	70.00	50.00	1650	4641/74	
	25.00	11.65	1600	4642/74	
	70.00	15.80	1540	4643/74	
	75.00	25.00		4644/74	Full analysis
83.00	78.00		1675	4645/74	
85.00	80.00	18.90	1730	4646/74	
87.00	83.00		1700	4647/74	
89.00	85.00		1700	4648/74	
91.00	88.00			4649/74	Full analysis
93.00	89.00		1480	4650/78	
95.00	92.00		1510	4651/74	
97.00	94.00		1575	4652/74	
99.00	95.00	10.40	1625	4653/74	
101.00	98.00	17.00		4654/74	Full analysis
103.00	99.00		1540	4655/74	
105.00	101.00		1575	4656/74	
107.00	104.00		1100	4657/74	
109.00	106.00		1600	4658/74	
111.00	108.00	25.00		4870/74	Full analysis
121.00	118.00		1600	4871/74	
127.00	127.00	15.00	1625	4872/74	
127.00	127.00	15.00		4873/74	Full analysis

[illegible] Stn. No.

[illegible] Sheet No.

[illegible] Bore Folder No.

PF Nº S10538 M.H

DEPARTMENT OF MINES SOUTH AUSTRALIA

HYDROGEOLOGY SECTION

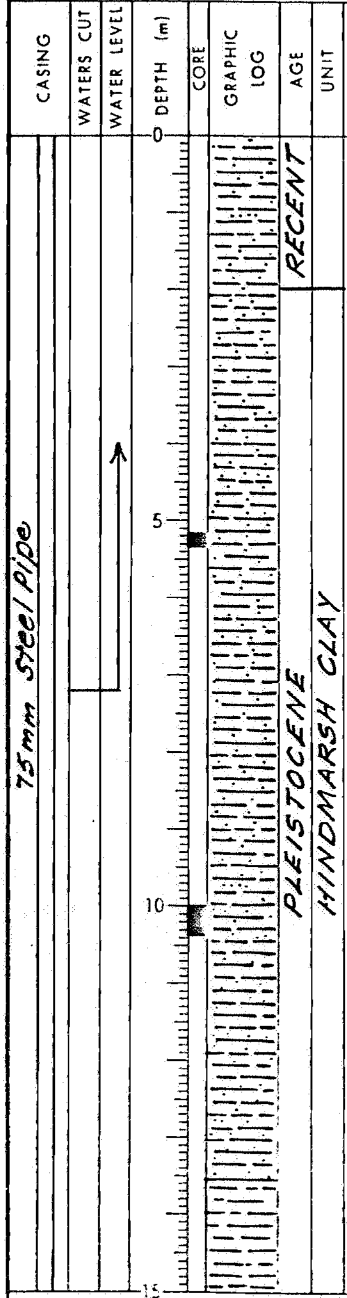
BORE LOG

HIRER *S.A. DEPARTMENT OF MINES*

Drill type *Cable Tool*		A.M.G. Zone	HUNDRED *WILLUNGA*
Circulation *Water*	Logged by *J.O. Waterhouse*	Coords. E	SECTION *610*
Driller *A. Sturak.*	Date logged *5·2·74 to*	" N	STATE No. *697061002*
Start	Bore Diameter	Datum Elev.	Project No. *WLG. 38*
Finish	DEPTH *309m.*	(m) Ref. Pt. Elev.	Docket No. *1185/73*
		Surface Elev.	Bore Serial No.

Depth to Water cut (m)	Depth to standing water (m)	SUPPLY		TOTAL DISSOLVED SOLIDS	
		litres/sec	Method of test	Milligrammes/litre	Analysis W No.
	SEE	*ATTACHED*	*SHEET*		

REMARKS *Temporary Number QA17. First Willunga Basin Investigation bore of 1974 series. Completed as observation bore WLG 38 with sandscreen in North Maslin Sand aquifer.*

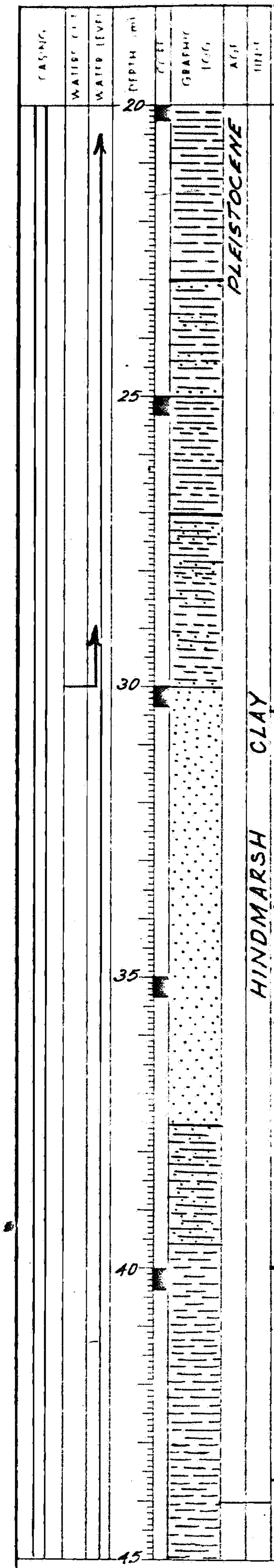


DEPTH (m) from	to	DESCRIPTION
0	*2*	*LUTITE slightly silty, stiff, red/brown. Contains minor undifferentiated arenite grains less than 0·5mm.*
2	*8*	*LUTITE slightly gritty - minor subangular to sub-rounded, brown limonitic grains to approx. 3mm. Stiff. Rare red ochrous pellets to 1cm. Light brown/red-brown/light grey-blue mottled - over-all pale red-brown.*
8	*11·5*	*LUTITE As above but different appearance because more red-brown colouring. Overall dark red-brown.*
11.5	*13·5*	*LUTITE slightly gritty - brown limonitic grains to 1mm. Stiff. Yellow-brown/light blue grey mottling with minor red/brown.*
13.5	*23*	*LUTITE As above (11.5 - 13·5m), but no limonitic grains.*

[illegible]	Sheet 1 of *16*
Date	Bore Folder No.

PF No 510537 MH

DEPARTMENT OF MINES — SOUTH AUSTRALIA



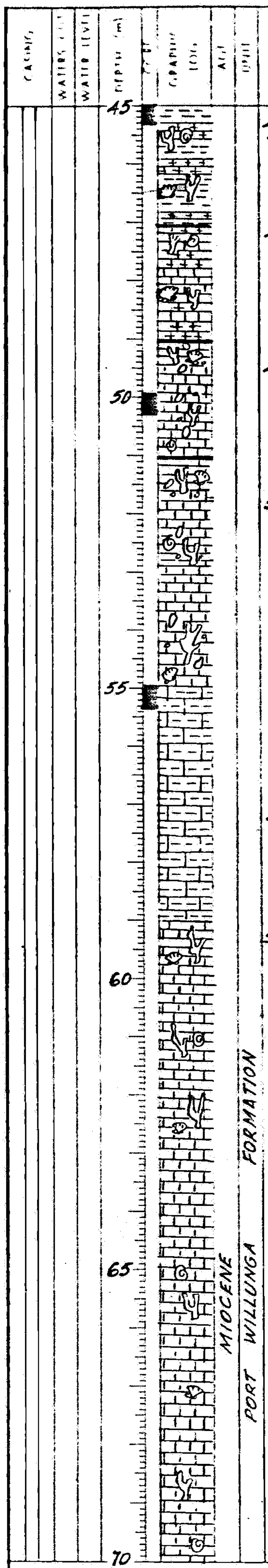
DEPTH m from	to	DESCRIPTION
13·5	23	
23	25	LUTITE slightly gritty - limonitic and red ochrous grains to 1mm. Red-brown / light grey-blue mottled.
25	27	LUTITE - Contains about 50% fine silt. Yellow brown with minor light blue-grey mottling.
27	30	LUTITE Silty. Contains 30% quartz arenite, 0·1 - 0·6mm. most 0·3-0·4m sub-rounded to rounded, mostly colourless, some pink. Yellow-brown with minor light blue-grey and red-brown mottling.
30	33·5	ARENITE Moderately cemented fragments, with quartz grains as above. Minor silt, lutite in matrix. Light grey-fawn with minor red/brown streaks.
33·5	35·5	ARENITE Quartz as above, with rare grains to 1mm. Minor off-white silty lutite.
35·5	37·5	ARENITE As above, with fawn silty lutite matrix. Minor yellow and red (remnant) staining on quartz grains.
		LUTITE - ARENITE Equal proportions of quartz arenite (as above) and yellow-brown lutite with light blue-grey mottling.
39·5	44	SILT Sub-angular quartz, maximum 0·2mm, colourless. Minor Lutite. Light grey.
44 -	45	LUTITE Silty. slightly. 10% quartz silt - arenite to 0·6mm. Some white calcareous grains (angular) to 0·6mm. Orange - brown.

Borehole State No. 687061002

By DWW | Sheet 2 of 16
Date | Bore Folder No.

PF Nº S10537a MH

DEPARTMENT OF MINES — SOUTH AUSTRALIA



DEPTH m from	to	DESCRIPTION
45	47	CALCARENITE. Very fossiliferous. Obvious foraminifora to 2 mm, bryozoal & echinoderm fragments to 5mm. 30% calcisiltite, minor marl, and quartz silt to 0·2 mm. Cream yellow.
47	49	CALCARENITE. As above, with orange-brown calcisiltite and minor marl. Some well-cemented, fawn calcarenite fragments to 1cm. Minor quartz silt.
49	51	CALCARENITE. Mainly well cemented fragments to 1cm. Fossiliferous (as above). Light brown with common milky quartz grains from silt size to 5mm, mainly sub-rounded.
51	57	CALCARENITE Well cemented fragments, cream to fawn with minor bryozoal and shell fragments to 5mm. Obvious foraminifera. Minor cream marly blebs, quartz silt. 51-53 contains 20% quartz grains to 3mm, sub-rounded, milky to colourless. 53-55. Contains 10% quartz as above. 55-57. Quartz absent, except as minor silt size fraction.
57	59	CALCARENITE. As above with minor orange-brown silty marl. Fragments cover range between two extreme types (1) Brown, massive and (2) White fossiliferous.
59	71	CALCARENITE. Well cemented white-brown fragments, with some white recognisable fossils. Rare separate bryozoal fragments to 3mm, rare subrounded colourless quartz grains to 3mm, minor quartz silt, glauconite. 63-67m Rare well preserved foraminifera to 2 mm. 67-79 Minor orange-brown silty marl, some as blebs. 69-83 Contains minor quartz arenite, subangular to sub-rounded, from silt size to 2mm. Milky and colourless.

Borehole State No. 69706I002

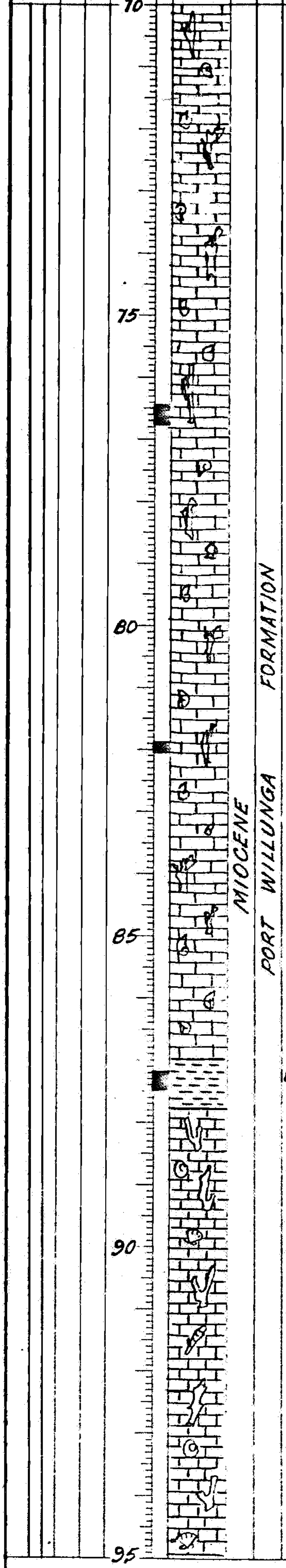
Drn DWW Sheet 3 16

Date Bore Folder No

PE Nº 5105 37a MH

DEPARTMENT OF MINES — SOUTH AUSTRALIA

CASING | WATERS CUT | WATER LEVEL | DEPTH (m) | CORE | GRAPHIC LOG | AGE | UNIT



DEPTH m from	to	DESCRIPTION
	83	to 83 m - previous page.
87	87.80	SILT Quartz, colourless, most 0.1 - 0.2 mm. Minor yellow quartz, silt 0.1 - 0.2 mm. 30% - 50% calcareous fragments, orange-brown, rarely grey & white, from silt size to 2mm, some shell fragments. Minor grey-brown clay gives overall colour.
87.80	90	CALCARENITE. Well cemented fragments, with grey-pink-brown grains from silt size to 6mm. Shell fragments common, pale yellow-white-grey, some recrystallized to 6mm. 10% quartz, subrounded to rounded, odourless to milky to pale yellow, silt size to 3mm. Common glauconite grains to 1.5mm.
90	92	CALCARENITE. As above, with fewer pink grains. 20% quartz as above. Recognizable echinoderm fragments, foraminifera. Less glauconite.

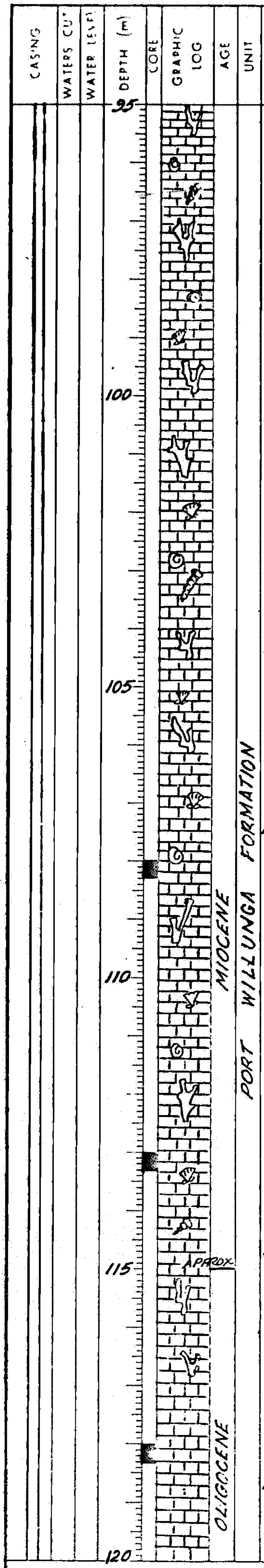
Borehole State No 697061002

Drn DWW ; Sheet 4 of 16

Date | Bore Folder No

PE Nº 5105.37a MH

DEPARTMENT OF MINES — SOUTH AUSTRALIA



DEPTH (m) from	to	DESCRIPTION
92	94	CALCARENITE. Light brown, well cemented, massive, fragments. 10% shell fragments and bryozoal to 4mm. 20% quartz arenite, 0-2·2mm, angular to subangular, rarely rounded. Most colourless, some milky. Rare angular milky quartz fragments to 1cm.
94	96	CALCARENITE. Moderately cemented brown fragments composed of white-yellow-brown grains, most less than 2mm. Some glauconite to 1·5mm, and recrystallized fossiliferous fragments to 3mm.
96	98	CALCARENITE. Moderately to well cemented, pale grey to fawn fragments, composed of white-yellow-brown grains, most less than 2mm. Some glauconite grains 1-2mm and recrystallized fossiliferous fragments to 1c.m. 10% quartz, subangular to subrounded, 0·2-0·3mm, rarely to 2mm and rounded. Most colourless, some pale yellow brown. Minor subangular brown grains to 1mm.
98	102	CALCARENITE. Weakly to moderately cemented off-white to pale fawn fragments, composed of calcareous grains (50% fossiliferous) to 3mm. Minor angular to rounded, opaque brown grains from silt size to 2mm. 20%-30% quartz, arenite - silt, colourless, sub-rounded to 1·5mm. Minor fine glauconite.
102	104	CALCARENITE, White to pale yellow fragments, from silt size to 2mm. 30%-50% fossiliferous. 30%-50% Quartz arenite silt size to 2mm, angular to rounded (most rounded), colourless to orange brown. 10% angular to rounded brown opaques to 2mm.
104	110	CALCARENITE Moderately to well cemented, off-white to fawn fragments. Mainly fossiliferous fragments to 1cm, some recrystallized. Minor glauconite. Rare limonite grains subrounded, to 2mm. Rare quartz from silt size to 4mm, colourless to milky and brown stained. Rare well rounded blue-grey quartzite fragments to 4mm. 108-110m 10%-20% quartz limonite grains. Minor white to orange brown silky clay.
110	113	CALCARENITE. Off-white to pale grey. Essentially angular fossiliferous fragments from silt size to 6mm. Minor brown stained, colourless quartz, generally subangular to subrounded, to 1-2mm. Minor green staining. 112-113 20% subangular brown grains to 5mm minor massive white angular calcareous grains to 3mm. A few well cemented calcarenite fragments.
113	117m	SILT. Colourless angular to subangular quartz. 10-20% of grains up to 1·5-2mm, subrounded and brown stained. Minor fossil fragments to 4mm. Rare glauconite grains to 1-2mm.

Borehole State No. 697061002

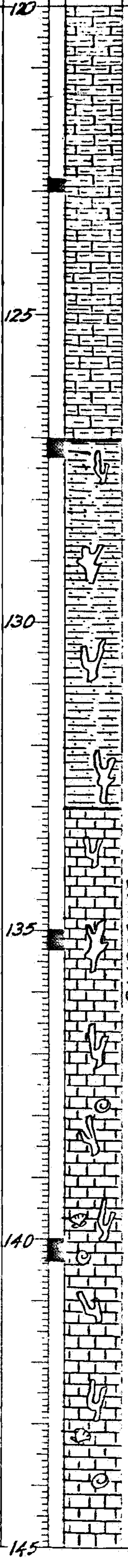
DWW | Sheet 5 of 16

Date | Bore Folder No

PF Nº S10537a MH

DEPARTMENT OF MINES — SOUTH AUSTRALIA

CASING | WATERS CUT | WATER LEVEL | DEPTH m | CORE | GRAPHIC LOG | AGE | UNIT



AGE: OLIGOCENE

UNIT: PORT WILLUNGA FORMATION

DEPTH in from	to	DESCRIPTION
		Minor clay - overall grey brown. 115-117m 50% weakly cemented fragments of greenish fossiliferous calcarenite to 3cm, with light green glauconite silt pellets to 5mm
117	121m	CALCARENITE. Essentially fossil fragments to 5mm. 30% Colourless; subangular quartz silt. 5-10% quartz arenite to 2mm, subangular, to subrounded, stained brown. Minor glauconite grains to 2mm. 5% brown clay gives overall colour.
121	123m	CALCARENITE. Essentially fossil fragments to 3-4mm, most less than 1mm, white-pink-grey, with 30% quartz silt, colourless, subangular. Rare quartz grains to 1-2mm, stained brown. Rare glauconite grains. Minor clay gives overall grey-brown colour.
123	127m	CALCARENITE. Well cemented off-white to grey fragments to 2cm. Essentially fossil fragments to 5mm. Common glauconite grains to 2mm. 5% colourless, subangular quartz silt. Minor white clay blebs. 126·8 - 127 contains 30% dark grey calcisiltite
127	133	ARENITE Colourless quartz from silt size to 0·3mm, rarely to 2mm and light pink. Subangular. 10% fossiliferous fragments to 3mm. 10% dark brown clay (overall plastic). Minor light brown silt and glauconitic grains to 0·3 mm. From 131 - 133m Some quartz - red also rarely to 4mm.
133	139	CALCARENITE. Mainly bryozoal & shell fragments from silt size to 2mm. Off-white - pale brown - pale pink. Common glauconite grains to 2mm. 133 - 135m 30% subangular quartz (colourless) to 0·3mm mainly, rarely to 4mm & angular. 10% brown silty clay. 135 - 139m 5% fine quartz silt, 10% light brown silty clay.
139	144·7	CALCARENITE. Weakly to moderate cemented fragments show pale greenish-brown and reddish-brown layers up to 4mm thick, comprising fossiliferous grains in a finer matrix. Mainly bryozoal and shell fragments to 2-5mm, minor fine quartz silt and red-brown silty clay. Common glauconite grains to 1·5mm.
144·7	148	CALCARENITE. Mainly bryozoal and shell fragments, mainly 0·3-3mm, rarely to 5mm. White to pale brown, and light pink to pink-brown near 148m. Minor glauconite and quartz silt.

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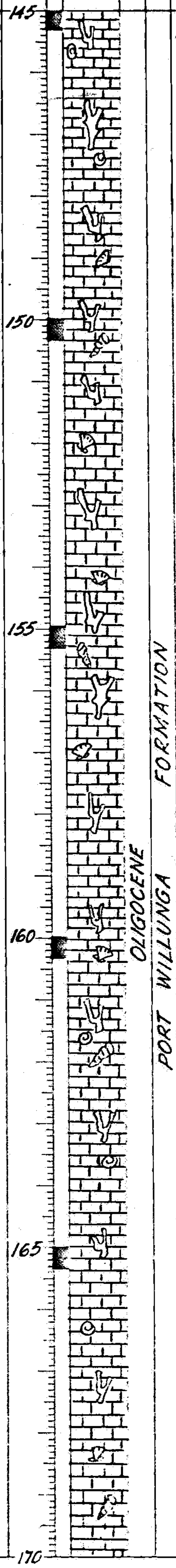
	Date	Bore Folder No

PE Nº 5105379 MH

DEPARTMENT OF MINES — SOUTH AUSTRALIA

CASING | WATERS CUT | WATER LEVEL | DEPTH (m) | CORE | GRAPHIC LOG | AGE | UNIT



DEPTH m from	to	DESCRIPTION
148		
148	152	CALCARENITE. Mainly bryozoal and other fossiliferous fragments 0·3-3mm, rarely to 6mm. Minor pink granular cherty fragments to 3mm. Rare angular milky quartz to 3mm from silt size. Minor blebs of pink-brown clay. Overall pale brown.
152	160	CALCARENITE. Mainly bryozoal and fossil fragments from 0·3-4mm, most greater than 1mm, off-white to buff. Rare subround, colourless quartz from silt size to 1mm.
160	180	CALCARENITE. Moderately cemented in parts. Mainly bryozoal and fossiliferous fragments from silt size to 5mm, off-white to buff and pale pink. Minor subrounded to rounded, colourless quartz from silt size to 1·5mm. Minor pale cherty material to 3mm. Rare brown grains to 1-2mm, some fine opaques. Minor light brown clay. 168-174 Contains 30% colourless and milky, rounded to subrounded quartz, silt size to 2mm. Rare glauconite. 174-180 As 168-174, with 5% fine opaques. Overall light pinkish brown.

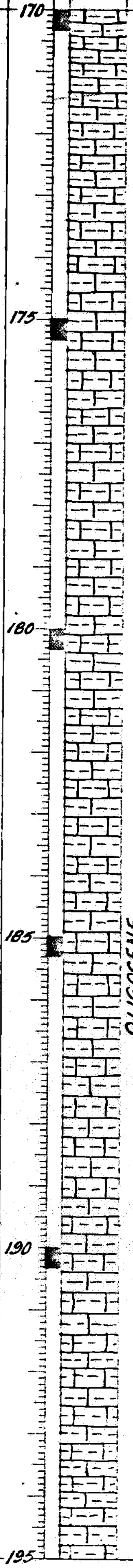
Borehole State No 697061002

Ltr DWW | Sheet 7 of 16

Date | Bore Folder No

DEPARTMENT OF MINES — SOUTH AUSTRALIA

CASING	WATERS CUT	WATER LEVEL	DEPTH (m)	CORE	GRAPHIC LOG	AGE	UNIT	DEPTH m from	to	DESCRIPTION
			170–195			OLIGOCENE	PORT WILLUNGA FORMATION	180	186	CALCARENITE. Mainly bryozoal and other fossiliferous fragments from silt size to 4mm. White/pink/buff. Minor colourless subangular to subrounded quartz from silt size to 1mm. Some red and brown staining on calcareous grains. Minor glauconite, fine opaques. 5-10% brown clay. 184-186m Quartz 10-20%. 186-188m 50% moderately cemented greenish brown fossiliferous calcarenite fragments. 188-196 Quartz 20-30%.



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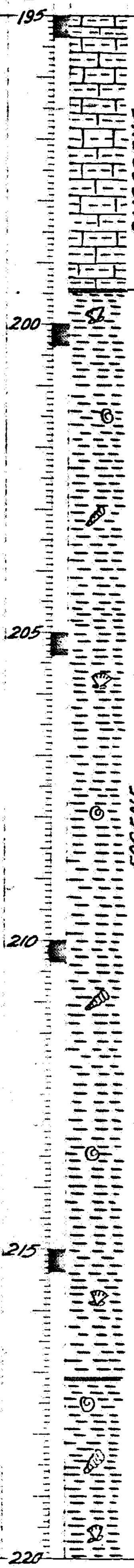
Date
Bore Folder No

DEPARTMENT OF MINES — SOUTH AUSTRALIA

CASING | WATER CUT | WATER LEVEL | DEPTH (m) | CORE | GRAPHIC LOG | AGE | UNIT



OLIGOCENE

PORT WILLUNGA FM.

EOCENE

BLANCHE POINT FORMATION

DEPTH m		DESCRIPTION
from	to	
196	199·4	CALCARENITE Mainly bryozoal and fossiliferous fragments from silt size to 3mm. 50% Quartz, subangular to rounded, colourless silt size to 1·5mm, also to 4mm (red and angular).
199·4	201	SILT. Moderately calcareous. Dark grey/brown with greenish tinge in places. Very stiff. Appears to contain some fossiliferous material (white markings). Minor marl.
201	203	SILT. Moderately calcareous. Dark grey plastic. Minor quartz, colourless, subangular to 0·3mm. Calcareous grains, some fossiliferous, to 1mm.
203	205	SILT. Moderately calcareous. Dark grey. Minor white to brown calcareous grains to 1-2mm, some fossiliferous.
205	217	SILT. Moderately calcareous. Dark grey/brown. Common light pink/brown calcareous fragments, often fossiliferous (Turritella) to 5mm plus. Common light green glauconite blebs to 3mm. Minor marl.
		211-213 Rare angular milky quartz grains to 5mm. 213-217. Minor weakly cemented grey calcisiltite fragments.
217	221	CALCISILTITE. Dark brown with minor marl Common pink brown shell fragments to 5mm, and glauconite grains to 1mm. 5% well-cemented massive brown calcisiltite fragments to 5mm. Minor colourless, angular quartz to 1mm. 219-221 Rare red/brown grains to 1mm.

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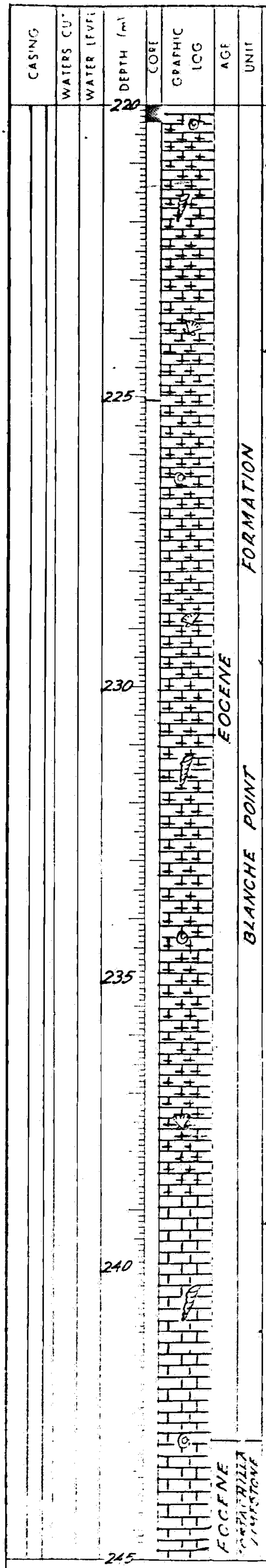
Date | Bore Folder No

PE Nº 510537a MH

DEPARTMENT OF MINES — SOUTH AUSTRALIA



DEPTH (m) from	to	DESCRIPTION
221	223	CALCISILTITE Mainly dark brown, well cemented, angular fragments to 5mm. 10% Glauconite to 1mm, subangular. Minor light green glauconitic silt pellets to 3mm. 10% Shell fragments to 5mm, angular, pink-brown. Rare subangular to subrounded colourless quartz to 0·5mm.
223	225	CALCISILTITE. Dark brown with minor marl. 30% glauconite grains to 1·5mm. 10% Shell fragments to 3mm - colourless & pink/brown.
225	229	CALCISILTITE. Dark brown - grey brown, marly. 5% glauconite grains to 1·5mm. 10% shell fragments, brown - pale pink/brown, to 3-5mm. Rare colourless quartz, subangular, to 0·5mm. 20% moderately cemented dark brown calcisiltite fragments to 3mm. 227-229m 30-50% well cemented calcisiltite minor light green glauconitic silt.
229	239	CALCISILTITE. Dark brown. At least 75% well cemented massive fragments, with 10% glauconite grains less than 1mm and shell fragments to 2-3mm. 10-20% unconsolidated and marly, with loose shell fragments to 3-4mm. Rare colourless, subangular quartz silt-arenite to 0·8mm. 235-237 Minor light green silty marl. 237-239 20% green/brown silty marl.
239	245	CALCISILTITE. Grey brown well cemented angular fragments to 5mm with 5-10% dark green subrounded glauconite grains to 2mm. Minor grey brown silty marl and pale green glauconitic silt. Minor pink/brown fossiliferous fragments. 241-243 Moderately cemented, with rare, grey, angular, massive, calcareous fragments to 5mm 243-245 30% weakly to moderately cemented glauconitic fragments with fawn, well cemented calcareous layers. 20% Quartz arenite, colourless and yellow, subrounded to well rounded, max. 1mm, most grains 0·5mm, in a fine glauconitic matrix.

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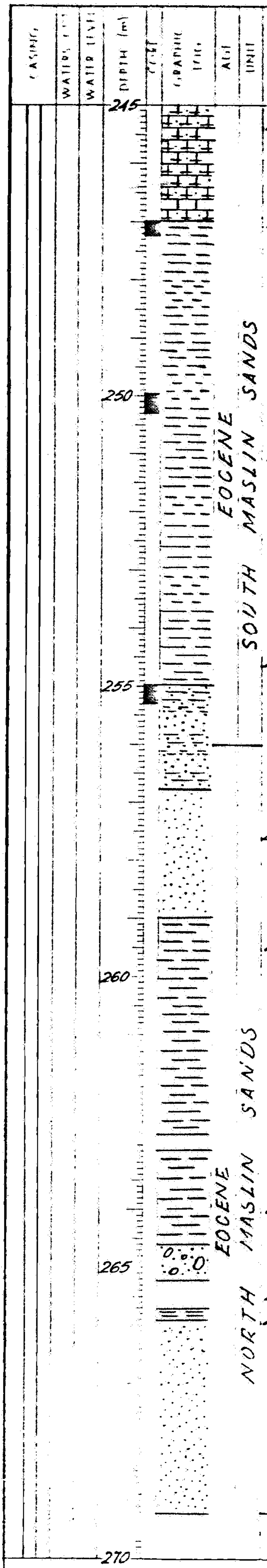
Bore Reference No

RF Nº 5105 370 MH



DEPTH m from	to	DESCRIPTION
245	247	ARENITE. Quartz, colourless and yellow, subrounded to rounded to 1mm, most 0·5mm in a fine green, glauconitic matrix. 20% moderately cemented brown glauconitic calcisiltite as above.
247	249	LUTITE. Black, lignitic, emits H_2S with acid. 5% Quartz silt, 0·1 - 0·3mm, rarely to 1mm, subrounded, colourless. Common fine white mica.
249	251	LUTITE Black/brown lignitic, emits H_2S with acid, weakly cemented. 25% quartz silt - arenite to 0·5mm, rarely to 1mm, subangular to subrounded, colourless. Common fine white mica.
251	255	LUTITE. Black, with brown 2mm layers, lignitic, emits H_2S with acid. 30% quartz silt arenite to 2mm, rounded to angular, colourless to milky. Common fine white mica.
		ROTARY DRILLING COMMENCED 255m.
255	256	ARENITE Quartz, silt size to 1mm, most <0·5mm subangular to well rounded, colourless, occasionally milky. Rare rounded glauconite pellets and brown, rounded ferruginous grains. Rare shell fragments, fine white mica. Pyritic. Lutite matrix, black 255 - 255·15. Brown silty matrix.
256	259	ARENITE. As above, some to 1·5mm. Interbedded with silty lutite, finely laminated, brown, micaceous 256·8 - 258 NO RECOVERY.
259	264·6	LUTITE Finely laminated, brown, micaceous. Minor quartz arenite as above, some bioturbation and a few carbonised plant remains. 262·73 - 263 NO RECOVERY.
264·6	-265·23	ARENITE - RUDITE Quartz to 4mm, rounded. Silty, carbonaceous lutite matrix. Massive. 265·23 - 265·71 NO RECOVERY
265·71	-265·90	LUTITE Laminated, black/brown, carbonaceous.
265·9	- 268·4	ARENITE Quartz, silt size to 3mm, most 0·1 - 0·5mm, angular to rounded, colourless. Rare fine white mica. Carbonaceous clay matrix. Massive. Brown 267·50 Higher proportion lutite, a few thin zones finely laminated, arenite free. A few rounded quartz rudite grains to 8mm near 268·40m. 268·40 - 281·5 NO RECOVERY.

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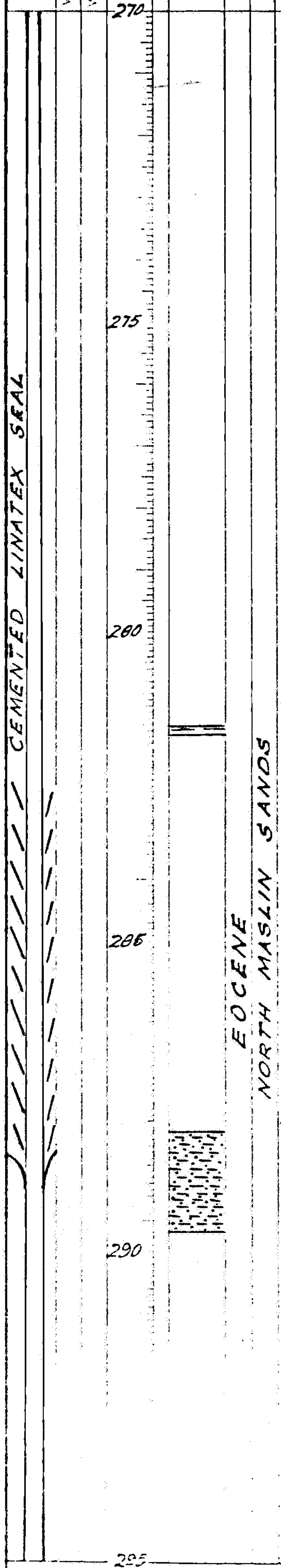

DEPTH (m) from	to	DESCRIPTION
281·5	281·6	LUTITE Carbonaceous, slightly micaceous. A few carbonised plant remains.
		281·6 - 288 NO RECOVERY.
288	289·60	SILTITE - ARENITE. Varying proportions, quartz, bimodal: silt size to 0·2 mm, subangular, and 0·5 - 1 mm subrounded. Minor brown lutite matrix, indistinct layering, micaceous. 289·30: 0·03 m thick layer of pyrite cemented high porosity sandstone, quartz grains to 0·2 mm, subangular to subrounded.
		289·60 - 295 NO RECOVERY.

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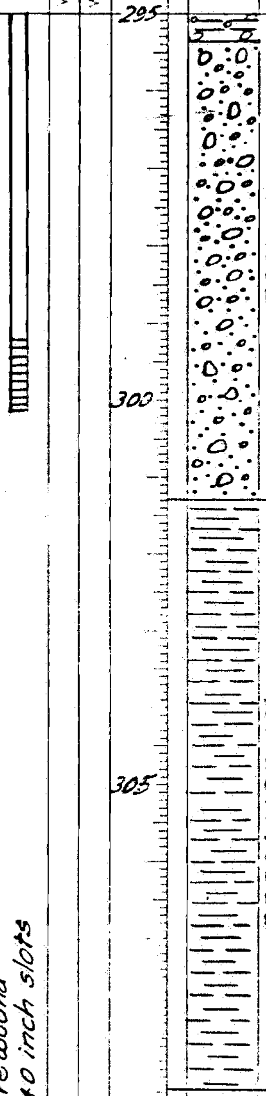
DEPARTMENT OF MINES — SOUTH AUSTRALIA



3 inch diam. galv. wire wound screen with 0.040 inch slots

AGE	UNIT	DEPTH m from	to	DESCRIPTION
EOCENE	NORTH MASLIN SANDS	295	295.30	RUDITE - LUTITE Carbonoceous silty lutite with leaf imprints, micaceous, with well cemented pyritic conglomerate, quartz grains to 1 cm, subrounded, milky and colourless.
		295.30	301.30	ARENITE - RUDITE. Quartz to 3mm, subangular to rounded, colourless and milky, minor pyrite cementation and red/brown opaques. Minor brown lutite. (Sample worked by driller).
PRECAMBRIAN	UNDIFFERENTIATED	301.30	309	SLATE Weathered grey-green slate with indistinct cleavage.

309 m END OF HOLE

CORE DESCRIPTION

5·17-5·35 LUTITE Kaolinitic, slightly calcareous, with light cream calcareous patches. Rare quartz arenite, silt size to 3mm, angular to subangular, colourless & red. Massive, with grey to orange/brown mottling.

10·00-10·35 LUTITE. Massive, mottled. Red/brown with minor light coloured calcareous grains to 1-2mm. Slightly silty.

15·00-15·35 LUTITE. Massive, kaolinitic, grey/brown mottled.

20·00-20·27 LUTITE. As above.

25·00-25·35 LUTITE. As above, slightly silty.

30·00-30·35 LUTITE. Massive, mottled yellow-brown, kaolinitic. 50% quartz arenite, 0·2-0·5mm, subangular to rounded, colourless and pink-brown stained. Rare rounded black opaques. Bottom of sample showed 5-10cm layer of quartz arenite, with irregular contact. Arenite 0·1-0·8mm, most colourless, subangular to rounded, rare black opaques. Overall massive, pale yellow brown.

35·00-35·35 ARENITE Quartz, angular to rounded, 0·1-1·5mm most less than 0·5mm, most colourless and milky, rarely red/yellow. Minor off-white silty lutite. Moderately cemented.

40·00-40·35m ARENITE-SILTITE. Quartz, to 0·2mm, subangular to rounded, colourless and milky. Minor lutite and black opaques

CORE DESCRIPTION

45·00 - 45·35 CALCARENITE - ARENITE Moderately cemented, fossiliferous (bryozoal fragments, shell fragments etc). Off-white to orange brown. Common, fine glauconite, oxidised brown in some cases. Some lumps of orange brown silty lutite, with 30% fine quartz arenite, and 30% off-white to brown fossil fragments to 4mm.

50·00 - 50·35 SILTITE. Calcareous. Quartz to 5mm, brown, with 10% fossil fragments. Common glauconite to 1mm, often oxidised. Undisturbed brown lumps show weak layering 1-3mm thick with white calcareous blebs and irregular markings, and fossil fragments - a quartz silt matrix (unconsolidated). Minor white mica flakes to 0·5 - 0·8mm. Minor orange-brown lutite.

55·00 - 55·35 As above.

76·50 - 76·80. White markings 600 conspicuous, very calcareous 10% fossil fragments to 4mm. Weak layering of more intense brown 1-2mm thick, 5mm apart. Possible cross-bedding in one place.

82 - 82·12 SILTITE. As above, with fragments of well cemented calcareous siltstone, containing 40% quartz arenite angular to rounded. Common fine glauconite, brown with white markings, massive.

87·20 - 87·50 ARENITE - SILTITE Quartz to 2mm, silt size to 0·3mm, rarely larger, rounded, colourless. 20% fossil fragments to 4mm, with dark, rounded glauconite grains often oxidised brown. Minor lutite matrix - overall dark grey brown.

135 - 135·30 CALCARENITE - CALCISILTITE Fossil fragments (dominantly bryozoal) to 4mm, white and pink/brown. 20-30% quartz to 1mm, angular to rounded, colourless and yellow/brown. 10% green glauconite pellets to 1·5mm, minor brown lutite. Weakly cemented, friable, massive.

Borehole Store No 697061002

14 16

CORE DESCRIPTION

140 - 140·35 CALCARENITE - CALCISILTITE. Fossil fragments (dominantly bryozoal) to 3 mm, buff and orange. Minor quartz, 0·1 - 0·2 mm, angular, colourless. Minor lutite matrix. Weakly cemented, massive, orange and yellow/brown mottled. Minor lutite matrix.

145 - 145·35 As above. Fawn.

150 - 150·35 As above. Fawn-Pink.

155 - 155·35. As above. Fawn.

160 - 165·35 As above. A few bands of moderately cemented fossiliferous calcarenite, 20 mm thick, slightly quartzose, little or no fines, fawn.

165 - 165·30 CALCARENITE As above. Minor quartz arenite, to 0·8 mm, rounded, colourless. Abundant brown, polished ferruginous grains to 0·5 mm.

170 - 170·35 CALCARENITE. As above.

proportion of fossils decreasing due to increased effects of recrystallisation.

175 - 175·35 CALCARENITE As above.

180 - 180·35 CALCARENITE As above.

185 - 185·35 CALCARENITE. As above.

190 - 190·35 CALCARENITE. As above.

Borehole Stat. No 697061002

15 16

CORE DESCRIPTION

195 - 190·30 CALCARENITE - CALCI-SILTITE. Most grains < 0·5mm, a few fossils (white/fawn) to 5mm. Minor quartz arenite to 0·5mm, rounded to sub-rounded, colourless.

200 - 200·30 CALCILUTITE. SILTY. A few pink fossils. Massive but with bedding plane parting when dry. Grey/brown.

205 - 205·30 CALCILUTITE As above, abundant fine white mica to 0·5mm. Dark brown.

210 - 210·30 CALCILUTITE. AS 205 - 205·30. One brown recrystallised molluscs, 2cm.

215 - 215·30 CALCILUTITE AS 205 - 205·30. Turritella to 2cm.

220 - 220·30 CALCILUTITE AS 205 - 205·30. Abundant glauconite pellets to 0·4mm. Grey.

225·13 - 225·15 CALCISILTITE Massive. Common rounded glauconite pellets to 0·5mm, most less than 0·2mm. Minor fine white mica to 0·5mm. Rare white fossil fragments to 1mm. Minor silt-colourless quartz. Brown/grey.

247 - 247·30 ARENITE Quartz to 0·8mm, most 0·3 - 0·4mm, subangular, colourless (occasionally milky and blue, angular, to 2mm. 20% green glauconite pellets to 0·5mm, and if irregular to 1mm. Minor fine white mica to 0·5mm. Minor siltite - lutite matrix, dark brown, unconsolidated.

250 - 250·35 ARENITE Quartz, silt size to 0·8mm, most < 0·3mm subangular to well-rounded, colourless. Common white mica to 0·5mm. Carbonaceous lutite matrix with oxidised pyrite. Massive.

255 - 255·35 ARENITE As above, with common, well cemented pyritic sandstone fragments, rounded and irregular grains to 3mm.

Borehole State No 697061002

16. 16

Bore Folder No

DEPARTMENT OF MINES — SOUTH AUSTRALIA

SUMMARY OF WATER ANALYSES

WLG 38

Progressive depth of bore (m)	Sampling depth (m)	Water level (m)	Total dissolved solids (Milligrammes/litre)	Analysis W No	Remarks
7·2	7·2	4·00	9,800	549/74	
10·2	10·2	4·00	9,453	550/74	Full Analysis
32	32	-	3,150	555/74	
34	34	-	3,221	556/74	Full Analysis
36	36	29	3,190	584/74	
38	38	29	3,230	585/74	
40	40	29	2,490	586/74	
47	47	20·5	1,675	587/74	
49	49	20·5	1,654	588/74	Full Analysis
51	51	20·5	1,895	696/74	
53	53	20·5	1,815	697/74	Full Analysis
55	55	20·5	1,840	698/74	
57	57	20·5	1,760	699/74	
59	59	20·5	2,350	700/74	
61	61	20·5	1,920	701/74	
63	63	20·50	2,421	702/74	Full Analysis
65	65	20·5	2,140	765/74	
67	67	20·5	2,140	766/74	
69	69	20·5	2,717	767/74	Full Analysis
71	71	20·5	2,030	768/74	
73	73	20·5	2,530	807/74	
75	75	20·5	2,565	808/74	
77	77	20·5	2,375	809/74	
79	79	20·5	2,288	810/74	Full Analysis
81	81	20·5	2,240	811/74	
83	83	20·5	2,425	973/74	
87	87	21·4	2,490	974/74	
89·40	89·40	21·4	2,400	975/74	
91	91	20·4	2·115	976/74	
93	93	20·4	-	977/74	Empty bottle.
95	95	20·4	2,115	978/74	
97	97	20·5	2315	1163/74	
97	97	20·5	2315	1163/74	
99	99	20·5	4000	1164/74	
101	101	20·5	>21,000	1165/74	
103	103	20·5	24,956	1166/74	
105	105	20·5	>21,000	1167/74	

[illegible] State No. [illegible]

Sheet 17

DEPARTMENT OF MINES — SOUTH AUSTRALIA

SUMMARY OF WATER ANALYSES

WLG 38

Progressive depth of bore (m)	Sampling depth (m)	Water level (m)	Total dissolved solids (Milligrammes/litre)	Analysis W No.	Remarks
107	107	20·5	>21,000	1168/74	
109	109	22·2	> 21,000	1169/74	
111	111	22·2	>21,000	1170/74	
113	113	22·2	>21,000	1171/74	
115	115	22·2	6,300	1172/74	
117	117	22·2	25,902	1173/74	Full Analysis
119	119	22·2	> 7,500	1174/74	
121	121	22·2	> 7,500	1175/74	
123	123	22·2	< 7,800	1176/74	
125	125	22·2	> 6,900	1177/74	
127	127	22·2	< 7,500	1178/74	
129	129	22·5	48,485	1329/74	Full Analysis
131	131	22·5	> 21,000	1330/74	
133	133	22·5	>21,000	1331/74	
135	135	22·5	>21,000	1332/74	
137	137	22·2	>21,000	1333/74	
139	139	22·2	43,961	1334/74	Full Analysis
141	141	22·2	>21,000	1335/74	
143	143	22·2	>21,000	1336/74	
145	145	22·2	>21,000	1337/74	
147	147	22·2	>21,000	1338/74	
149	149	22·2	>21,000	1339/74	
151	151	22·2	69,128	1340/74	Full Analysis
153	153	25·1	>21,000	1341/74	
155	155	25·1	>21,000	1342/74	
157	157	25·1	>21,000	1343/74	
159	159	25·1	>21,000	1344/74	
161	161	25·1	>21,000	1345/74	
163	163	25·1	65,510	1347/74	Full Analysis
165	165	25·1	>21,000	1347/74	
167	167	26·5	>21,000	1348/74	
169	169	26·5	> 21,000	1349/74	
171	171	26·1	>21,000	1350/74	
173	173	26·8	>21,000	1351/74	
175	175	26·5	90,082	1352/74	Full Analysis
177	177	26·5	>21,000	1459/74	
179	179	26·5	>21,000	1460/74	
181	181	26·5	> 21,000	1461/74	

DEPARTMENT OF MINES — SOUTH AUSTRALIA

SUMMARY OF WATER ANALYSES

WLG 38

Progressive depth of bore (m)	Sampling depth (m)	Water level (m)	Total dissolved solids (Milligrammes/litre)	Analysis W No	Remarks
183	183	26·5	>21,000	1462/74	
185	185	26·5	>21,000	1463/74	
187	187	26·5	>21,000	1464/74	
189	189	26·5	92,469	1465/74	Full Analysis
191	191	26·5	>21,000	1466/74	
193	193	26·5	>21,000	1467/74	
195	195	26·1	>21,000	1468/74	
197	197	26·5	>21,000	1469/74	
199	199	26·5	>21,000	1470/74	
199	199	26·5	127,273	1965/74	Full Analysis
300	300	-	136,795	3018/75	Full Analysis (Bailed sample after development)

DEPARTMENT OF MINES — SOUTH AUSTRALIA

SUMMARY OF WATER ANALYSES

WLG 39

Progressive depth of bore (m)	Sampling depth (m)	Water level (m)	Total dissolved solids (Milligrammes/litre)	Analysis W No.	Remarks
	56		5600	W1519/75	
	56		5450	W1520/75	

Borehole State No.	Drn :	Sheet of
	Date :	Bore Folder No.

PF Nº S10538 MH

PROJECT **WILLUNGA BASIN GROUNDWATER INVESTIGATION**

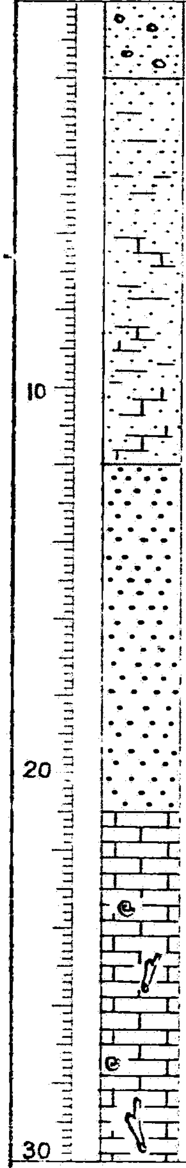
DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

BORE LOG

HOLE NO. WLG 40
UNIT/STATE NO 697041201
SERIAL NO
FOLDER NO

LOCATION OR CO-ORDS
SEC Adj 412 HD WILLUNGA
EL Surface
EL ref point
Datum

DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	SUPPLY		TOTAL DISSOLVED SOLIDS	
		litres/sec	Method of test	milligrammes/litre	Analysis No
		SEE	ATTACHED SHEET		



DEPTH (m) from	to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE
0	2	SAND: Red-brown, clayey, gravelly.		QUATERNARY
2	12	SAND: Brown, becoming fine grained & silty. Calcareous in part.		
12	21	SANDSTONE: Pale brown to pale grey, fine to coarse grained. Dominantly medium grained.		
21	23	LIMESTONE: Yellow-brown, fossiliferous, sandy.	PORT WILLUNGA FMN	MIOCENE
23	46	LIMESTONE: Pale yellow to cream, sandy, consists almost entirely of bryozoa, foraminifera & shell fragments.		

*NOTE 1·25 litres/sec = 1000 gals/hr

REMARKS Completed as observation well.

DRILL TYPE Percussion
LOGGED BY D.J.W.B
CIRCULATION None
DATE 11-12-78
START
TRACED BY
FINISH
DATE
SHEET 1 OF 8
DRAWING NO S 13833

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

BORE LOG

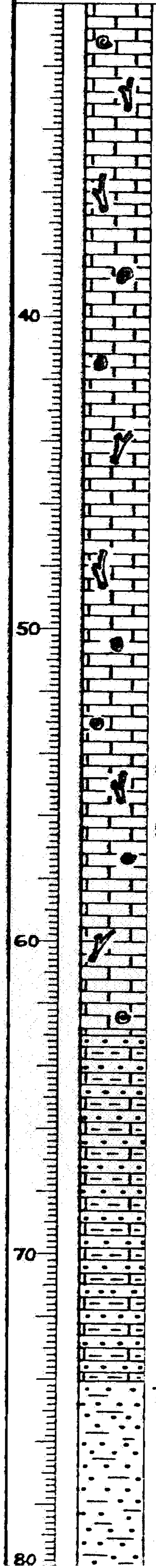
CONTINUATION SHEET

PROJECT WILLUNGA BASIN
GROUNDWATER INVESTIGATION

HOLE NO. WLG 40

UNIT/STATE NO
697041201

HOLE DIA | DEPTH m | CORE | GRAPHIC LOG



DEPTH (m) from	to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE	CASING	WATERS CUT	WATER LEVEL
46	54	LIMESTONE: Essentially as above. Becoming generally finer grained and more sandy.	PORT WILLUNGA FMN.	MIOCENE TO OLIGOCENE			
54	56	LIMESTONE: Medium grey coloured, sandy to marly, well cemented aggregates.					
56	63	LIMESTONE: Medium grey, coarse grained. Richly fossiliferous with abundant bryozoa, shell fragments. Glauconitic.					
63	74	CALCARENITE: Essentially as above, but becoming finer grained & more sandy & silty. Glauconitic.					
74	90	SANDSTONE: Medium to dark grey, silty, carbonaceous, slightly fossiliferous, pyritic.	CHINA GULLY	EOCENE			

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

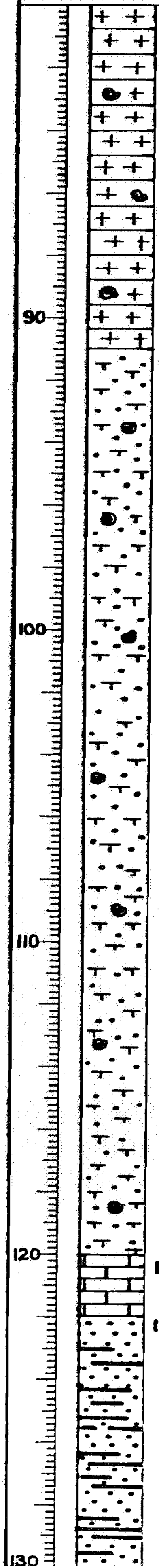
PROJECT: WILLUNGA BASIN GROUNDWATER INVESTIGATION

BORE LOG

CONTINUATION SHEET

HOLE NO. WLG 40

UNIT/STATE NO 69704/201



DEPTH (m) from	to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE	CASING	WATERS CUT	WATER LEVEL
79	91	CALCISILTITE: Medium to dark grey, soft & puggy. Fossiliferous with abundant shell fragments. Sandy, grading in part to marl.	BLANCHE POINT FMN.	LATE EOCENE			
91	120	MARL: Medium to dark grey as above, silty, sandy, glauconitic; abundant shelly fragments. Slightly pyritic in part.					
120	122	LIMESTONE: Pale to medium brown, sandy, with some ferruginous stained quartz.	SOUTH MASLIN SAND	EOCENE			
122	131	SANDSTONE: Medium to dark grey, dominantly medium grained; commonly fine grained & silty. Clayey in part. Carbonaceous, slightly micaceous. Glauconitic & fossiliferous near top.					

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

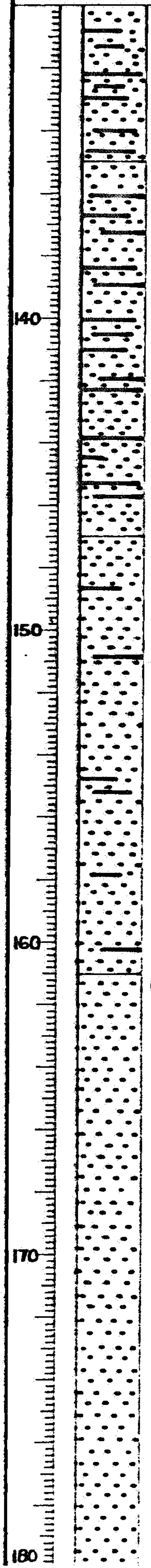
BORE LOG

CONTINUATION SHEET

PROJECT WILLUNGA BASIN
GROUNDWATER INVESTIGATION

HOLE NO. WLG 40

UNIT/STATE NO 69704/201



DEPTH (m) from	to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE	CASING	WATERS CUT	WATER LEVEL
131	135	SANDSTONE: Medium to dark grey, as above, but becoming coarser grained with common lithic fragments. Carbonaceous & micaceous.	NORTH MASLIN SAND	EOCENE			
135	147	SANDSTONE: As above, dominantly medium grained, commonly coarse grained, moderately sorted, carbonaceous, slightly micaceous.					
147	161	SANDSTONE: Medium grey, becoming generally finer grained & cleaner. Moderately to well sorted. Less carbonaceous. Slightly micaceous.					
161	180	SANDSTONE: Medium grey, becoming coarse to very coarse grained & conglomeratic. Common quartzitic & lithic pebbles up to 10 mm. Generally poorly sorted.					

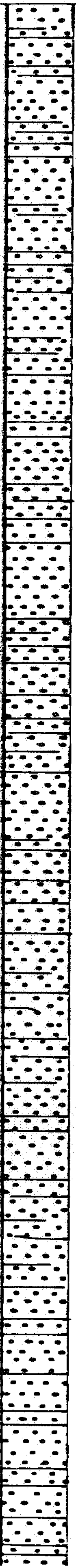
DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

PROJECT WILLUNGA BASIN
GROUNDWATER INVESTIGATION

BORE LOG

CONTINUATION SHEET

HOLE NO. WLG 40
UNIT/STATE NO 697041201



HOLE DIA	DEPTH m	CORE	GRAPHIC LOG	DEPTH (m) from	to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE	CASING	WATERS CUT	WATER LEVEL
	190 200 210 220 230			180	340	SANDSTONE: White to pale grey, fine to coarse grained, generally poorly sorted. Occasional quartzose & lithic pebbles. Commonly silty to argillaceous.	CAPE JERVIS BEDS	PERMIAN			

SHEET 5 OF 8

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

BORE LOG

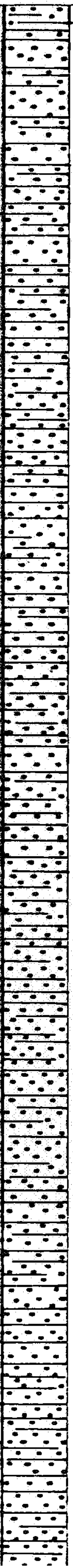
CONTINUATION SHEET

PROJECT WILLUNGA BASIN GROUNDWATER INVESTIGATION

HOLE NO. WLG 40

UNIT/STATE NO 697041201

HOLE Dia DEPTH m	CORE	GRAPHIC LOG	DEPTH (m) from — to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE	CASING	WATER CUT	WATER LEVEL
240									
250									
260					CAPE JERVIS BEDS	PERMIAN			
270									
280									



SHEET 6 OF 8

DEPARTMENT OF MINES - SOUTH AUSTRALIA
ENGINEERING DIVISION

HOLE NO. WLG 40

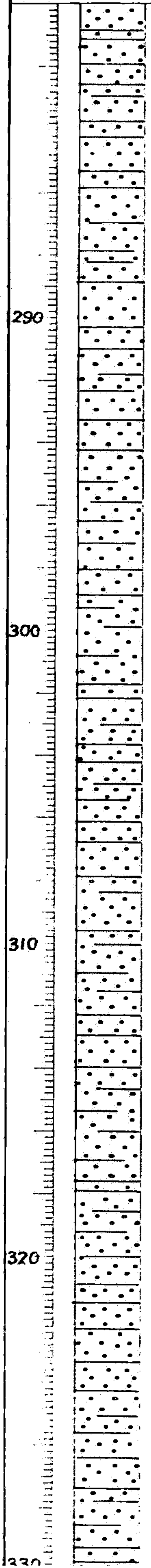
UNIT/STATE NO
697041201

PROJECT WILLUNGA BASIN
GROUNDWATER INVESTIGATION

BORE LOG

CONTINUATION SHEET

HOLE DIA	DEPTH m	CORE	GRAPHIC LOG	DEPTH (m) from to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE	CASING	WATER CUT	WATER LEVEL
						CAPE JERVIS BEDS	PERMIAN			



SHEET 7 OF 8

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

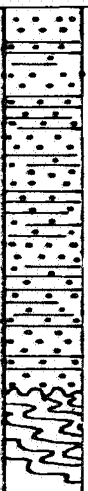
HOLE NO. WLG 40

UNIT/STATE NO 697041201

PROJECT WILLUNGA BASIN
GROUNDWATER INVESTIGATION

BORE LOG

CONTINUATION SHEET

HOLE Dia DEPTH m	CORE	GRAPHIC LOG	DEPTH (m) from	DEPTH (m) to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE	CASING	WATERS CUT	WATER LEVEL
						CAPE JERVIS BEDS	PERMIAN			
340			340	340·1	WEATHERED SLATE END OF HOLE 340·1 metres		PRECAMBRIAN			

DEPARTMENT OF MINES — SOUTH AUSTRALIA

SUMMARY OF WATER ANALYSES

WLG 40

Progressive depth of bore (m)	Sampling depth (m)	Water level (m)	Total dissolved solids (Milligrammes/litre)	Analysis W No.	Remarks
	24.0		3230	W943/75	
	26.0		3150	W944/75	
	28.0		3100	W945/75	
	30.0		3000	W946/75	
	32.0		3050	W947/75	
	34.0		3741	W948/75	Full analysis
	36.0		3100	W949/75	
	38.0		3150	W950/75	
	40.0		3075	W951/75	
	42.0		3050	W952/75	
	44.0		3679	W953/75	Full analysis
	46.0		3000	W954/75	
	48.0		3230	W1085/75	
	50.0		3150	W1086/75	
	52.0		2350	W1087/75	
	54.0		2585	W1088/75	Full analysis
	56.0		3050	W1089/75	
	58.0		3050	W1090/75	
	60.0		3100	W1091/75	
	62.0		3125	W1092/75	
	64.0		3949	W1093/75	Full analysis
	66.0		5375	W1094/75	
	68.00		5525	W1095/75	
	70.0		5025	W1096/75	
	74.0		5339	W1258/75	Full analysis
	92.0		4775	W1253/75	
	95.0		9800	W1254/75	
	103.0		10850	W1255/75	
	110.0		11200	W1256/75	
	112.0		11200	W1257/75	
	116.0		10150	W1649/75	
	121.0		9450	W1650/75	
	129.0		9800	W1651/75	
	137.0		8500	W1652/75	
	143.0		7800	W1653/75	
	156.0		21 000	W1654/75	approx. 26 250
	160.0		21 000	W1655/75	approx 34 650
	166.0		21 000	W1656/75	approx 37 800
	168.0		21 000	W1657/75	approx 39 200
	174.0		21 000	W1658/75	approx 41 300
	177.0		21 000	W1659/75	approx 41 300
	179.0		21 000	W1660/75	approx 41 300
	182.0				

Borehole State No.	Drn :	Sheet of
	Date :	Bore Folder No.

PF Nº 510538 MH

PROJECT: Willunga Basin
Groundwater Investigation

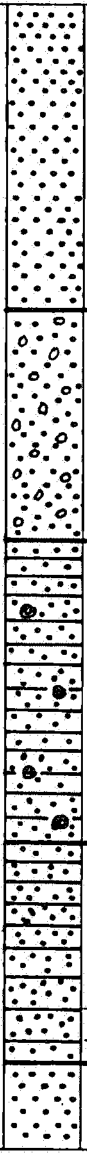
DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

BORE LOG

HOLE NO. WLG 41
UNIT/STATE NO:. 697001406
SERIAL NO:
FOLDER NO.

LOCATION OR CO-ORDS:
EL Surface
SEC. HD. EL ref. point Datum

DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	SUPPLY		TOTAL DISSOLVED SOLIDS	
		*litres/sec	Method of test	milligrammes/litre	Analysis W NO.



HOLE Dia.	DEPTH m	CORE	GRAPHIC LOG	DEPTH (m) from	to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE	CASING	WATERS CUT	WATER LEVEL
				0	8	SAND: Pale brown - yellow brown, silty, slightly clayey, medium grained, occasionally coarse; subangular to subrounded.	SOUTH MASLIN SND. BLANCHE PT. FMN.				
	5										
				8	14	SANDSTONE: Pale grey to pale grey, medium to coarse grained, subangular to subrounded. Common cherty fragments, some glauconite pellets. Becoming conglomerate towards 14 m.					
	10										
	15			14	22	CLAY: Pale to medium grey, sandy and silty, richly glauconitic, common shell fragments.					
	20										
				22	28	SANDSTONE: Medium grey to brown, clayey, subangular to rounded, fine to coarse grained, poorly sorted.					
	25										
				28	41	SANDSTONE: Dark brown to dark grey, fine to coarse grained, grading to grit size, angular					
	30										

*NOTE: 1·25 litres/sec = 1000 gals/hr

REMARKS Completed as Observation Well for Willunga Basin network.

DRILL TYPE C/Tool	LOGGED BY: J.W.B.
CIRCULATION: None	DATE: 2-1-75
START:	TRACED BY: M.R.
FINISH:	DATE: SEPT 1978
SHEET 1 OF 3	DRAWING NO. S 13631

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

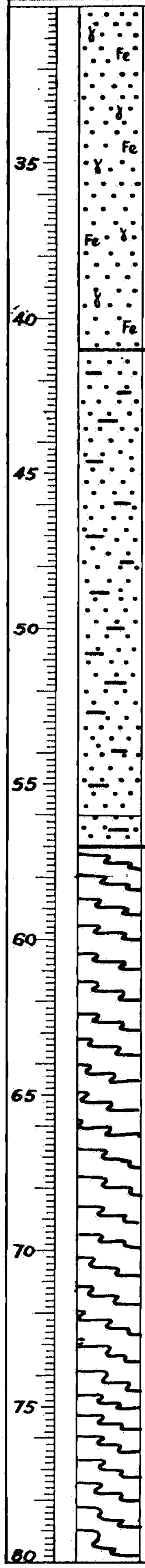
PROJECT: *Willunga Basin Groundwater Investigation*

BORE LOG

CONTINUATION SHEET

HOLE NO. *WLG 41*

UNIT/STATE NO: *697001406*



DEPTH (m) from	to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE
		to subrounded, carbonaceous, micaceous. Abundant iron oxide pellets (possibly weathered glauconite). Sand becomes conglomerate in part.		
41	57	SANDSTONE: Dark brown to black, weakly cemented, carbonaceous, pyritic, generally fine to medium grained, occasionally coarse grained.	NORTH MASLIN SAND	
57	90	METASILTSTONE: Medium grey to buff coloured weathered phyllitic siltstone containing traces of pyrite and mica. Section is clayey to approximately 65 metres, becoming less weathered below.		PRE-CAMBRIAN

CASING | WATERS CUT | WATER LEVEL

SHEET 2 OF 3 DRAWING NO S 13631

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

PROJECT: *Willunga Basin Groundwater Investigation*

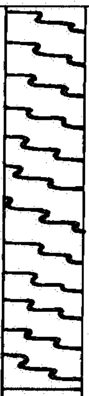
BORE LOG

CONTINUATION SHEET

HOLE NO. WLG 41

UNIT/STATE NO: 697001406

HOLE Dia.	DEPTH m	CORE	GRAPHIC LOG	DEPTH (m) from	DEPTH (m) to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE	CASING	WATERS CUT	WATER LEVEL
	85							PRE - CAMBRIAN			
	90					END OF HOLE					



SHEET 3 OF 3

DRAWING NO S 13631

DEPARTMENT OF MINES — SOUTH AUSTRALIA

SUMMARY OF WATER ANALYSES

WLG 41

Progressive depth of bore (m)	Sampling depth (m)	Water level (m)	Total dissolved solids (Milligrammes/litre)	Analysis W No	Remarks
	7.00		960	W641/75	
	14.00		1180	W642/75	
	16.00		1180	W643/75	
	18.00		1200	W644/75	
	20.00			W645/75	Full analysis
	22.00		1070	W646/75	
	24.00		1150	W647/75	
	26.00		1120	W648/75	
	28.00		1150	W649/75	
	30.00			W650/75	Full analysis
	32.00		180	W651/75	
	34.00		1070	W652/75	
	36.00		990	W653/75	
	38.00		1020	W654/75	
	40.00			W655/75	Full analysis
	42.00		850	W656/75	
	44.00		825	W657/75	
	46.00		850	W658/75	
	48.00		850	W659/75	
	50.00				Full analysi
	52.00		935	W661/75	
	54.00		800	W662/75	
	56.00		825	W663/75	
			850	W664/75	
	60.00			W574/75	Full analysis
	63.00		850	W575/75	
	67.00		935	W576/75	
	73.00		1070	W577/75	
	75.00		1120	W578/75	
	77.00			W579/75	Full analysis
	79.00		1100	W580/75	
	81.00		1100	W581/75	
	83.00		1120	W582/75	
	85.00		1120	W583/75	
	87.00			W584/75	Full analysis
	89.00		1070	W585/75	

Borehole State No.

Drr

Sheet of

Date

Bore Folder No

PF Nº 510538 MH

PROJECT: Willunga Basin Groundwater Investigation

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

BORE LOG

HOLE NO. WLG 42

UNIT/STATE NO: 697017402

SERIAL NO:

FOLDER NO.

LOCATION OR CO-ORDS:

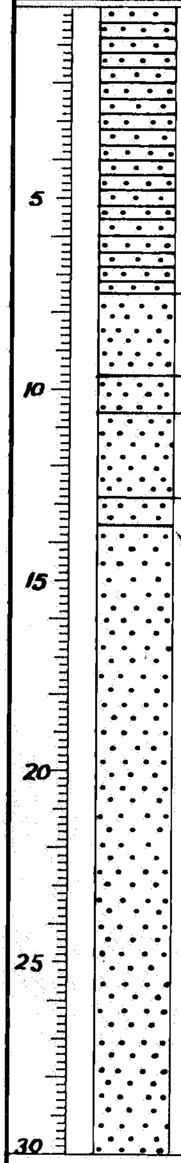
SEC. 174 HD. WILLUNGA

EL Surface

EL ref. point

Datum

DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	SUPPLY		TOTAL DISSOLVED SOLIDS	
		*litres/sec	Method of test	milligrammes/litre	Analysis W. NO



DEPTH (m) from	to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE	CASING	WATERS CUT	WATER LEVEL
0	7·5	CLAYEY SAND: Pale grey to yellow/brown, medium to coarse grained, moderately to well rounded; occasional ferruginous staining. Much fine silty and clayey matrix material.	PT WILLUNGA FMN.				
7·5	9·8	No core recovery					
9·8	10·5	SANDSTONE: Pale yellow/brown, firm to moderately friable. Some thin, dark, heavy mineral laminae					
10·5	12·8	Sand becomes a deep orange colour.					
12·8	13·5	No core recovery					
13·5	31·0	SANDSTONE: Whitish, sugary, friable, medium grained, well sorted.					
		No core recovery					

HOLE Dia | DEPTH m | CORE | GRAPHIC LOG

*NOTE 1·25 litres/sec = 1000 gals/h

REMARKS Completed as Observation Well

DRILL TYPE Rotary	LOGGED BY J.W.B.
CIRCULATION Mud	DATE
START:	TRACED BY M. R
FINISH: 17-3-75	DATE Sept '78
SHEET 1 OF 4	DRAWING NO S 13632

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

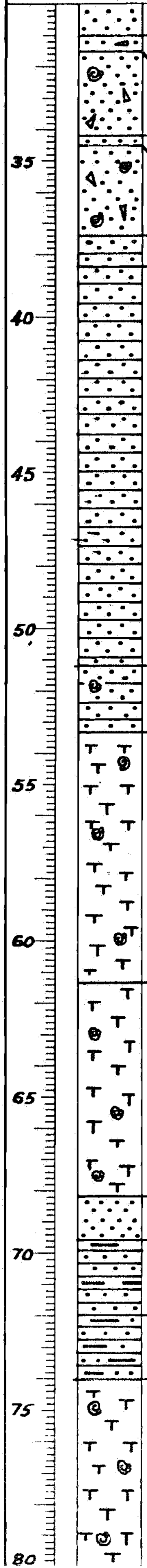
HOLE NO. WLG 42

UNIT/STATE NO 697017402

PROJECT Willunga Basin Groundwater Investigation

BORE LOG

CONTINUATION SHEET



DEPTH (m) from	to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT
31·0	31·5		
31·5	34·2	SANDSTONE: Mottled whitish and yellow-brown, conglomerate with coarse (to 3 mm.) well rounded pebbles of quartz, chert and flint.	
34·2	34·5	No core recovery.	
34·5	37·4	SANDSTONE: Uniform orange colour with traces of mica and plant remains. Pebbles up to 10 mm. Occosional brachiopod casts.	
37·4	38·4	No core recovery.	
38·4	51·2	SANDSTONE: Buff coloured, poorly sorted, coarse to very coarse with silty matrix. SANSTONE: Buff to pale grey coloured, soft and friable, medium to coarse grained, even grained. Common small orange coloured ferruginous inclusions. Slightly calcareous, slight traces of mica. Becoming generally more silty towards 50 m.	
51·2	53·3	SANDSTONE: Becoming more orange-brown in colour, silty and tight. Occasional shell fragments. Becoming more calcareous.	
53·3	61·3	MARL: Pale grey to cream with orange mottling, silty, sandy, richly fossiliferous in parts. Common thin, hard, calcitic bands.	
61·3	68·2	MARL: Becoming dark grey in colour, soft and friable, silty and sandy, rubbly in part; slightly micaceous. Highly fossiliferous with bryozoa, brachiopods, pelecypods, foraminifera etc. Becomes greenish coloured and glouconitic towards 68 m. Strongly calcareous.	CHINAMAN GULLY
68·2	69·6	SANDSTONE: Dark grey, mod. firm to friable, non-calcareous. Coarse to fine grained, dirty & tight.	
69·6	72	SANDY SILTSTONE: Dark grey to black, firm and dense, argillaceous, carbonaceous and slightly micaceous.	
72	74	SANDY SILTSTONE: As above, pale to medium grey, less carbonaceous.	
74	97·6	MARL: Medium grey, soft and friable, richly fossiliferous, slightly micaceous.	BLANCHE PT.

SHEET 2 OF 4 DRAWING NO S 13632

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

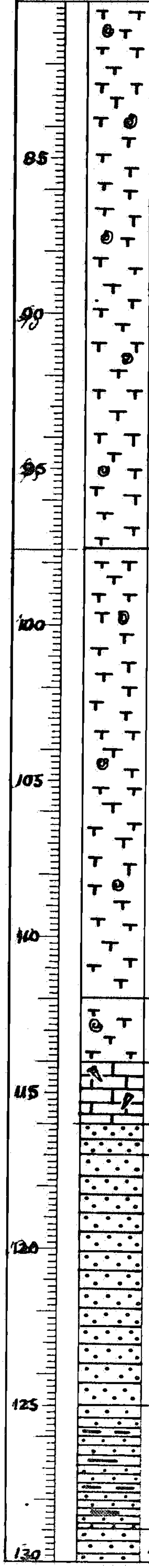
PROJECT: *Willunga Basin Groundwater Investigation*

BORE LOG

CONTINUATION SHEET

HOLE NO. *WLG 42*

UNIT/STATE NO. *697017402*



DEPTH (m) from	to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT
97·6	112·0	MARL: Uniformly medium grey coloured, richly fossiliferous throughout, abundant glauconite. Generally soft and friable with common hard, dense bands. In some samples, glauconite traces up to 20% of the total rock. Quite porous and sandy in part, samples becoming more richly fossiliferous toward 112 m.	
112	114	MARL: As above, but becoming more glauconitic with common pure glauconite inclusions. Highly fossiliferous with abundant bivalves.	TORTACHILLA FMN.
114	116	LIMESTONE: Greenish brown coloured with abundant glauconite which is commonly oxidised. Abundant cherty pebbles (to 5 mm).	
116	117	SANDSTONE: Kahki coloured, coarse to v. coarse gr.	(North)
117	125	SANDSTONE: Dark grey, silty to coarse grained, subangular to subrounded, friable to thinly bedded, lignitic. Abundantly micaceous in part. Becomes essentially as fine sandy siltstone toward 125 m.	MASLIN SAND (South)
125	129	SILTSTONE: Pale grey to buff, firm to friable, micaceous. Common large inclusions of carbonaceous matter.	
129	132·5	SANDSTONE: Dark brown to black,	

SHEET 3 OF 4

DRAWING NO S 13632

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

BORE LOG

CONTINUATION SHEET

PROJECT Willunga Basin Groundwater Investigation

HOLE NO. WLG 42

UNIT/STATE NO: 697017402

HOLE DEPTH	DEPTH (m) from	DEPTH (m) to	GEOLOGICAL DESCRIPTION OF SAMPLE	AGE
			medium grained to silty, very dirty and carbonaceous. Common coarse, well rounded, qtz. grns.	
	132·5	134·4	No core recovery.	
135	134·8	135·6	SANDSTONE: Pale brown, medium grained, well sorted, slightly carbonaceous.	
	135·6	1374	No core recovery.	
	137·4	138·6	SANDSTONE: Pale to dark grey, silty, carbonaceous	
140	138·6	143·2	No core recovery.	
	143·2	144·8	SANDSTONE: Pale to medium brown, medium to coarse grained, carbonaceous, micaceous.	
145	144·8	147·4	No core recovery.	
	147·4	149	SANDSTONE: Dark brown to black, dirty and carbonaceous, becoming silty in part, micaceous, thinly laminated.	
150	149	163	MUDSTONE: White to pale grey, dense and flowery,	
155				PRE-CAMBRIAN
160				
163			END OF HOLE 63 m.	

SHEET 4 OF 4 DRAWING NO S 13632

DEPARTMENT OF MINES SOUTH AUSTRALIA

HYDROGEOLOGY SECTION

BORE LOG

HIRER *S.A. Dept. of Mines & Energy*

Drill type *Cable Tool Rotary*
Circulation *Water*
Driller *W.H. James/R. Febey*
Start *25·9·74*
Finish *8·4·75*

Logged by *J.D. Waterhouse.*
Date logged *On site & Aug.'76*
Bore Diameter *Various*
DEPTH *185m* (m)

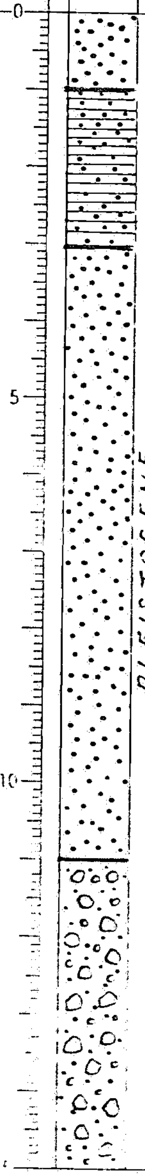
A.M.G. Zone
Coords. E
" N
Datum Elev.
Ref. Pt. Elev.
Surface Elev.

HUNDRED *WILLUNGA*
SECTION *Adj. 8*
STATE No. *697000806*
Project No. *WLG 43*
Docket No. *1185/73*
Bore Serial No. *123/75* *965/75*

Depth to Water cut (m)	Depth to standing water (m)	SUPPLY litres/sec.	SUPPLY Method of test	TOTAL DISSOLVED SOLIDS Milligrammes/litre	TOTAL DISSOLVED SOLIDS Analysis W. No.
	SEE	*ATTACHED*	*SHEET*		

REMARKS

CASING	WATERS CUT	WATER LEVEL	DEPTH (m)	CORE	GRAPHIC LOG	AGE	UNIT
9m of 250mm.			0–15			*PLEISTOCENE*	

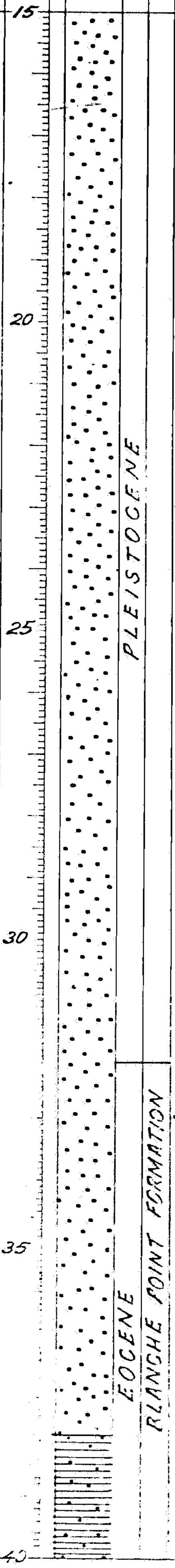


DEPTH (m) from	to	DESCRIPTION
0	*1*	***ARENITE*** *Quartz, 0·1-0·3mm, rarely to 2mm, angular to subrounded, rarely rounded, most colourless, some milky, rarely red/brown coated. Fawn. 0·5-1m 50% rounded to subangular red/brown ferruginous sandstone.*
1	*3*	***LUTITE*** *Plastic, orange-brown. 30% arenite-siltite, quartz, most 0·1-0·2mm, angular and colourless, rarely to 1mm, milky and brown.*
3	*7*	***ARENITE*** *Quartz, most 0·1-0·3mm, angular to rounded, colourless, rarely to 5mm. Grains > 0·5mm, usually milky-yellow, angular to subangular. Minor orange-brown lutite, some well cemented brown sandstone fragments 5-7mm. Maximum 2mm, no yellow grains or sandstone.*
7	*11*	***ARENITE*** *Quartz, mostly 0·1 - 0·5mm, rarely to 1·5mm, angular to rounded, colourless, 30% brown stained, a few milky. Minor light brown lutite.*
11	*13*	***ARENITE-RUDITE*** *Quartz to 3mm, 30% greater than 1mm angular to rounded, most colourless, some milky and orange-brown. Light brown overall.*
13	*15*	***ARENITE-RUDITE*** *Quartz, 0·1-5mm, angular to rounded, colourless and milky. Minor orange-brown lutite, dark brown moderately cemented ferruginous sandstone fragments*

PE NO 910537 MH

DEPARTMENT OF MINES — SOUTH AUSTRALIA

CASING | WATER CUT | WATER LEVEL | DEPTH m | CORE | GRAPHIC LOG | AGE | UNIT



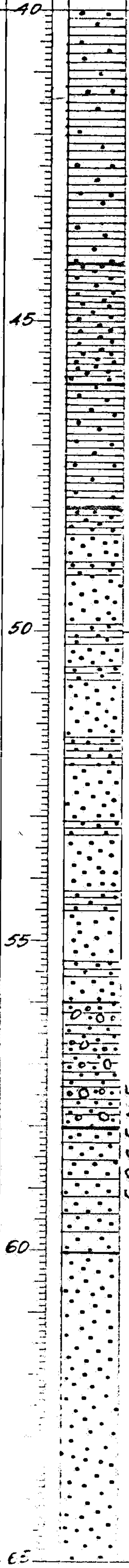
DEPTH m from	to	DESCRIPTION
15	19	ARENITE Quartz, silt size to 1mm, most 0·2 - 0·3mm, subangular, colourless and milky. Minor ferruginous sandstone, as above. Brown. 17 -19m. A few pale yellow grains, most quartz 0·2 - 0·5mm.
19	23	ARENITE Quartz, silt size to 2mm, most 0·5 -1·5mm, angular to rounded, colourless and brown. Minor orange-brown lutite matrix.
23	33	ARENITE Quartz, silt size to 0·5mm, most 0·2-0·3mm, subangular, most orange-brown, some colourless. 50% fragments of sandstone - moderately cemented, quartz, ferruginous, brown. Rare weathered mica flakes to 1mm. Red/brown overall. 25-26m. Sandstone well cemented. 26 -30m. A few layers 5mm. thick of brown/black Limonite (?goethite)m weakly cemented ferruginous sandstone. 30-32m. As 26 -30m, but 5% quartz rudite, 0·5 - 5mm, subrounded, colourless, milky and brown. 32-33m. As 30 -32m, with 50% siltite/lutite matrix, grey- brown - orange.
33	38	SANDSTONE Quartz 0·1 - 0·5mm, subangular to subrounded, colourless and brown, with minor white mica to 1mm, Moderately to well cemented, ferruginous in part, some silicified, brown-red-fawn.
38	46	SILTITE -LUTITE dark green-brown. 10 -20% quartz arenite - siltite. 30% dark and light green glauconite to 1mm, subangular to rounded. Minor fine white mica, rarely to 1mm

Borehole Sheet No 697000806

Sheet 2 of 8

Bore Fence N.

DEPARTMENT OF MINES — SOUTH AUSTRALIA



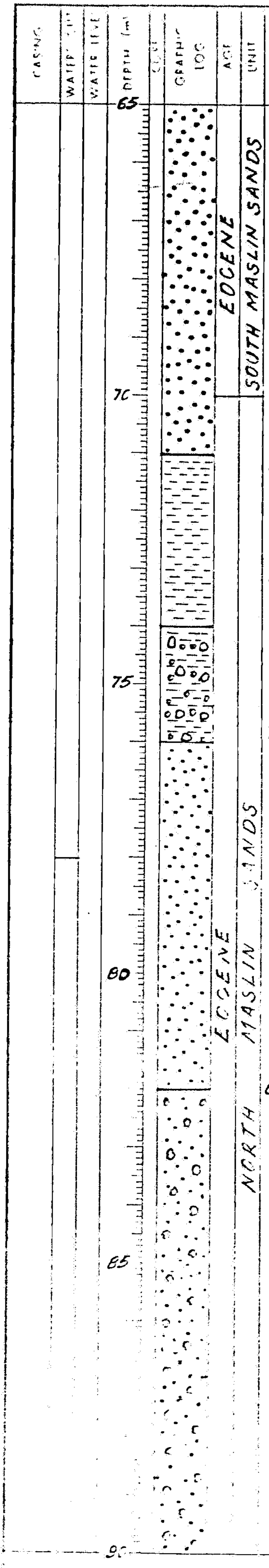
AGE	UNIT	DEPTH (m) from	to	DESCRIPTION
EOCENE	BLANCHE POINT FORMATION			40-42m Glauconite to 2mm 10-20%. Minor orange-brown quartz siltite-arenite (additional)
				42-44m 30% quartz siltite-arenite, most 0·2-0·3mm, as above, rare red grains. 10% glauconite as 40-42m.
				44-46m. 50% quartz siltite-arenite. Mica very common.
				46-48m. As 42-44m.
		48	56	ARENITE Silt size to 0·5mm rarely to 1mm, subangular to subrounded, light and dark green. 20% siltite, minor glauconite, dark brown lutite. Rare angular, irregular pyritic cemented quartz sandstone grains to 3mm. Common fine white mica to 1mm
EOCENE	SOUTH MASLIN SANDS			50-52m. Rare rounded, colourless quartz 0·5-1mm. Less than 10% siltite
				52-56m Siltite minor, no lutite, rare quartz as 50-52m.
		56	58	ARENITE-RUDITE Quartz, silt size to 10mm, angular to rounded, colourless and milky. 30% siltite-lutite matrix, green brown. Common glauconite grains, silt size to 3mm, subangular to rounded, light and dark green.
		58	71	ARENITE Quartz, silt size to 0·3mm, subangular to subrounded, colourless and pale green, rarely pink. 5-10% glauconite grains silt size to 1mm, most < 0·3mm. 25% siltite matrix with minor lutite, dark green/brown. 60-66m. Most quartz 0·1-0·2mm, glauconite to 1·5mm. Siltite/lutite matrix very minor constituent.

Borehole Sheet No 697000806

3 8

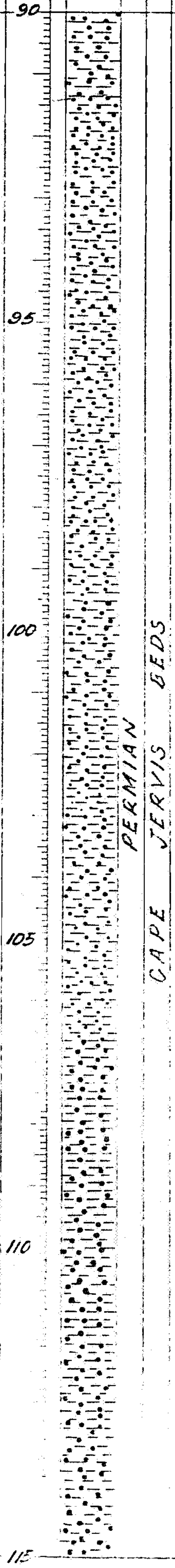
Borehole No.

DEPARTMENT OF MINES — SOUTH AUSTRALIA



DEPTH m from	to	DESCRIPTION
		66-70m. Quartz is rarely orange, and occasionally to 1mm. Rare fine white mica to 0.5mm. Minor siltite-lutite matrix.
		70-71m. Most quartz is well cemented pyritic sandstone. Rare rounded milky quartz rudite to 1cm. 5-10% grey/brown silty lutite.
71	73	SILTITE. Very fine, carbonaceous, dark brown. Minor lutite, quartz arenite to 1mm, rounded, colourless and light green. Rare pyritic sandstone fragments. Rare dark green glauconite to 1mm.
73	76	SILTITE Very fine, light brown. Minor lutite. Minor fine white mica to 0.5mm, quartz arenite to 1.5mm, rounded, colourless. Fine layers 0.5-3mm. 74-76 m 10-25% pyrite, fine grain 2cm, irregular.
76	82	ARENITE Quartz, silt size to 1.5mm, most 0.25-0.75mm, rounded, minor angular, colourless and milky, minor red. 5% fine white mica to 0.5mm. Rare lignitic fragments to 1cm. 5-10% light brown siltite blebs. Common angular pyrite grains to 1mm. 78-80m. Quartz mostly 0.5-1mm, 30% of grains brown. Pyrite to 2-3mm. 80-82m. Common white mica flakes to 2-3mm. Rare friable lignite fragments to 1cm.
82	90	ARENITE-RUDITE Quartz, silt size to 1cm, most 0.5-3mm, angular to rounded, colourless, milky and fawn. A few rock fragments. Rare friable lignite fragments to 3mm (driller reported several cm) Very rare loose well preserved quartz crystals. Abundant white mica, silt size to 3mm, some as brown lutite blebs. Rare angular pyrite to 3mm, also well cemented pyritic sandstone fragments to 10cm. 84-86m. Maximum grain size 4mm. 86-90m. " " " 10mm, pyritic sandstone to 5mm.

DEPARTMENT OF MINES — SOUTH AUSTRALIA



DEPTH from	to	DESCRIPTION
90	173	ARENITE Quartz, silt size to 2mm most 0·2-0·5mm subrounded to well rounded, often high sphericity, rarely angular, colourless and milky, rarely pink. Rare rounded sandstone and quartzite grains to 2mm. All in very fine white lutite/siltite matrix (predominantly very fine white mica) 92-94m Rarely to 4mm. 96-98m. Very little matrix, rare black opaques, pyrite and white mica to 2mm. 98-100m. Most quartz 0·5-1mm, commonly 2-4mm. 102-104m. A few fragments of well cemented pyritic sandstone nodules (? Tertiary contamination). Rare subrounded to rounded quartzite pebbles to 1cm.

E57000806

5 8

DEPARTMENT OF MINES — SOUTH AUSTRALIA

CASING | WATERS CUT | WATER LEVEL | DEPTH (m) | CORE | GRAPHIC LOG | AGE | UNIT | DEPTH (m) from to | DESCRIPTION

Casing: 200mm.

Depth: 115, 120, 125, 130, 135, 140

Age: PERMIAN

Unit: CAPE JERVIS BEDS

119m. A few pebbles to 4cm.

119-173m. Slight increase in grain size until most are 0·2 - 1mm, decrease in proportion of well rounded grains.

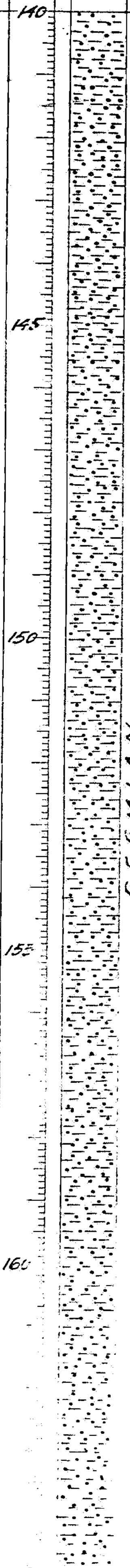
Borehole Stat. No 697000806

6 6

PE Nº 510537a MH

DEPARTMENT OF MINES — SOUTH AUSTRALIA

CASING	WATER CUT	WATER LEVEL	DEPTH (m)	CORE	GRAPHIC LOG	AGE	UNIT	DEPTH (m) from	to	DESCRIPTION
			140–165			PERMIAN	CAPE JERVIS BEDS			

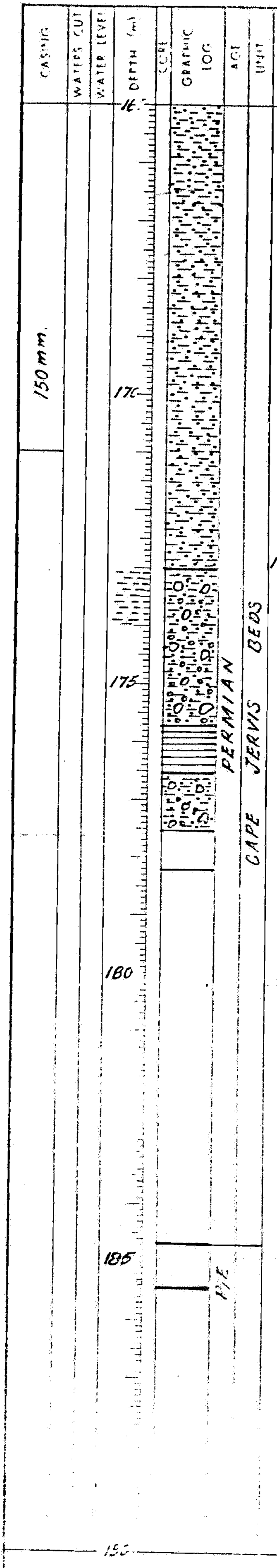


Envelope Seq. No. 657000806

Sheet 7 of 8

Bore Record

FF No 510537e MP



DEPARTMENT OF MINES — SOUTH AUSTRALIA

DEPTH (m) from	to	DESCRIPTION
		ROTARY DRILLING COMMENCED.
173	184·75m	ARENITE - RUDITE. Dominantly quartz, silt size to 0·5mm, most less than 0·3mm, angular to rounded (most approaching roundness), most colourless, a few orange, pink, milky in a lutite 'siltite matrix (10% -50% of sample). Common rock fragments 1-50% and rounded pebbles from 5mm to at least 5cm (cored boulders likely) - weathered slate, assorted metamorphics and coarse grained granite. Overall massive, weakly jointed, weakly to moderately cemented. Lutite dominant (75%+) 173·40 - 173·70m, olive 5/4, massive, also 176·40 - 177·50m. Pale yellow 7/4 to 176·70, then mottled grey N6/ and pale red 6/2 to 177·50. 180·30 - 180·60m. Weak, wavy bedding of white and grey (lutite rich) layers to 3mm thick. 181·90 - 182m. Layering as above. 182 - 184·75m. Rudite common, some as cores through inferred large boulders, some clay rich layers with a little bedding as above.
		184·75 - 185·50m. SHALE. Fresh dark grey pyritic finely layered well cemented shale.
		185·50 END OF HOLE.

Borehole Sheet No. Є5700080Є

Є Є

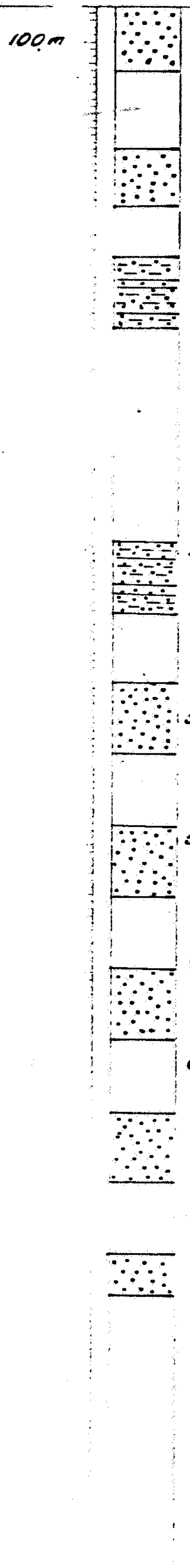
PE Nº 510537c MF

DEPARTMENT OF MINES — SOUTH AUSTRALIA

CORE DESCRIPTION

HOLE NO. WLG 43

UNIT/STATE NO:
697000806



5.00 - 5.40m. SANDSTONE Quartz, most 0.05 - 1mm, angular - rarely rounded, colourless with yellow-brown cementation staining grains, Minor dark brown limonite opaques. White, orange and brown, massive.

0.00 - 10.40m. SANDSTONE, as above.

40 - 40.50m. SILTITE - LUTITE Dark green-brown. 30-50% quartz arenite silt size to 0.3mm, angular to subangular, colourless to green. 5% glauconite as pellets 0.3 - 0.5mm, and silty irregular grains. Rare pyrite-embayed irregular grains. Rare gypsum crystals to 0.5 - 1mm, (? formed after collection of sample, with common yellow, soft, fine grained material) Massive.

45.00 - 45.50m. ARENITE Quartz as 40 - 40.50m, with accessories as above and 25% siltite-lutite matrix as above.

50 - 50.50m. ARENITE Quartz, even grained 0.05 - 0.1mm, colourless, Minor brown lutite matrix, minor glauconite. Massive.

55.00 - 55.50m ARENITE as above, with a few 3mm diameter infilled tubes (? worms)

60.00 - 60.50m AS 55.00 - 55.50m.

65.00 - 65.50m. AS 55.00 - 55.50m.

74 - 74.30m AS 55.00 - 55.50m, common fine white mica, thin layers (1-4mm) of carbonaceous lutite.

Borehole Sheet No.

PF Nº 510749 MH

DEPARTMENT OF MINES — SOUTH AUSTRALIA

SUMMARY OF WATER ANALYSES WLG 43

Progressive depth of bore (m)	Sampling depth (m)	Water level (m)	Total dissolved solids (Milligrammes/litre)	Analysis W No.	Remarks
	27.0		420	W5994/74	
	30.0		398	W5995/74	
	33.0		343	W5988/74	
	36.0		386	W5989/74	
	38.0		467	W5996/74	Full analysis
	40.0		410	W5990/74	
	42.0		420	W5997/74	
	44.0		430	W5998/74	
	46.0		420	W5991/74	
	48.0		502	W5992/74	Full analysis
	50.0		430	W5993/74	
	52.0		410	W6000/74	
	54.0		441	W6001/74	
	46.0		441	W6002/74	
	60.0		398	W6003/74	
	62.0		475	W6004/74	
	64.0		430	W6005/74	
	68.0		481	W6006/74	Full analysis
	70.0		410	W6007/74	
	74.0		360	W6008/74	
	58.0	*	481	W6009/74	Full analysis
	66.0	*	370	W6010/74	
	72.0	*	415	W6011/74	
	76.0		380	W6012/74	
	78.0		517	W6013/74	Full analysis
	80.0		415	W6014/74	
	82.0		410	W6015/74	
	84.0		415	W6016/74	
	86.0		420	W6017/74	
	88.0		700	W6084/74	Full analysis
	90.0		485	W6085/74	
	92.0		585	W6086/74	
	94.0		595	W6087/74	
	96.0		560	W6088/74	
	98.0		776	W6089/74	Full analysis
	100.0		545	W6390/74	
	102.0		508	W6388/74	
	104.0		545	W6389/74	
	106.0		620	W6391/74	
	108.0		906	W6392/74	Full analysis
	110.0		585	W6398/74	
	112.0		585	W6394/74	
	114.0		575	W6395/74	
	116.0		625	W6396/74	
	118.0		967	W6397/74	Full analysis
	120.0		635	W6398/74	
	122.0		630	W6399/74	
	124.0		635	W6400/74	
	126.0		567	W6401/74	
	128.0		816	W6919/74	Full analysis
	131.0		612	W6920/74	
	134.0		650	W6921/74	
	137.0		640	W6922/74	

Borehole State No.	Drn:	Sheet of
	Date:	Bore Folder No

PF Nº S10538 MH

PROJECT *WILLUNGA BASIN INVESTIGATION*

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

BORE LOG

HOLE NO. *WLG 44*

UNIT/STATE NO *697038802*

SERIAL NO *120/77*

FOLDER NO

LOCATION OR CO-ORDS

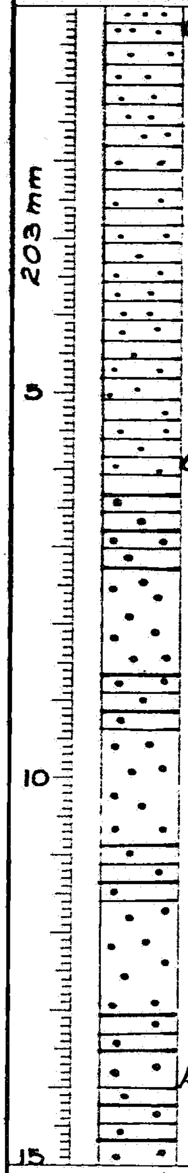
SEC *Adj 388* HD *WILLUNGA*

EL Surface

EL ref. point

Datum

DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	SUPPLY		TOTAL DISSOLVED SOLIDS	
		*litres/sec	Method of test	milligrammes/litre	Analysis No
50	43		Not tested	12245	4427/76
68	43		See attached sheet	4802	4437/76
75	43			3380	4440/76



HOLE Dia	DEPTH m CORE	GRAPHIC LOG	DEPTH (m) from	to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE	CASING	WATER CUT	WATER LEVEL
203 mm			0	6	LUTITE: pale yellow/brown to buff, soft and puggy, arenaceous with approx. 30% medium to coarse, subangular to subrounded quartz, moderately sorted strongly calcareous.	Hindmarsh Clay	Quaternary	203 mm to 68·25m.		
			6	14	ARENITE: medium brown to red/brown, generally fine to coarse grained, poorly sorted with occasional very coarse well rounded, clear to milky quartz, subangular to subrounded. Some grains show reddish iron staining. Red	Port Willunga Beds	Oligocene - Miocene			
			14	26	ARENACEOUS LUTITE: medium yellow/brown, soft and puggy. Approx. 30% quartz arenite. ranging from fine to very coarse grained					

*NOTE 1·25 litres/sec = 1000 gals/h

REMARKS *Drilled as investigation well in Willunga Basin hydrogeological investigation programme. 2m Paringa screen 68·25 - 70·25 m.*

DRILL TYPE *C.T.*

CIRCULATION

START *19/8/76*

FINISH *24/9/76*

SHEET *1* OF *5*

LOGGED BY *Q.J.W.B*

DATE

TRACED BY

DATE

DRAWING NO

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

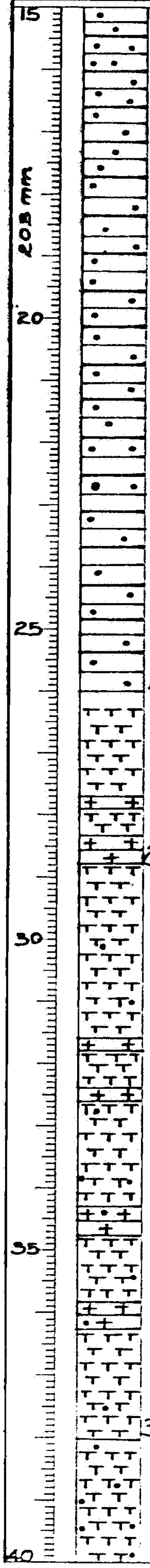
PROJECT *WILLUNGA BASIN INVESTIGATION*

BORE LOG

CONTINUATION SHEET

HOLE NO. *WLG44*

UNIT/STATE NO *697033802*



HOLE Dia DEPTH m	CORE	DEPTH (m) from	to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE	CASING	WATERS CUT	WATER LEVEL
203 mm				with large grains (to 3mm) moderately rounded quartz. Arenite is generally subangular to well rounded, moderately to poorly sorted clear quartz with some iron staining; non calcareous. Becoming medium brown at 22m. to more arenaceous. Occasional firm white to brown chips of silty clay.	Port Willunga Beds	Oligocene - Miocene	203 mm to 68·25 m		
		26	28	MARL: medium brown, firm, slightly arenaceous with approximately 10% of subangular to subrounded, fine to coarse quartz and lithic fragments and common firm and hard whitish clay chips, moderately calcareous. Commonly mottled pale grey, medium brown and red/brown.	Blanche Point Marls	Upper Eocene			
		28	38	MARL: medium brown/grey to buff soft and plastic, slightly silty; rare fine to medium sandy grains. Grades in part to calcisiltite.					
		38	40	MARL: as above but becoming firmer and slightly darker in colour. Common coarse sandy grains and silty fragments.					

SHEET 2 OF 5 DRAWING NO S

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

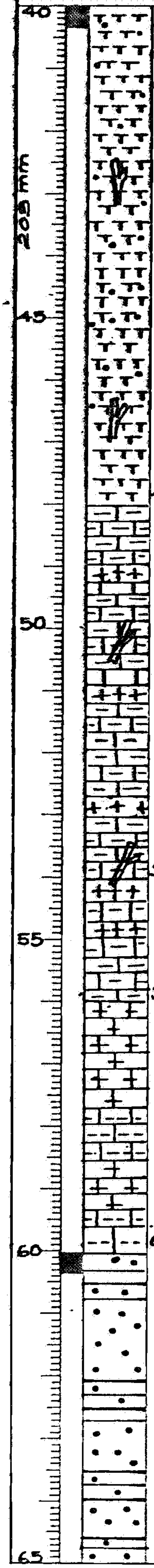
BORE LOG

CONTINUATION SHEET

PROJECT: WILLUNGA BASIN INVESTIGATION

HOLE NO. WLG 44

UNIT/STATE NO 697038802



DEPTH (m) from	to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE
40	48	MARL: dark brown to grey, dense and firm, generally silty, commonly sandy with occasional coarse, moderately rounded quartz grains. Common glauconite (5%) slightly micaceous. Fossiliferous with common small brachiopods (?) and occasional bryozoa.	Blanche Point Marls	Upper Eocene
48	54	CALCILUTITE: dark brown, dense and firm, silty and grading to a calcisiltite, sandy in part with thin lenses of fine grained arenite and thin bands of hard calcisiltite. Slightly calcareous. Rare bryozoa sticks, micaceous.		
54	56	MARL: blue/green colour, silty and sandy, rich in glauconite, occasional white clayey inclusions. Richly fossiliferous with large bivalves.		
56	60	CALCISILTITE/CALCARENITE: yellow/brown to dark green/brown, fine to medium grained poorly sorted quartz and limonite with large (to 2mm) well rounded grains of limonite. Limonite comprises 40-50% of sample. The arenite is angular to well rounded and is dirty and tight with a pale blue/grey clayey and silty matrix. Moderately calcareous.		
60	66	ARENITE: dark brown to greenish/brown, fine to coarse grained, poorly sorted, subangular to well rounded, clear to amber quartz. Abundant medium grained, well rounded limonite and some traces of glauconite. Moderately calcareous. Matrix consists of pale brown to pale grey argillaceous and silty matter. Generally friable and unconsolidated.	Sth. Maslin Sands	Upper Eocene

CASING: 203 mm to 68·25 m

WATERS CUT: 1st water cut 43m

WATER LEVEL: Standing level of all waters cut 43m

SHEET 3 OF 5 DRAWING NO S

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

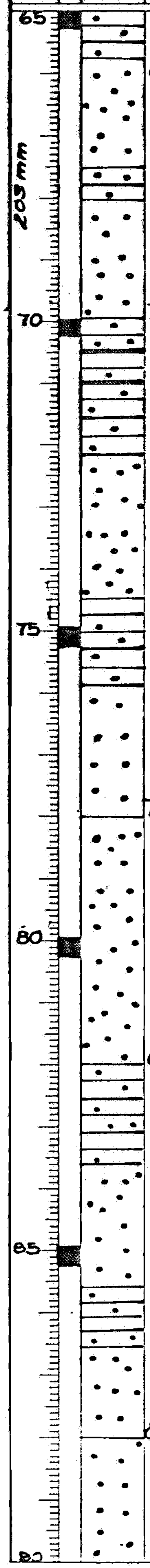
PROJECT *WILLUNGA BASIN INVESTIGATION*

BORE LOG

CONTINUATION SHEET

HOLE NO. WLG 44

UNIT/STATE NO 697038802



DEPTH (m) from	to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE	CASING	WATERS CUT	WATER LEVEL
66	70	ARENITE: medium to dark brown, medium to coarse grained, moderately to well sorted, subangular to subrounded, clear, amber and brown coloured quartz; 2-5% of medium grained, well rounded limonite. Occasional pale green glauconite. Generally friable and unconsolidated. Matrix consists of brown argillaceous and silty material.	South Maslin Sands	Upper Eocene	203 mm casing shoe at 68·25m	2nd water cut 68m.	
70	78	ARENITE: as above but becoming slightly lighter in colour and more argillaceous. Occasional very coarse, angular quartz fragments. Approximately 30% of samples consist of dark brown, well rounded grains of limonite.				3rd water cut at 75m.	
78	82	ARENITE: dark brown, generally medium to coarse grained and occasional very coarse grained, subangular to well rounded quartz. Approximately 40% of samples consist of well rounded limonite.					
82	88	ARENITE: dark grey to black, becoming generally medium grained but with 10% very coarse grained quartz and limonite, unconsolidated. Generally well sorted, subangular to subrounded. Abundant dark grey matrix material. Limonite comprises up to 50% of samples.					
88	92	ARENITE: Conglomeratic. Samples consist essentially of 2 size fractions. The smaller fraction is as above. The larger fraction consists of subangular to well rounded, smokey, milky, amber and clear					

SHEET 4 OF 5 DRAWING NO S

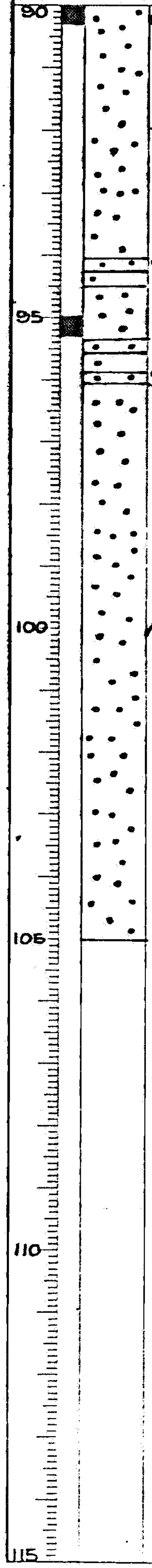
DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

BORE LOG

CONTINUATION SHEET

PROJECT *WILLUNGA BASIN INVESTIGATION*

HOLE NO. WLG 44
UNIT/STATE NO. 697038802



DEPTH (m) from	to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE	CASING	WATERS CUT	WATER LEVEL
88	92	quartz, limonite and lithic grains. Some fragments consist of quartz grains cemented with haematite and limonite. Rare traces of pyrite and felspar occur.	South Maslin Sands	Upper Eocene			
92	94	ARENITE: as above but with fewer large lithic fragments. Common grains of heavy minerals – heamatite.					
94	96	ARENITE: as above but much more argillaceous with dark khaki green matrix material.					
96	100	ARENITE: dark grey, less argillaceous; generally well sorted but with common large well rounded pebbles of dark grey siltstone, up to 20mm. Limonite, haematite and rare pyrite comprise 15% of sample. Rare larger fragments with heamatite cement.					
100	105	ARENITE: as above but becoming much more conglomeratic. Dark grey firmer, weathered basement.					
		END OF HOLE 105m.					

SHEET 5 OF 5 DRAWING NO. S

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

BORE LOG

HOLE NO. WLG 45

UNIT/STATE NO 697044902

SERIAL NO

FOLDER NO

PROJECT: WILLUNGA BASIN INVESTIGATION

LOCATION OR CO-ORDS:

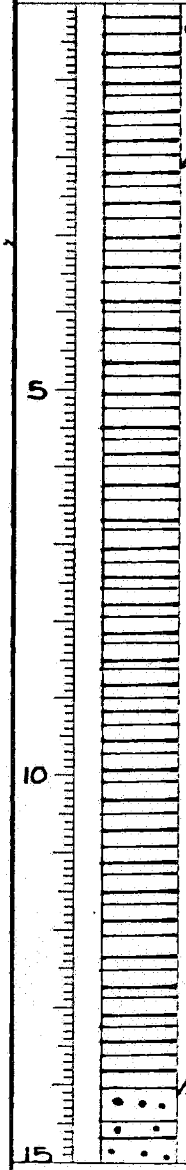
SEC adj. 449 HD WILLUNGA

EL Surface

EL ref. point

Datum

DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	SUPPLY		TOTAL DISSOLVED SOLIDS	
		*litres/sec	Method of test	milligrammes/litre	Analysis W. No.
18	13		Not tested	625	856/77
60	37		see attached	735	862/77
90	50		sheet	850	866/77



DEPTH (m) from	to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE	CASING	WATER LEVEL
0	2	CLAY: mottled medium brown/pale grey, soft plastic, slightly silty.	Hindmarsh Clay	Quaternary		S.W.L. 13m uppermost aquifer
2	14	CLAY: becoming darker brown and generally firmer; less mottled. Silty.				
14	20	CLAY: as above, softer and more plastic silty and sandy with fine to medium grained poorly sorted quartz sand.				

*NOTE 1·25 litres/sec = 1000 gals/hr

REMARKS Drilled as investigation well in Willunga Basin hydrogeological investigation programme. Suspended at 176m - tools lost in well.

DRILL TYPE C.T.

LOGGED BY Q.J.W.B

CIRCULATION

DATE 12/76

START 13/10/76

TRACED BY

FINISH Suspended

DATE

SHEET 1 OF 8

DRAWING NO S

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

HOLE NO. WLG 45

UNIT/STATE NO 697044902

PROJECT WILLUNGA BASIN INVESTIGATION

BORE LOG

CONTINUATION SHEET

DEPTH m	DEPTH (m) from	to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE	WATERS CUT	WATER LEVEL
20	20	28	CLAY: as above, medium to dark brown stiff and firm. Samples contain up to 30% fine to coarse, subangular to subrounded poorly sorted quartz sand, lithic fragments and quartzitic chips.	Hindmarsh Clay	Quaternary	Upper Aquifer 18m.	
25	28	36	CLAY: as above, mottled brown and pale grey. Becoming generally softer and more plastic. Sandy as above.				37m. S.W.L 2nd Aquifer.
30							
35			Possible Tertiary top at 36 m ?				
	36	42	CLAY: pale brown to cream, soft, becoming sandy with approximately 20% fine to coarse, subangular to well rounded, moderately sorted quartz.	P.W.B.			
40							

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

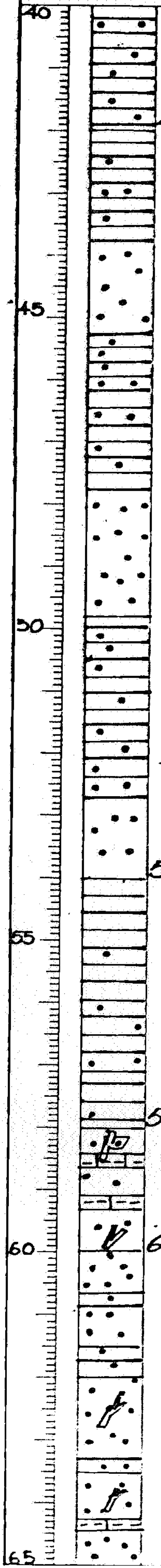
PROJECT WILLUNGA BASIN INVESTIGATION

BORE LOG

CONTINUATION SHEET

HOLE NO. WLG 45.

UNIT/STATE NO 697044902



DEPTH (m) from	to	GEOLOGICAL DESCRIPTION OF SAMPLE
42	54	SANDSTONE: pale brown to yellow/brown, predominantly medium grained, grading to coarse grained, moderately to well sorted, subangular to subrounded; argillaceous with approximately 40% clay. Becoming clearer and lighter coloured toward 54 m.
54	58	CLAY: pale brown, moderately firm; sandy with up to 40% medium to coarse sand as above.
58	60	SANDSTONE: medium yellow to dark grey coloured, fine to medium grained, well sorted, subangular to subrounded, slightly argillaceous. Occasional bryoza. Calcareous.
60	92	SANDSTONE: yellow/brown, fine grained, well sorted argillaceous with up to 30% clay. Grading in part to medium brown in colour. Generally unconsolidated throughout.

UNIT: Port Willunga Beds

AGE: Oligocene - Miocene

WATERS CUT: 60m 2nd Aquifer.

WATER LEVEL: 50m. S.W.L 3rd Aquifer.

SHEET 3 OF 8

DRAWING NO S

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

PROJECT *WILLUNGA BASIN INVESTIGATION*

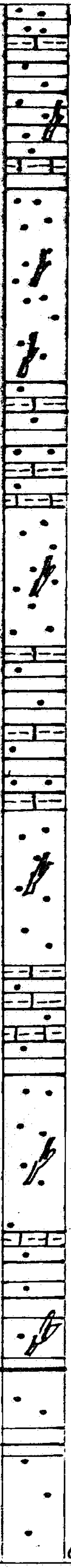
BORE LOG

CONTINUATION SHEET

HOLE NO WLG 45

UNIT/STATE NO 697044902

HOLE Dia	DEPTH m	CORE	GRAPHIC LOG	DEPTH (m) from	DEPTH (m) to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE	CASING	WATERS CUT	WATER LEVEL
	65			60	92	SANDSTONE (continued)	Port Willunga Beds	Oligocene - Miocene		90m. 3rd Aquifer.	
	70										
	75										
	80										
	85										
	90			60	92	SANDSTONE					



SHEET 4 OF 8 DRAWING NO S

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

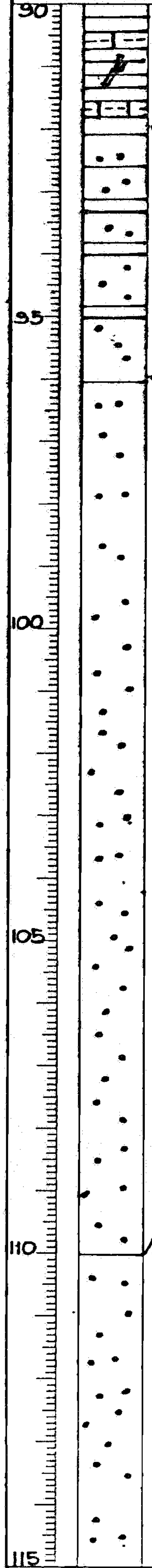
PROJECT *WILLUNGA BASIN INVESTIGATION*

BORE LOG

CONTINUATION SHEET

HOLE NO *WLG 45*

UNIT/STATE NO *697044902*



HOLE DIA DEPTH m	CORE	GRAPHIC LOG	DEPTH (m) from	to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE	CASING	WATERS CUT	WATER LEVEL
			92	96	SANDSTONE: pale to medium grey with some red/brown mottling. Very fine grained, grading in part to medium grained; generally well sorted. Argillaceous and silty with up to 40% clay.	Port Willunga Beds.	Oligocene - Miocene.			
			96	110	SANDSTONE: pale grey, fine to medium grained, well sorted, clean, angular to subangular; unconsolidated.					
			110	116	SANDSTONE: buff coloured, medium grained, well sorted, clean, subangular to subrounded. Rare well rounded coarse grains.					

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

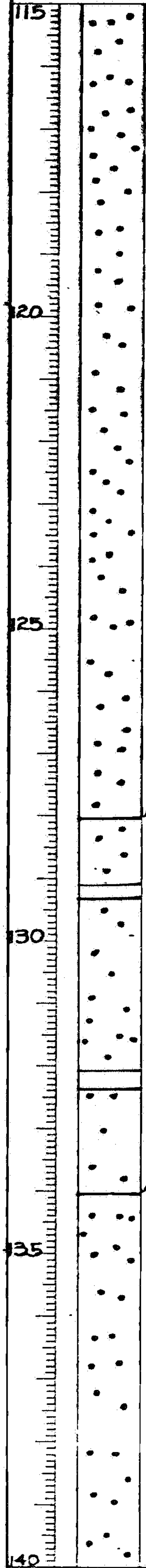
PROJECT *WILLUNGA BASIN INVESTIGATION*

BORE LOG

CONTINUATION SHEET

HOLE NO *WLG 4*

UNIT/STATE NO *697044902*



HOLE DIA DEPTH m	CORE	GRAPHIC LOG	DEPTH (m) FROM	TO	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE	CASING	WATERS CUT	WATER LEVEL
			116	128	SANDSTONE: medium grey, fine to coarse grained, poorly sorted. Coarse fraction generally subrounded. Finer fraction generally angular to subangular. Common cemented medium to coarse grained aggregates, but dominantly unconsolidated.	Port Willunga Beds	Oligocene — Miocene			
			128	134	SANDSTONE: essentially as above but becoming better sorted. Occasional lithic fragments of dark grey silstone occur.					
			134	142	SANDSTONE: pale buff colour, medium to coarse grained, subangular to rounded; generally well sorted. Coarser grains generally more rounded. Rare orange coloured cemented aggregates.					

SHEET *6* OF *8* DRAWING NO S

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

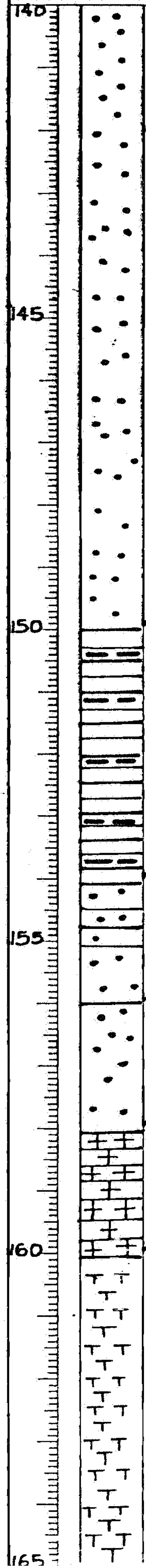
PROJECT *WILLUNGA BASIN INVESTIGATION*

BORE LOG

CONTINUATION SHEET

HOLE NO. WL645

UNIT/STATE NO 697044902



DEPTH (m) from	to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE	CASING	WATERS CUT	WATER LEVEL
142	150	SANDSTONE: dark grey, fine to coarse grained poorly sorted, occasional very coarse grains. Coarser fraction generally well rounded, finer fraction more angular. Common fine grains of black organic(?) material.	Port Willunga Beds	Oligocene - Miocene			
150	154	CLAY: black, lignitic, very firm and stiff; silty in part.	Chinaman's Gully Beds	Oligocene			
154	156	SANDSTONE: dark grey, medium to coarse grained, subangular to rounded generally well sorted. Slightly argillaceous.					
156	158	SANDSTONE: pale grey, fine to very fine grained, subangular to subrounded, well sorted, clean.					
158	160	CALCISILTITE: dark grey, firm and stiff, very argillaceous and grading in part to marl; strongly calcareous.					
160	170	MARL: dark grey to dark buff coloured firm and stiff.	Blanche Point Marls	Upper Eocene			

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

PROJECT WILLUNGA BASIN INVESTIGATION

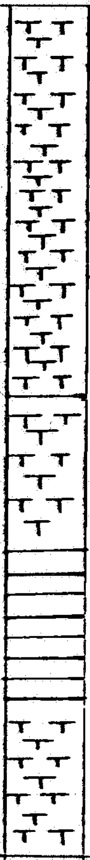
BORE LOG

CONTINUATION SHEET

HOLE NO. WLG 45

UNIT/STATE NO 697044902

HOLE Dia DEPTH m	CORE	GRAPHIC LOG	DEPTH (m) from to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE	CASING	WATERS CUT	WATER LEVEL
165									
170				MARL: becoming darker grey and softer; silty in part. Strongly calcareous.	Blanche Point Marls	Upper Eocene			
175				END OF HOLE 176 m.					
180									



SHEET 8 OF 8 DRAWING NO S

DEPARTMENT OF MINES — SOUTH AUSTRALIA

SUMMARY OF WATER ANALYSES

WLG 45

Progressive depth of bore (m)	Sampling depth (m)	Water level (m)	Total dissolved solids (Milligrammes/litre)	Analysis W No.	Remarks
	18		625	W856/77	
	20		555	W857/77	
	22		545	W858/77	
	26		540	W859/77	
	28		555	W860/77	
	60		735	W861/77	
	62		975	W862/77	
	64		980	W863/77	
	66		910	W864/77	
	68		1120	W865/77	
	70		950	W866/77	
	92		850	W867/77	
	102		384	W868/77	
	104		357	W869/77	
	106		353	W870/77	
	108		357	W871/77	
	110		351	W872/77	
	112		351	W873/77	
	114		435	W874/77	
	116		440	W875/77	
	118		610	W876/77	
	120		545	W877/77	
	122		555	W878/77	
	124		575	W879/77	
	126		710	W880/77	
	128		710	W881/77	
	130		660	W882/77	
	132		670	W883/77	
	142		755	W884/77	
	144		860	W885/77	
	146		745	W886/77	
	148		730	W887/77	
	150		755	W888/77	
	156		820	W889/77	
	158		830	W890/77	
	94		407	W891/77	
	96		370	W892/77	
	98		346	W893/77	
	100		370	W894/77	

Borehole State No.

Drn :

Sheet of

Date :

Bore Folder No.

PE Nº S10538 MH

PROJECT: KTP 14.

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

BORE LOG

HOLE NO. KTP 14

UNIT STATE NO
446085401

SERIAL NO

FOLDER NO

LOCATION OR CO-ORDS:

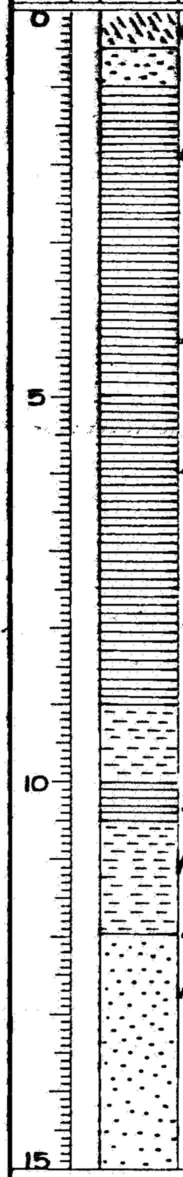
SEC. 854 HD. KUITPO

EL Surface

EL ref. point

Datum

DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	SUPPLY		TOTAL DISSOLVED SOLIDS	
		*litres/sec	Method of test	milligrammes/litre	Analysis No.
			see attached sheet		



DEPTH (m) from	to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE	CASING	WATER CUT	WATER LEVEL
0	0·5	ARENITE-RUDITE. Subrounded to rounded quartz, colourless, silt size to 1cm. Minor angular quartzite fragments, siltite and brown lutite. Road Fill.					
0·5	1	ARENITE Quartz, colourless, often pink and brown stained, silt size to 1·5mm. Rare angular quartz fragments to 4mm. Common brown ferruginous sandstone, grains, rounded to subrounded, well cemented, to 4mm. 10% grey to brown mottled silty lutite.					
1	1·2	LUTITE. Grey/brown and black, friable 25-50% fine siltite. 10% quartzite siltite - arenite to 0·8mm, colourless with minor red/brown staining, rounded.					
1·2	5	LUTITE Yellow/brown and black. Minor quartz siltite - arenite as above, some subangular. Minor well cemented red and brown sandstone fragments to 4mm. Colour grades to brown at 5m.					
5	9	LUTITE White and fawn. Minor quartz arenite, silt size to 0·5mm, colourless, rounded. Rare well cemented, irregular, brown sandstone fragments to 4mm. 5-7m. Rare subangular to subrounded rock fragments to 2cm.					
9	10	SILTITE Colourless quartz, with 5% fine white mica to 1mm.					
10	10·5	LUTITE White with common fine white mica, minor fine siltite.					
10·5	12	SILTITE Colourless fine quartz with 5% fine white mica to 1mm.					
12	16	ARENITE Quartz, silt size to 1mm, most 0·2-0·5mm, rarely to 0·8-1mm, subrounded to rounded. Common white mica flakes, very fine to 2mm.					

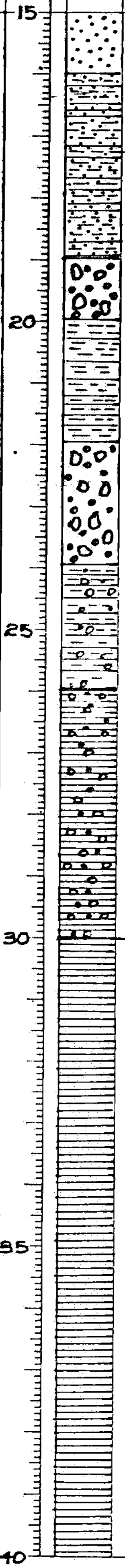
*NOTE: 1·25 litres/sec = 1000 gals/hr.

REMARKS Observation bore KTP14. Completed in basement.

DRILL TYPE	LOGGED BY
CIRCULATION	DATE
START	TRACED BY
FINISH	DATE
SHEET 1 OF 3	DRAWING NO S

DEPARTMENT OF MINES — SOUTH AUSTRALIA

CASING | WATERS CUT | WATER LEVEL | DEPTH (m) | CORE | GRAPHIC LOG | AGE | UNIT



DEPTH (m) from	to	DESCRIPTION
16	19	SILTITE-LUTITE Fawn at least 50% fine brown mica, rarely as 1mm flakes (white) 30% SILTITE - ARENITE, quartz colourless, to 1mm, subrounded to - rounded.
19	20	ARENITE - RUDITE Quartz, silt size to 6mm, most greater than 1mm. Angular to rounded, colourless, brown and blue/grey. Often with fawn fine micaceous siltite / lutite matrix. Common irregular pyritic, well cemented sandstone grains to 1cm.
20	22	LUTITE-SILTITE Mainly brown - fawn, fine white mica with minor-arenite as above. Rare, brown, subangular rock fragments to 1cm and lignitic fragments to 4mm.
22	24	ARENITE - RUDITE As 19-20m.
24	26	LUTITE As 20-22m, with minor arenite - rudite as above and rare pyritic sandstone grains to 4mm.
26	30	SILTITE Grey, fine white mica as above with minor lutite. Up to 50% quartz siltite - rudite, angular to rounded colourless and milky, most less than 1mm minor 1-3mm. Minor pyritic sandstone to 4mm. Common fine, friable black opaques. 28-30% quartz most less than 1mm rarely to 3mm.
30	45	LUTITE Blue green, cleavage in tube samples. Common fine white mica. (Weathered phyllite). Grades to quite hard, fractured phyllite by 45m.

Borehole State No.

Drn

Date

Sheet 2 of 3

Bore Folder No.

DEPARTMENT OF MINES — SOUTH AUSTRALIA

CASING	WATERS CUT	WATER LEVEL	DEPTH (m)	CORE	GRAPHIC LOG	AGE	UNIT	DEPTH (m) from	to	DESCRIPTION
			40							
			45					45	50	PHYLLITE Micaceous fragments, hard and greasy. Minor vein quartz Blue/grey and green.
			50							Total Depth 50m.

Borehole State No.	Drr	Sheet 3 of 3
	Date	Bore Folder No

DEPARTMENT OF MINES — SOUTH AUSTRALIA

SUMMARY OF WATER ANALYSES

KTP 14

Progressive depth of bore (m)	Sampling depth (m)	Water level (m)	Total dissolved solids (Milligrammes/litre)	Analysis W No.	Remarks
8.0	8.0		850	W7192/74	
11.0	11.0		595	W7193/74	
13.0	13.0	6.0	767	W7194/74	
15.0	15.0	6.0	767	W7195/74	
17.0	17.0	6.0	750	W7196/74	
19.0	19.0	6.0	810	W7197/74	Full analysis
21.0	21.0	6.0	755	W7198/74	
23.0	23.0	6.0	690	W7199/74	
25.0	25.0	6.0	720	W7200/74	
27.0	27.0	6.0	700	W7201/74	
29.0	27.0	2.75	951	W7202/74	Full analysis
31.0	29.0	2.75	715	W7203/74	
33.0	31.0	2.75	715	W7204/74	
50.0	45.0	2.75	720	W7205/74	
50.0	45.0	2.75	1005	W7206/74	Full analysis

Borehole State No.

Drn :

Sheet of

Date :

Bore Folder No.

PF Nº S10538 MH

DEPARTMENT OF MINES SOUTH AUSTRALIA

HYDROGEOLOGY SECTION

BORE LOG

HIRER S.A. Dept. of Mines

Drill type Cable Tool
Circulation Water
Driller H. James
Start 4-12-74
Finish 19-3-75

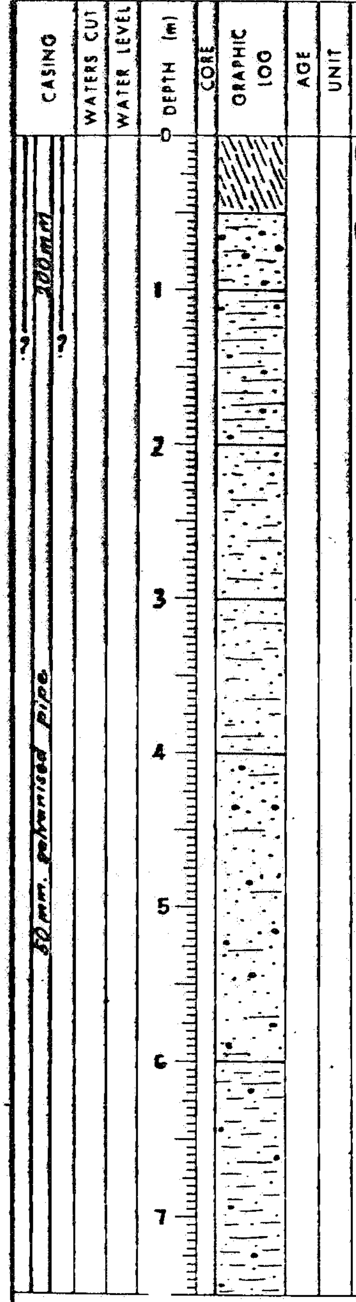
Logged by N.P. Tucker
Date logged 1975
Bore Diameter 200mm
DEPTH 24m

A.M.G. Zone
Coords. E
" N
Datum Elev.
(m) Ref. Pt. Elev.
Surface Elev.

HUNDRED KUITPO
SECTION 854 -
STATE No. 446085402
Project No. QA65 - KTP15
Docket No. 1185/73
Bore Serial No. 134/75

Depth to Water cut (m)	Depth to standing water (m)	SUPPLY		TOTAL DISSOLVED SOLIDS	
		litres/sec.	Method of test	Milligrammes/litre	Analysis W. No
6 6 6 6	1·25 7·30 5·83 1·60	NOT	TESTED	850 Samples discarded in error.	7322/74 7323/74 7324/74 7325/74

REMARKS Completed as Observation bore KTP 15 in quartz sand aquifer in Willunga Basin. Resin bonded sand screen 23-24m.



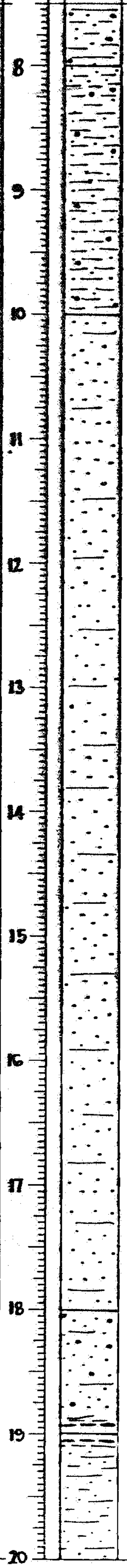
DEPTH (m) from	to	DESCRIPTION
0	0·5	TOPSOIL: angular to rounded colourless to brown quartz grains to 0·5mm. Orange brown.
0·5	1·0	SAND: subangular to well rounded colourless to orange quartz grains from silt size to 0·5mm. Most colourless. Common angular to rounded red black sandstone fragments to 6mm. Rare angular milky to white quartz fragments to 1cm. 20% clay, medium to dark brown.
1·0	2·0	CLAY: Up to 50% subangular to well rounded colourless to orange quartz grains from silt size to 0·5mm. Most grains colourless. Common angular to rounded red black sandstone fragments to 8mm. Dark brown almost black with yellow patches.
2·0	3·0	SAND: subangular to well rounded colourless to orange quartz grains from silt size (0·1mm) to 0·5mm. Common angular to subrounded reddish black siltstone fragments to 5mm. Rare angular to subrounded milky quartz fragments to 5mm. Up to 30% clay. Medium brown.
3·0	4·0	SAND: angular to rounded colourless to orange brown quartz grains from silt size to 1·5mm. Common angular to subrounded orange sandstone fragments to 6mm. Common angular to subrounded milky quartz fragments to 6mm. Common angular to subrounded reddish black ferruginous fragments to 5mm. Up to 20% clay medium brown.
4·0	6·0	SAND: subangular to well rounded colourless to orange quartz grains from silt size to 1mm. Common angular to subrounded white to orange to dark brown sandstone fragments to 1·5cm. Common angular to rounded milky to off white quartz fragments to 1cm. some highly polished. Common angular to rounded reddish ferruginous fragments to 8mm. Up to 20% clay, medium brown.

Drn R.H. Sheet 1 of 3
Date May '76 Bore Folder No 183/

PF No S10537 MH

DEPARTMENT OF MINES — SOUTH AUSTRALIA

CASING | WATERS CUT | WATER LEVEL | DEPTH (m) | CORE | GRAPHIC LOG | AGE | UNIT



DEPTH (m) from	to	DESCRIPTION
6·0	8·0	SILT: common subangular to well rounded colourless to orange quartz grains from silt size to 1mm, most about 1mm. Common angular to subrounded sandstone fragments to 8mm. Up to 20% clay. Off white.
8·0	10·0	SILT: Common angular to well rounded colourless to orange quartz grains to 1mm. Occasional angular to rounded orange to milky quartz fragments to 1·2cm. Up to 50% mottled clay, off white to light brown.
10·0	18·0	SAND: angular to subrounded colourless quartz grains from silt size to 0·5mm. 10% clay, light brown. 16-18m. most grains 0·2mm. 20% clay.
18·0	19·0	SAND: angular to rounded colourless to milky quartz grains from silt size to 2mm. mostly >1mm. Common angular milky to dark grey sandstone fragments to 6mm. 20% clay, grey brown to black.
19·0		LIGNITE: up to 50% clay and fine sand.
19·0	21·0	CLAY: up to 25% angular to rounded colourless quartz silt. Common angular to subangular colourless quartz grains to 5mm. Off white to grey brown.

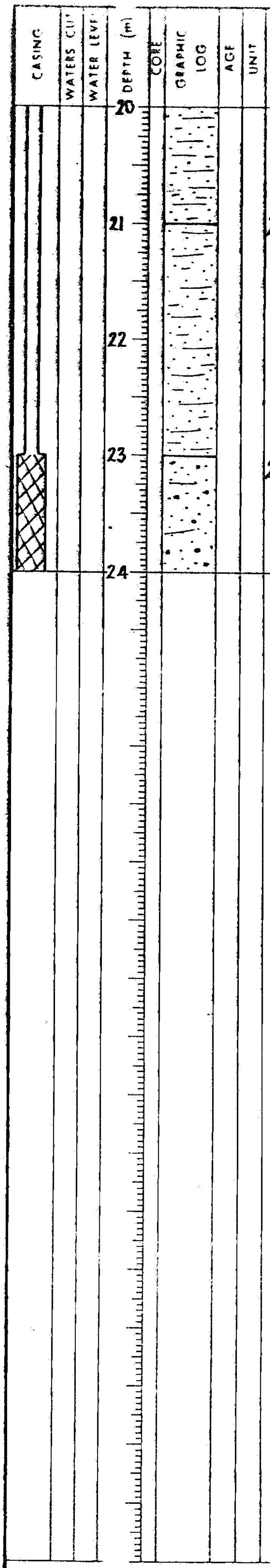
Borehole State No. 446085402

Drr R.N. | Sheet 2 of 3

Date May '76 | Bore Folder No 183/-

PE Nº 510537a MH

DEPARTMENT OF MINES — SOUTH AUSTRALIA



DEPTH (m) from	to	DESCRIPTION
21·0	23·0	CLAY: common angular to rounded colourless quartz silt. Rare angular black hard lignitic fragments to 1cm. Grey black.
23·0	24·0	SAND: angular to rounded colourless quartz grains from silt size to 1mm. Common angular to subangular milky to grey brown sandstone fragments to 8mm. Common angular to subangular milky quartz fragments to 5mm. Ocassional angular pyritic fragments interbedded with milky quartz fragments to 3cm. 10% clay, light brown.
		END OF HOLE 24m.

Borehole State No. 446085402

R.H.

Sheet 3 of 3

Date May '76

Bore Folder No 183/-

PF Nº 510537a MH

APPENDIX B

WIRELINE GEOPHYSICAL LOGGING DETAILS AND COMMENTS

WIRELINE GEOPHYSICAL LOGGING DETAILS

Well No.	Log type	Interval (m)
WLG1	Gamma ray	1-108
	Neutron	39-107
WLG5	Gamma ray	0-83
	Neutron	45-82
WLG6	Gamma ray	0-18
	Neutron	1-18
WLG8	Gamma ray	0-16
	Neutron	2-16
WLG9	Gamma ray	0-27
	Neutron	12-27
WLG10	Gamma ray	0-125
	Neutron	32-124
WLG12	Gamma ray	0-44
WLG13	Gamma ray	0-80
	Neutron	71-80
WLG15	Gamma ray	0-55
	Neutron	40-54
WLG18	Gamma ray	0-113
	Neutron	39-112
WLG21	Gamma ray	2-36
	Neutron	14-36
WLG23	Gamma ray	1-22
	Neutron	10-22
WLG24	Gamma ray	1-44
	Neutron	20-44
WLG37	Gamma ray	0-124
	Neutron	8-124
WLG38	Gamma ray	0-308
	Neutron	8-308
	Self potential	256-308
	Resistivity	256-308
	Temperature	0-308
WLG40	Gamma ray	0-339
	Neutron	21-338
	Self potential	202-338
	Resistivity	202-338
	16 inch Normal	196-339
	64 inch Normal	198-335
	6 foot Lateral	199-339
WLG41	Gamma ray	0-16
	Neutron	4-16
WLG42	Gamma ray	0-135
	Neutron	31-135
	Self potential	2-163
	Resistivity	1-163
	Temperature	1-163
	6 foot Lateral	2-163
WLG43	Gamma ray	0-183
	Neutron	23-179

Well No.	Log type	Interval (m)
WLG44	Gamma ray	0-308
	Neutron	39-66
KTP1	Gamma ray	0-17
	Neutron	2-16
KTP5	Gamma ray	0-48
	Neutron	16-48
KTP15	Gamma ray	0-9
Hd. Willunga	Gamma ray	1-50
Sec 144, bore 02	Neutron	29-50
Sec 242 bore 01	Gamma ray	0-44
	Neutron	10-44
Sec 246 bore 01	Gamma ray	0-20
Sec 454 bore 01	Gamma ray	0-53
	Neutron	0-48
Sec 459 bore 01	Gamma ray	0-105
	Neutron	34-105
Hd. Kuitpo	Gamma ray	1-22
Sec 197, bore 02	Nuetron	14-22

Most of the investigation wells in the Willunga Basin were drilled by means of a cable tool drilling plant. This method requires that casing be driven closely behind the bit and the well is therefore fully cased (or nearly so) when total depth is reached.

In some cases, casing was withdrawn from the well to enable a complete suite of wireline geophysical logs to be run in it, since electrical resistivity logs cannot be obtained inside casing. Unfortunately, the withdrawal of casing resulted in collapse of the wells thereby preventing the geophysical logging of much or most of the section penetrated.

If a full complement of wireline logs are required, it is better that an investigation well be drilled by means of a rotary plant and the walls of the well be supported by means of drilling mud. However, the cable tool method enables good water samples to be obtained from all aquifers penetrated whereas the rotary method does not.

One alternative is to drill an investigation well by the cable tool method, fill it with mud, withdraw the casing and run a complete set of wireline logs. By this process, good water sampling of all aquifers and comprehensive wireline logging can be achieved. However, this method can be time consuming and expensive, and there is no guarantee that the drilling mud will support the walls of the well when the casing is withdrawn.

The geophysical well logging programme carried out since the investigation began, was performed by various operators using a variety of logging equipment. This practive tends to lead to geophysical response curves of varying character in similar strata in similar localities.

For these reasons, it is recommended that future investigation wells be drilled by means of cable tool rigs where possible. Nuclear wireline logs only should be run because it is considered that water sampling is more important than obtaining electrical resistivity logs in determining the nature of aquifers. In addition, it is recommended that in a groundwater investigation of this nature, the same operator, using the same equipment should be employed where ever possible.

For the requirements of computer modelling, it is more important that nuclear logs of the entire section be obtained rather than a full set of logs for only part of the section. Nuclear logs will allow an aggregate thickness of aquifers to be determined over the sedimentary section penetrated.

WELL No	SAMPLE DEPTH (metres)	AQUIFER	CONDUCTIVITY micro-s/cm at 25°C	TOTAL DISSOLVED SOLIDS (calc as HCO·=CO₃)	Ca mg/l	Ca me/l	Mg mg/l	Mg me/l	Na mg/l	Na me/l	K mg/l	K me/l	HCO_3 mg/l	HCO_3 me/l	SO_4 mg/l	SO_4 me/l	Cl mg/l	Cl me/l	NO_3 mg/l	NO_3 me/l	CATIONS me/l	ANIONS me/l	TOTAL HARDNESS AS $CaCO_3$	CARBONATE HARDNESS AS $CaCO_3$	NON-CARBONATE HARDNESS AS $CaCO_3$	ALKALINITY AS $CaCO_3$	REACTION pH	Na TO TOTAL CATION RATIO(%)	ANALYSIS W No
WLG 23	39.0	N Mas Sds	1644	774	56	28	38	3	188	8.2	5	0.1	203	3.3	49	1.0	1337	9.5	<1	0	14.2	13.9	296	167	129	167	7.5	57.5	2406/74
WLG 24	23.5	Basement	7059	4309	168	8.4	164	13.5	1230	53.5	18	0.5	769	12.6	246	5.1	2103	59.3	20	0	75.8	77.1	1094	631	463	631	7.2	70.6	4200/74
WLG 37	31.0	Quaternary	925	491	41	2.0	27	2.2	106	4.6	3	0.1	134	2.2	41	0.9	205	5.8	20	0	9.0	8.9	213	109	104	109	7.4	51.5	4043/74
	48.0	Blanche Pt Fm	1753	1018	102	5.1	42	3.5	218	9.5	10	0.3	417	6.8	126	2.6	315	2.9	<1	0	18.3	18.3	428	242	85	342	7.8	51.9	4293/74
	70.0	"	2973	1681	170	8.5	74	6.1	331	14.4	18	0.5	497	8.2	205	4.3	638	18.0	<1	0	29.4	30.4	729	408	321	408	7.5	48.9	4639/74
	81.0	"	-	1671	157	7.8	77	6.3	338	14.7	18	-	414	6.8	209	4.4	668	18.8	<1	0	29.3	30.0	705	339	370	339	7.3	50.1	4644/74
	91.0	S Mas Sds	3030	1719	167	8.5	76	-	353	15.4	-	-	467	7.6	214	4.5	664	18.7	<1	0	30.4	30.7	730	378	382	378	7.4	50.5	4649/74
	101.0	N " "	3042	1782	157	7.8	75	6.2	375	16.3	16	0.4	387	6.3	305	6.3	-	-	<1	0	30.7	31.4	701	317	383	317	7.6	53.1	4654/74
	111.0	"	3030	1794	153	7.6	78	6.4	370	16.1	18	0.5	411	6.7	333	6.9	640	18.0	<1	0	30.6	31.7	703	337	366	337	7.3	52.6	4870/74
	127.0	Basement	3177	1863	176	8.8	84	6.9	375	16.3	-	-	434	7.1	328	6.8	669	18.9	<1	0	32.5	32.8	785	356	429	356	7.2	50.2	4873/74
WLG 38	10.2	Quaternary	15174	9453	153	7.6	529	43.5	2680	116.6	31	0.8	596	9.8	579	12.1	5187	146.3	1.0	0	168.5	168.1	2559	489	2070	489	7.4	69.2	550/74
	34.0	"	5622	3221	20	1.0	28	23	1218	53.0	18	0.5	473	7.7	86	1.8	1589	44.8	<1	0	56.7	55.3	165	165	5	388	8.5	93.4	556/74
	49.0	Pt Will Fmn	2930	1654	100	5.0	82	6.7	410	17.8	10	0.3	500	8.2	82	1.7	724	20.4	<1	0	29.8	30.3	587	410	177	410	7.5	59.8	588/74
	53.0	"	3188	1815	109	5.4	92	7.6	462	20.1	11	-	489	8.0	81	1.7	819	23.1	1.0	0	33.4	32.8	651	401	250	401	7.6	60.2	697/74
	63.0	"	4193	2421	119	5.9	136	11.2	615	26.8	14	0.4	473	7.7	120	2.5	1184	33.4	<1	0	44.2	43.6	857	388	469	386	7.9	60.5	702/74
	69.0	"	4674	2717	124	6.2	152	12.5	699	30.4	15	-	451	7.4	143	3.0	1363	38.4	<1	0	49.5	48.8	935	370	677	370	7.6	61.5	767/74
	79.0	"	4000	2288	120	6.0	128	10.5	555	24.1	13	0.3	478	7.8	121	2.5	1115	31.5	<1	0	41.0	41.8	826	392	434	392	7.5	58.9	810/74
	103	"	35658	24956	757	37.8	744	61.2	7500	326.2	163	4.2	341	5.6	703	14.6	14921	420.8	<1	0	429.4	441.0	4952	272	4672	279	7.4	76.0	1166/74
	117	"	37366	25902	517	25.8	638	52.5	8400	365.4	188	4.8	360	5.9	762	15.9	15220	429.2	<1	0	448.5	451.0	3916	295	3621	295	7.2	81.5	1173/74
	129	"	83433	48485	972	48.5	1099	90.4	15900	691.7	357	9.1	242	4.0	1416	29.5	28623	807.2	<1	0	839.7	840.6	6949	198	6751	198	7.0	82.4	1329/74
	139	"	76616	43961	862	43	942	77.5	14450	628.6	357	9.1	302	5.0	1199	25	26002	733.3	<1	0	758.2	763.2	6029	248	5781	248	6.9	82.9	1334/74
	151	"	89495	69128	1296	64.7	1452	119.4	22550	980.9	592	15.1	-	-	1777	37	41312	1165	<1	0	1180.2	1207	9211	-	8963	-	6.8	83.1	1340/74
	163	"	too high	85511	1629	81.3	1744	143.4	28050	1220.2	750	19.2	297	4.9	2164	45	51028	1439	<1	0	1464.1	1488.9	11244	243	11001	243	6.6	83.3	1346/74
	175	"	-	190082	1677	83.7	1856	152.6	29700	1291.9	775	19.8	275	4.5	2118	44.1	53820	1517.7	<1	0	1548.1	1566.3	11825	225	11600	225	6.4	83.5	1352/74
	189	"	113674	92489	1614	80.5	1929	158.6	30300	1318.1	790	20.2	247	4.1	3076	64	54649	1541.4	<1	0	1577.4	1609.5	11968	203	11765	203	6.7	83.6	1465/74
	199.4	Blanche Pt Fm	178800	127273	2340	116.8	2560	210.5	41700	1814	1020	26.1	187	3.1	3178	66.2	76384	2154	<1	0	2167.3	2223.2	16377	153	16224	153	6.9	83.7	1965/74
	300	N Mas Sds	58041	136795	4750	237	1515	124.6	45000	1957.5	1125	28.3	27	0.4	3332	69.4	81023	2284.8	30	0.5	2347.9	2355.4	18095	22	18073	33	8.5	83.4	3018/74
WLG 40	34	Pt Will Fmn	5817	3535	177	8.8	148	12.2	970	42.2	16	0.4	407	6.7	205	4.3	1814	51.2	4.0	0.1	63.6	62.2	1051	334	717	334	7.6	66.3	948/75
	44	"	5711	3475	175	8.7	146	12	967	42.1	15	0.4	401	6.6	196	4.1	1774	50	5	0.1	63.2	60.8	1038	328	709	328	7.4	66.6	953/75
	54	"	3979	2381	110	5.5	111	9.1	655	28.5	17	0.4	401	6.6	104	2.2	1184	33.4	3	0.1	43.5	42.2	731	328	403	-	7.7	65.4	1088/75
	64	"	5968	3773	172	8.6	146	12	1045	45.5	21	0.5	347	5.7	219	4.6	1996	56.3	3	-	66.6	66.6	1080	285	746	285	7.5	68.3	1093/75
	74	"	8932	5169	262	13.1	208	17.1	1360	59.2	30	0.8	334	5.5	290	6	2853	80.4	2	0	90.1	92	1510	274	1236	274	7.3	65.7	1258/75
WLG 41	20	Blanche Pt Fm	2673	1270	70	3.5	53	4.4	328	14.3	7.0	0.2	157	2.6	123	2.6	592	16.7	20	0.3	22.3	22.1	393	129	264	129	7.6	64	645/75
	30	S Mas Sds	2328	1220	66	3.3	48	3.9	325	14.1	7	-	-	-	101	2.1	580	16.3	16	-	21.6	21.3	362	-	234	-	7.7	65.6	650/75
	40	"	1910	986	48	2.4	36	3	471	11.8	6	-	267	4.4	120	2.5	373	10.5	1	0	17.3	17.4	266	219	49	219	7.6	68.2	660/75
	50	"	1968	989	50	2.5	33	2.7	279	12.1	6	-	180	3	84	1.6	444	12.5	4	0.1	17.5	17.3	261	148	113	148	7.5	69.4	655/75
	60	Basement	1875	985	45	2.2	34	2.8	-	-	7	-	240	3.9	131	2.7	370	10.4	<1	0	17.4	17.1	252	197	55	197	7.2	69.9	574/75
	77	"	2299	1281	71	3.5	52	4.3	326	14.2	12	-	270	4.4	221	4.6	466	13.1	<1	0	22.3	22.2	391	222	170	222	7.1	63.6	579/75
	87	"	2353	1300	72	3.6	53	4.4	331	14.4	14	0.4	277	4.5	217	4.5	476	13.4	<1	0	22.7	22.5	396	227	171	227	7.5	63.4	534/75
WLG 43	38	Blanche Pt Fm	957	438	21	1	15	1.2	122	5.3	5	0.1	57	0.9	8	0.2	286	6.7	3	0.1	7.7	7.8	114	47	68	47	6.1	68.8	5996/74
	48	"	985	461	24	1.2	19	1.6	123	5.4	4	-	80	1.3	6	0.1	242	6.8	4	0.1	8.2	8.3	138	66	72	66	6.4	65.1	5992/74
	58	"	865	415	20	1	17	1.4	113	4.9	3	-	130	2.1	14	0.3	184	5.2	<1	0	7.4	7.6	120	107	13	107	7.1	66.5	6009/74
	68	"	913	430	22	1.1	18	1.5	115	5.0	3	-	100	1.6	11	0.2	211	6	1	0	7.7	7.8	129	22	47	82	6.3	65.3	6006/74
	78	N Mas Sds	933	446	23	-	20	1.6	118	5.1	4	-	140	2.3	16	0.3	196	5.5	<1	0	8	8.2	140	115	25	115	6.5	63.9	6013/74
	88	"	1120	565	41	2	38	3.1	124	5.6	5	-	267	4.4	38	0.8	187	5.3	<1	0	10.7	10.5	259	219	40	219	7.1	50.4	6084/74
	98	Permian	1168	606	50	2.5	46	3.8	118	5.1	4	-	334	5.5	35	0.7	189	5.8	<1	0	11.5	11.5	314	274	40	274	7.3	44.6	6089/74
	108.8	"	1312	674	65	3.2	62	5.1	110	4.8	5	-	457	7.5	30	0.6	177	5	<1	0	13.3	13.1	417	375	43	375	7.5	36.1	6394/74
	118	"	1347	706	69	3.4	69	5.7	106	4.6	6	0.2	514	8.4	-	-	173	4.9	<1	0	13.9	13.9	456	421	35	421	-	33.2	6397/74
	128	"	1500	644	55	2.7	52	4.3	121	5.3	6	-	334	5.5	46	1.0	200	5.6	<1	0	12.4	12	35	274	78	274	7.6	42.3	6919/74
WLG 44	50	Blanche Pt Fm	18713	12245	294	14.7	182	15	3913	170.2	53	1.4	332	5.4	1618	33.7	6020	169.8	2	0	201.2	208.9	1483	273	121	273	-	84.6	4427/76
	60	S Mas Sds	13521	10632	330	16.5	219	18	3250	141.4	44	1.1	430	7.1	1468	30.6	5010	141.3	99	1.6	177	180.5	1725	353	1373	353	7.4	79.9	4432/76
	70	"	8590	4802	183	9.1	119	9.8	1400	60.9	23	0.6	478	7.8	597	12.4	2244	63.3	2	0	80.4	83.6	947	392	555	392	7.7	75.7	4437/76
	79	"	6042	334	120	6	82	6.7	1000	43.5	18	0.5	450	7.4	359	7.5	1537	43.4	3	0.1	56.7	58.3	637	369	268	369	7.6	76.7	4442/76
	90	"	4512	238	96	4.8	60	4.9	695	30.2	16	0.4	458	7.5	267	5.6	1020	28.8	2	0	40.4	41.9	467	376	111	376	7.6	74.9	4447/76
	100	"	3498	2163	84	4.2	55	4.5	655	28.5	14	-	444	7.3	240	5	894	25.2	3	0	37.6	37.5	436	364	72	364	7.7	75.8	4452/76
	105	Basement	3800	2332	99	4.9	64	5.3	687	29.9	17	-	461	7.6	243	5.1	99	27.9	4	0.1	406	40.6	511	378	133	378	7.8	73.7	4456/76
KTP 14	19		1490	705	68	3.4	53	4.4	125	5.4	4	0.1	207	3.4	51	1.1	302	8.5	<1	0	13.3	13	388	170	218	170	7.5	40.9	7197/74
	29		1524	782	62	3.1	48	3.9	166	7.2	6	0.2	334	5.5	53	-	282	8	<1	0	14.4	14.5	352	274	79	274	7.2	50.1	7202/74
	50		1589	856	45	2.2	40	3.3	220	9.6	6	-	294	4.6	124	2.6	274	7.7	<1	0	15.3	15.1	277	24	36	24	7.4	62.5	7206/74

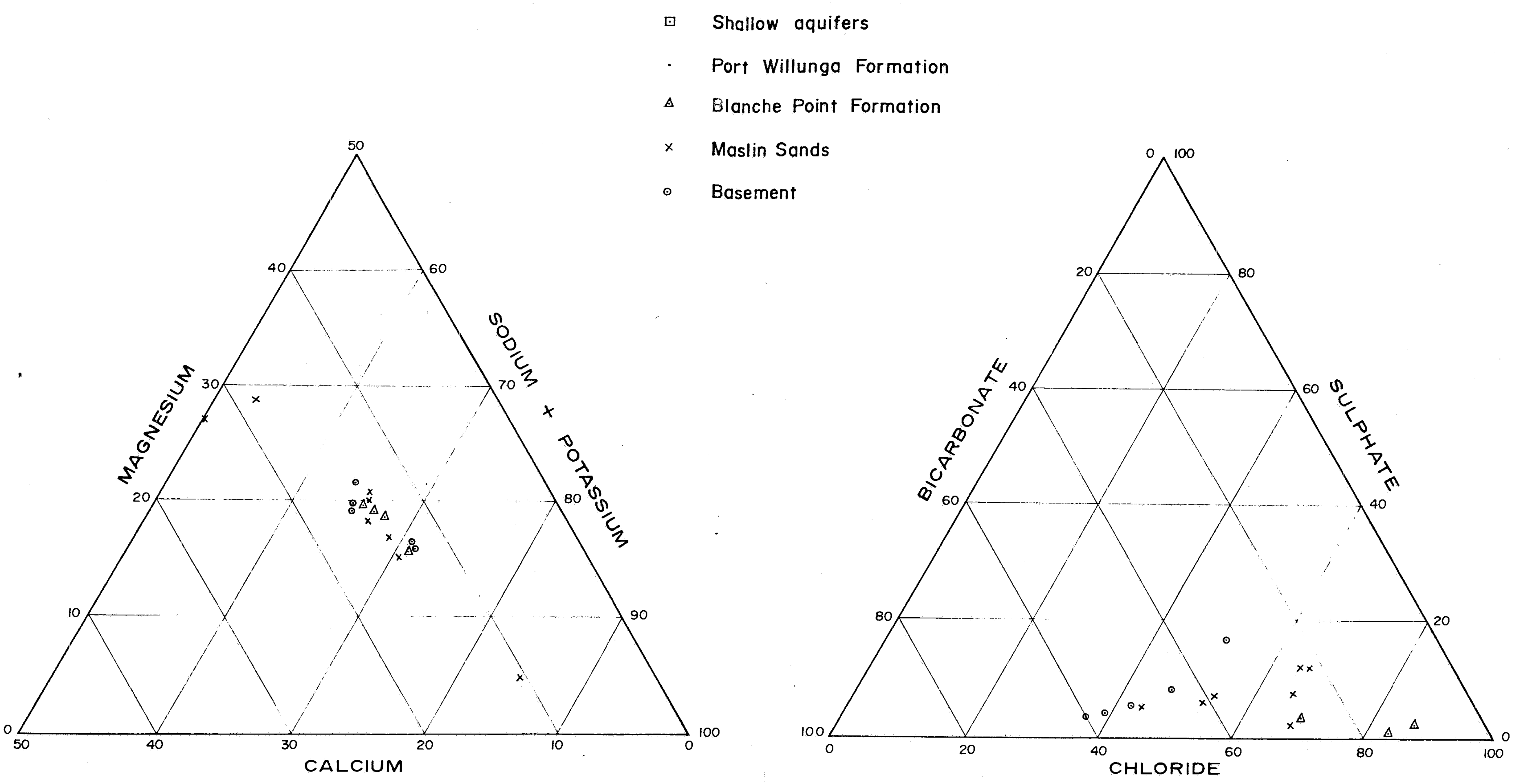
DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

COMP: JWB

WILLUNGA BASIN GROUNDWATER INVESTIGATION

WATER ANALYSES SUMMARY

78 – 783



Appendix C

FIG. 1

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

COMPILED J Bowering

DRN M.H.R. CKD

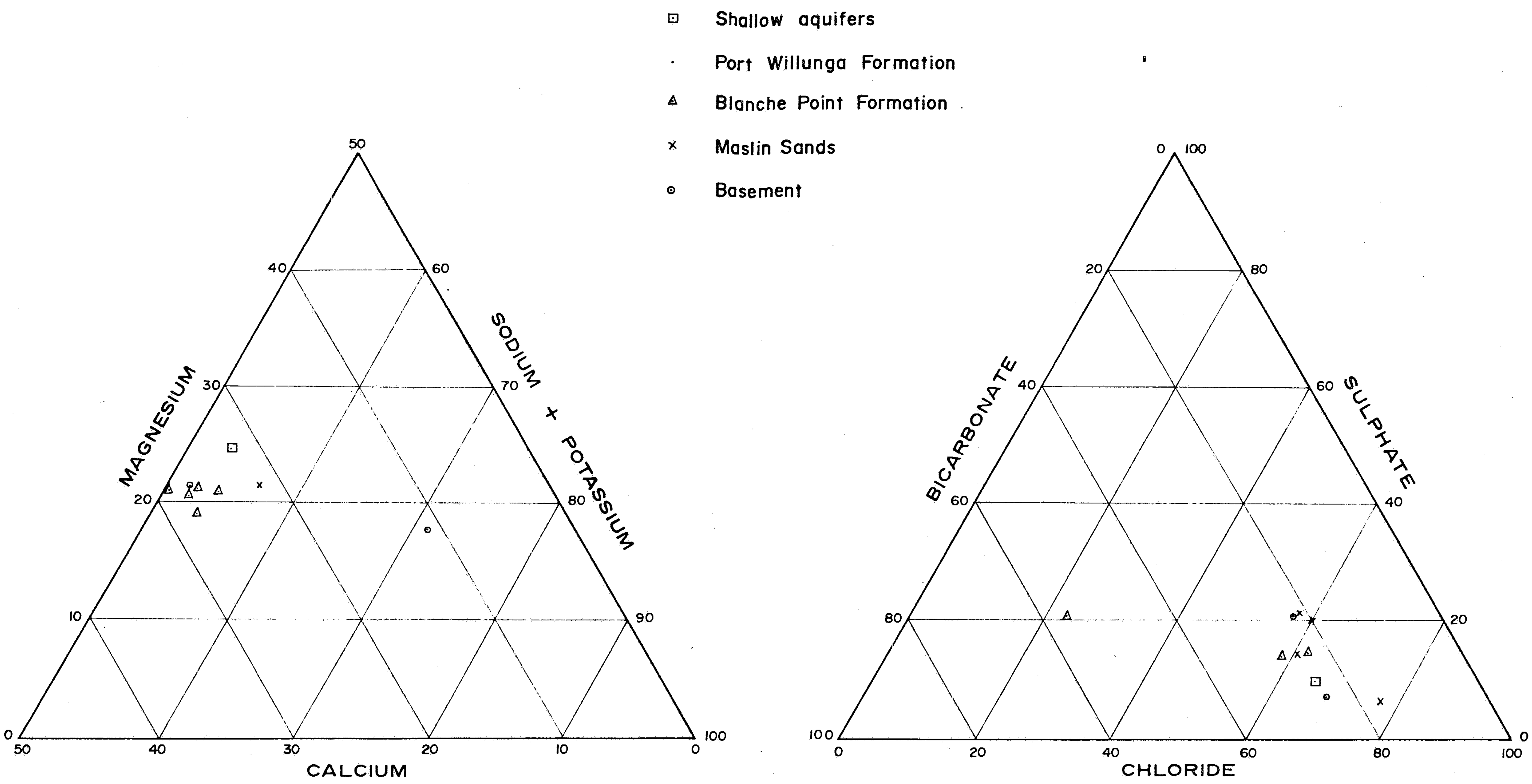
WILLUNGA BASIN GROUNDWATER INVESTIGATION

GROUNDWATER CHEMICAL ANALYSES
WELLS WLG. 41, 43 & KTP 14

SCALE —

DATE NOV. 1978

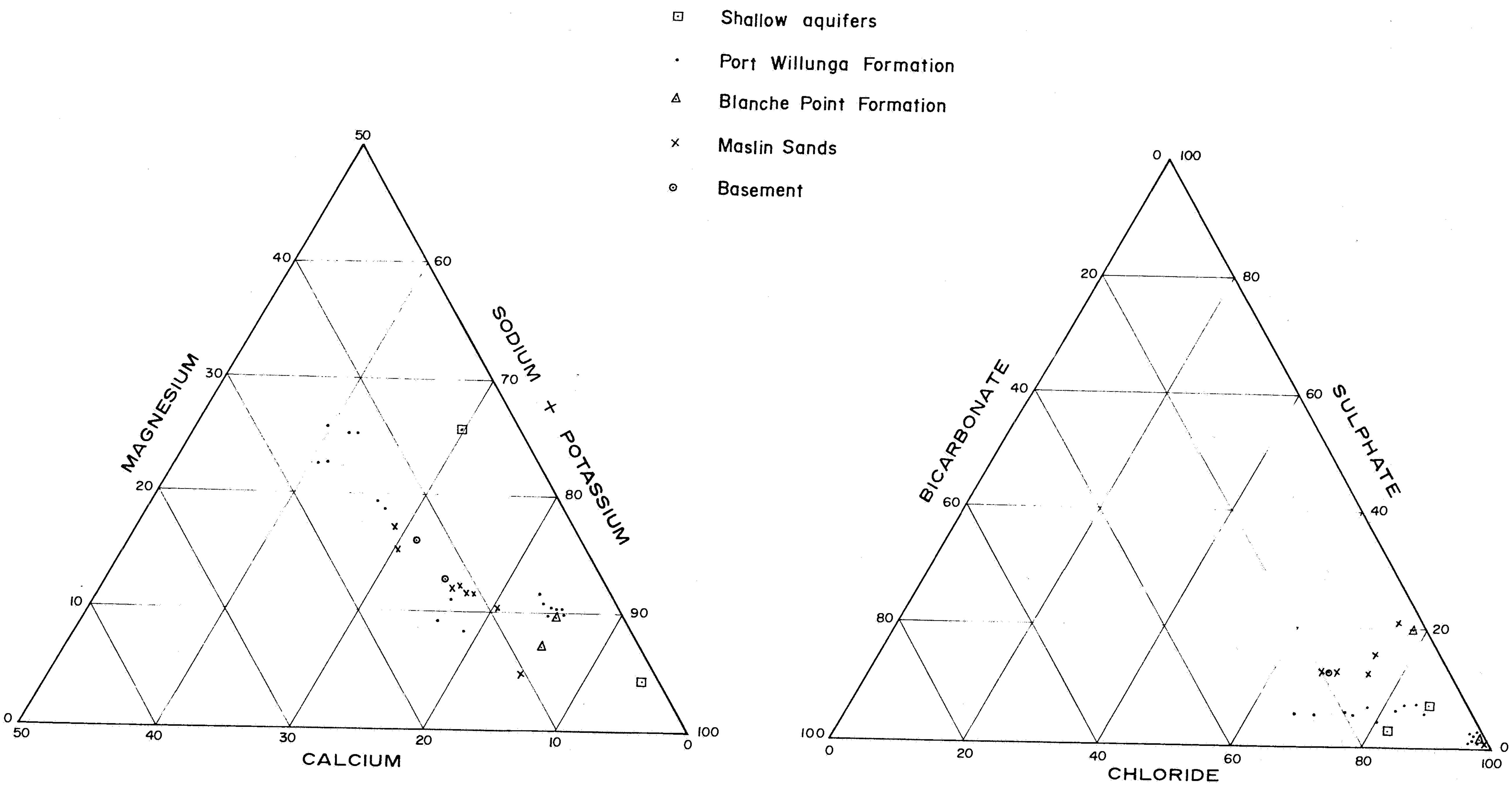
PLAN NUMBER 78-881



Appendix C

FIG. 2

	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE —	
COMPILED J Bowering	WILLUNGA BASIN GROUNDWATER INVESTIGATION	DATE NOV 1978	
DRN M.H.R.	CKD	GROUNDWATER CHEMICAL ANALYSES WELLS WLG. 23, 24 & 27	PLAN NUMBER 78 - 882



Appendix C FIG. 3

	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE —
COMPILED J. Bowering	WILLUNGA BASIN GROUNDWATER INVESTIGATION	DATE NOV 1978
DRN M.H.R. CKD	GROUNDWATER CHEMICAL ANALYSES WELLS WLG. 38, 40 & 44	PLAN NUMBER 78 - 883

APPENDIX D

WATER BALANCE DETERMINATION

APPENDIX D

WATER BALANCE DETERMINATION

1. Inflow

In determining the inflow component of the water balance equation, no distinction was made between water which entered the Willunga Basin by means of surface runoff and that which entered it by means of groundwater underflow, since both are derived from rainfall on the catchment areas.

To calculate the volume of water available for runoff or infiltration into the basin, the rainfall on each of the catchment areas, shown on figure 22, was determined by means of the isohyets from the Meteorological Bureau rainfall maps.

For catchment areas 1 to 5, the monthly rainfall distribution was based upon that at the Willunga weather station. For those catchments above Kangarilla, the distribution of rainfalls at the Meadows weather station was used. Rainfall exceeds potential evapotranspiration during the months of May, June, July and August.

The table below is of the monthly evapotranspiration figures for the Willunga Basin, based upon CSIRO evapotranspiration loss studies on irrigated pasture near Murray Bridge.

Month	Monthly Potential ENT (mm)
January	174
February	137
March	114
April	57
May	33
June	27
July	29
August	57
September	97
October	118
November	140
December	160

From the excess of rainfall over potential evapotranspiration, there must be subtracted the antecedent soil moisture deficit which must be overcome before recharge to the water table can occur. For the scarp face catchments (areas 1, 2, 3 and 4 on Figure 22) a soil moisture deficit of 130 mm, was used. For the plains area and the Baker Gully catchment a figure of 150 mm was used because of the shallower gradients and more sandy nature of the soils.

The results showed that there is no surplus over much of the flat plains area (area 8) during years of average rainfall. However, during wet years some recharge will occur and the inflow component, based upon average figures will tend to err slightly on the low side.

2. Change in Storage

Water level hydrographs are available for nine wells in the Willunga Basin, at seven different localities. The area of the basin was divided into seven areas by means of the "Theissen polygon" method. The water level fluctuations at the seven localities are assumed to be representative of the respective areas.

In the absence of storage coefficient data, approximate values were ascribed, according to the various types and lithologies of aquifers monitored by the respective observation wells. The values used are shown in Table 1 of this appendix.

To determine the actual change in volume of water storage, the equation:

$Vc = s \times S \times A$ is used

where s = the observed nett change in water level over a one year period

S = storage coefficient

A = the representative area

Vc = change in storage

The results are given in megalitres. For example, a change in level of 1 metre within an aquifer with a storage coefficient of 10% will result in a change of water volume of

$$1 \times 0.1 \times 10^6 = 10^5 \text{ m}^3$$

= 100 megalitres per square kilometre of the representative area

TABLE 1

DETERMINATION OF CHANGE IN STORAGE

Well	A(km^2)	S	s(m)	Vc/m^3(m^3)	Vc total (Ml)
WLG23	15	0.05	0	0	0
24	11	0.05	-1	0.05	-550
38	25	10^{-1}	0	0	0
39	25	5×10^{-3}	-2	10^{-2}	-250
40	25	10^{-3}	-1	10^{-3}	-25
41	34	0.15	-1	0.15	-510
42	62	10^{-3}	+1	10^{-3}	+62
KTP14	22	0.1	0	0	0
15	22	0.15	0	0	0
				TOTAL =	1273 Ml

A value of 1300 Ml has been used.

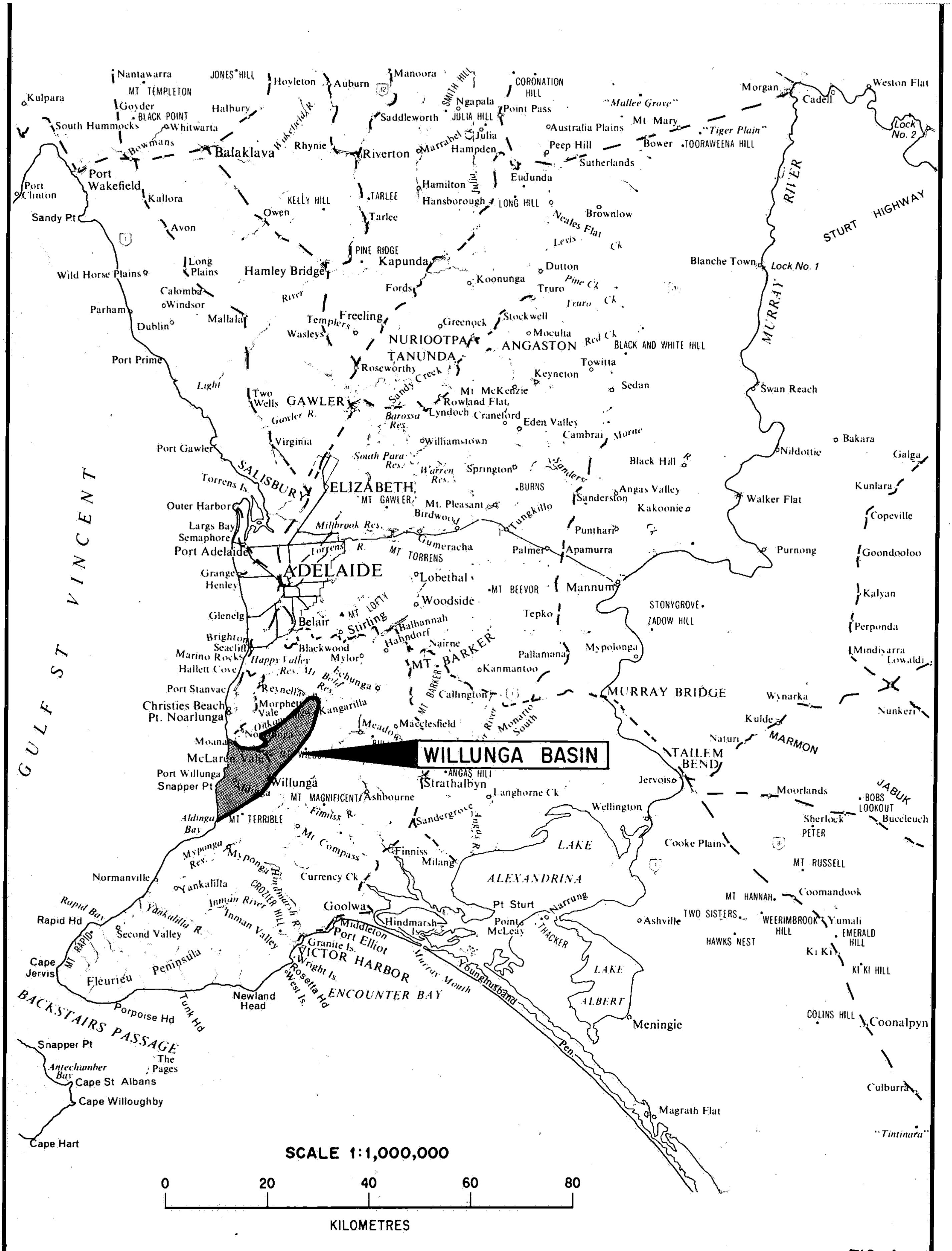


FIG. 1

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

SCALE 1 : 1,000,000

COMPILED J. Bowering

DRN M.H.R. CKD

WILLUNGA BASIN GROUNDWATER INVESTIGATION

LOCALITY PLAN

DATE AUGUST 1978

PLAN NUMBER
S 13696

JOB 919

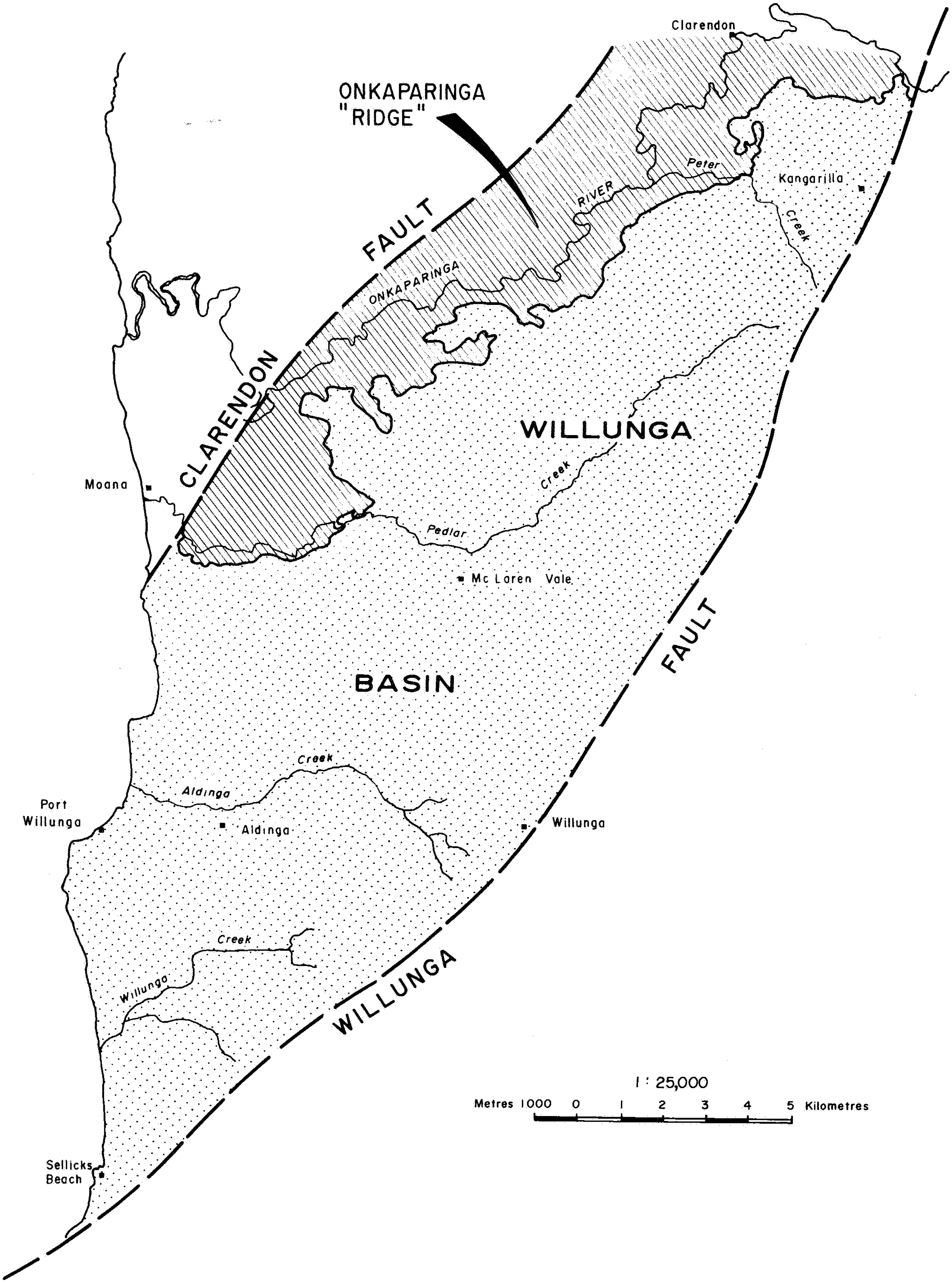


FIG. 2

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

SCALE: 1 : 25,000

COMPILED: J. W. B.

WILLUNGA BASIN GROUNDWATER INVESTIGATION

DATE: AUGUST 1978

DRN: M.H.R. CKD:

PHYSIOGRAPHIC FEATURES

PLAN NUMBER

B 919

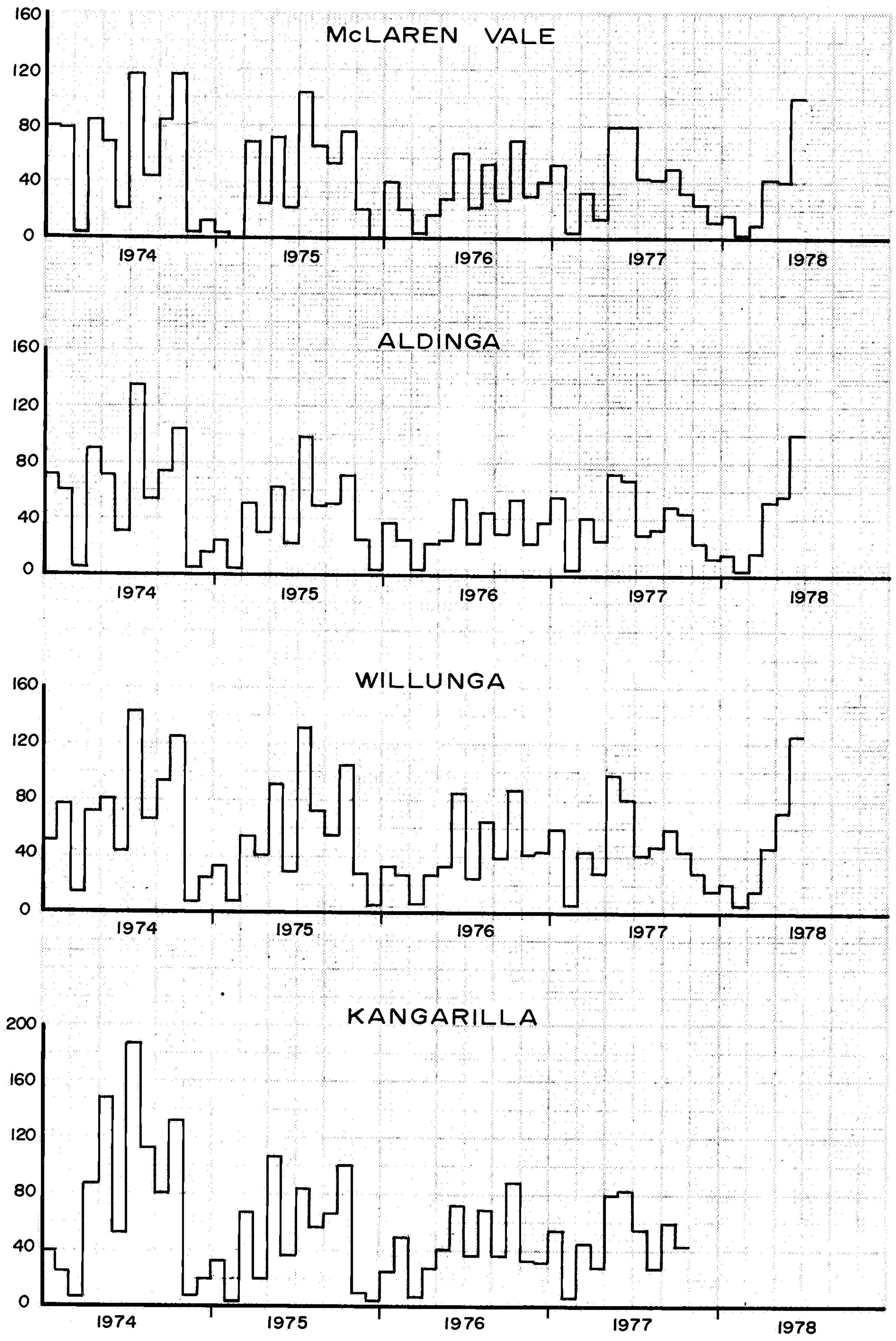


FIG. 3

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

COMPILED J. W. B.
DRN M.H.R. CKD

WILLUNGA BASIN GROUNDWATER INVESTIGATION

MONTHLY RAINFALL HISTOGRAMS

SCALE —
DATE AUGUST 1978
PLAN NUMBER

B 919

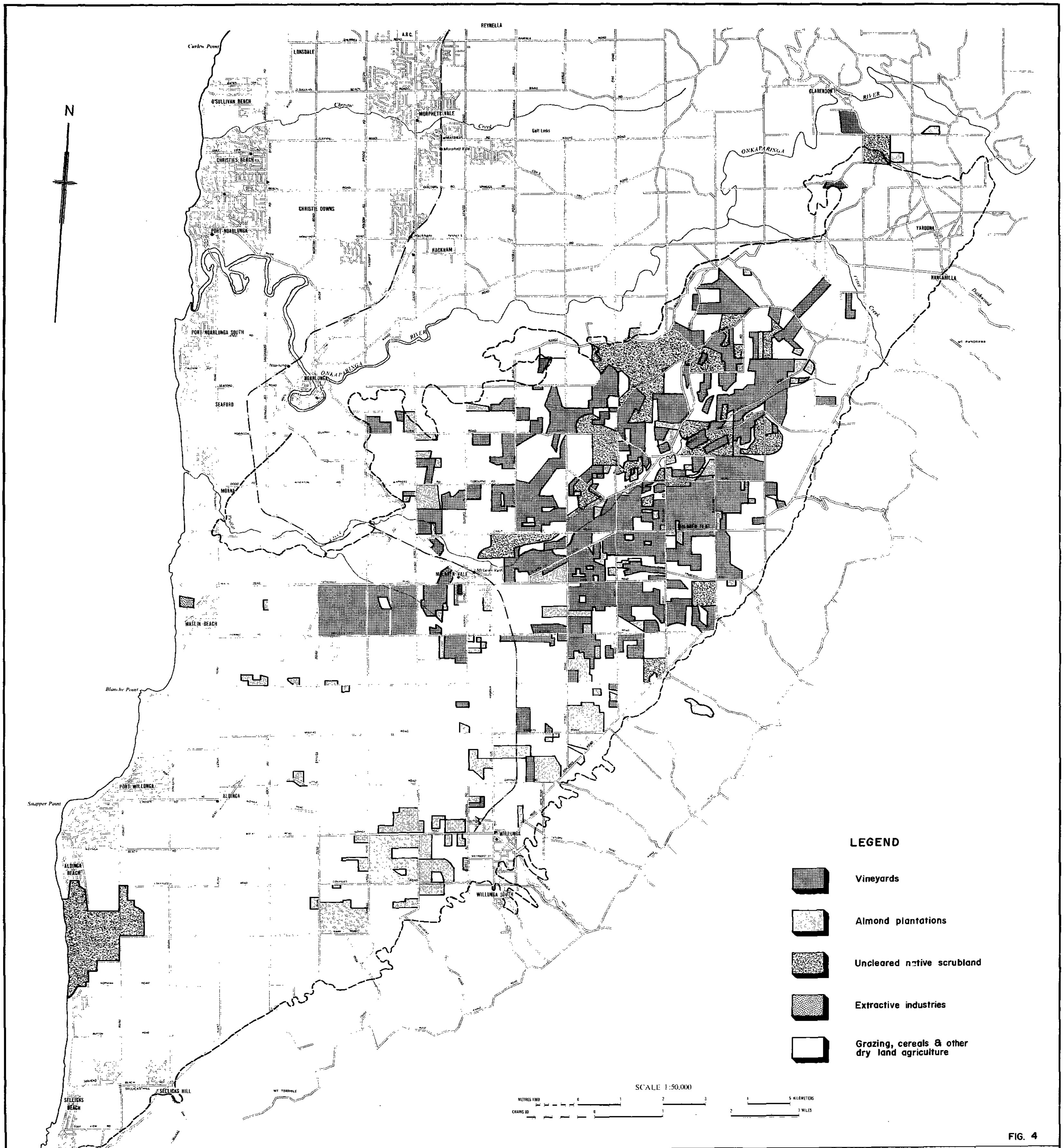


FIG. 4

	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE 1 : 50,000
COMPILED J. W. B.	WILLUNGA BASIN GROUNDWATER INVESTIGATION	DATE AUGUST 1978
DRN M.H.R. CKD	LAND USE – 1958	PLAN NUMBER 78 – 767

JOB 919

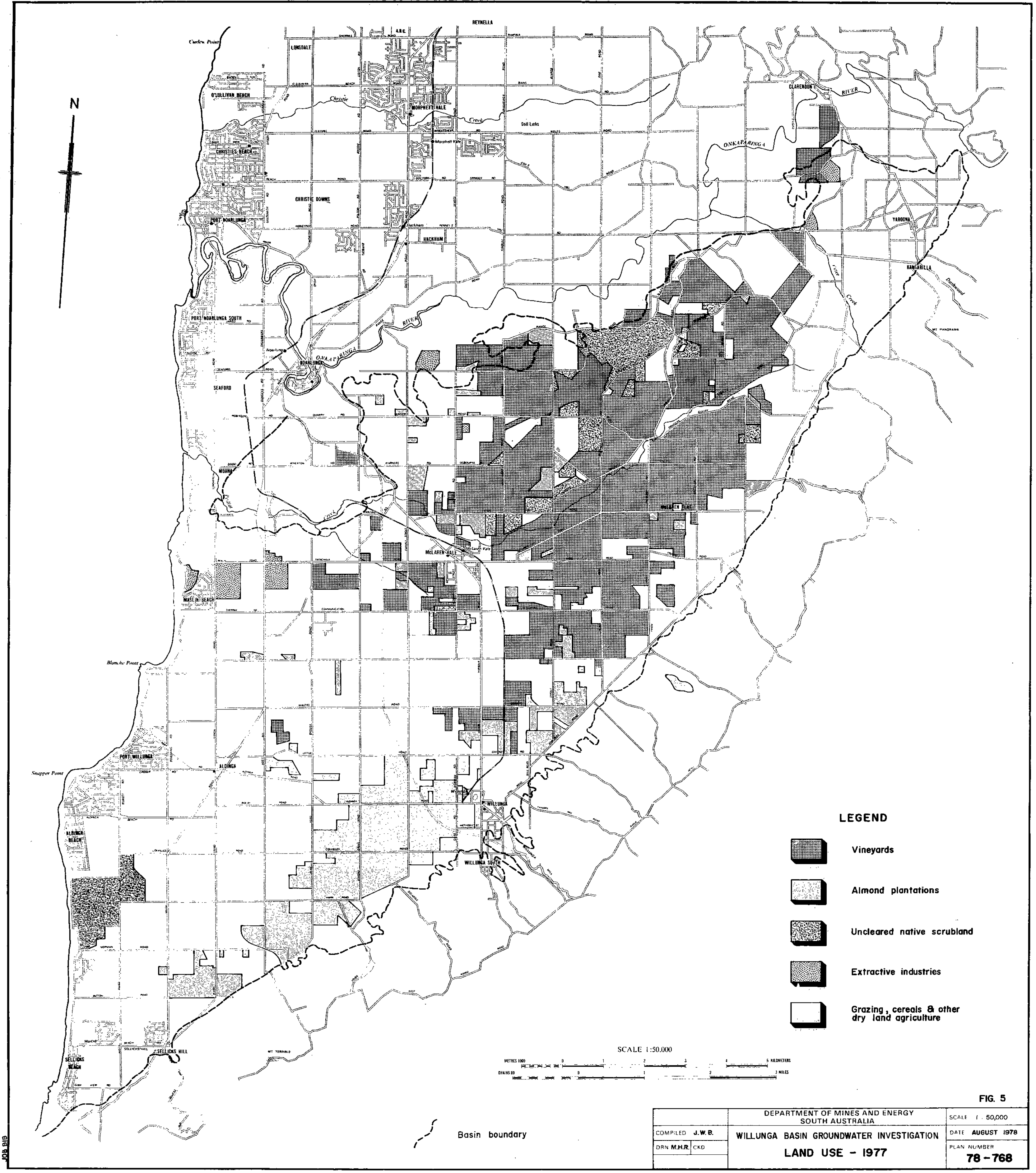
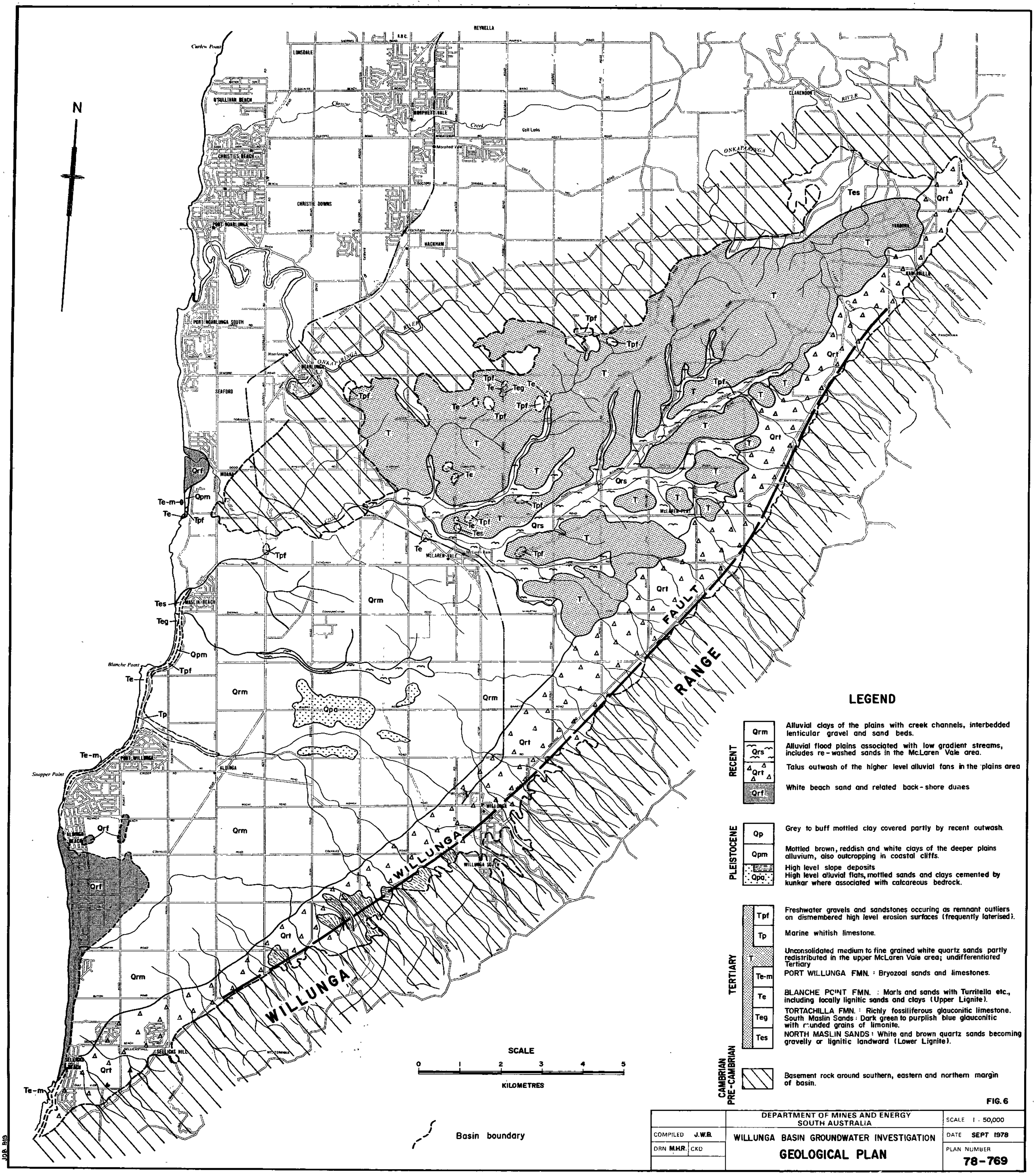


FIG. 5

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

COMPILED J.W.B.	WILLUNGA BASIN GROUNDWATER INVESTIGATION	SCALE 1 : 50,000
DRN M.H.R. CKD	LAND USE - 1977	DATE AUGUST 1978
		PLAN NUMBER 78-768



LEGEND

RECENT	Qrm	Alluvial clays of the plains with creek channels, interbedded lenticular gravel and sand beds.
	Qrs	Alluvial flood plains associated with low gradient streams, includes re-washed sands in the McLaren Vale area.
	Qrt	Talus outwash of the higher level alluvial fans in the plains area
	Qrf	White beach sand and related back-shore dunes
PLEISTOCENE	Qp	Grey to buff mottled clay covered partly by recent outwash.
	Qpm	Mottled brown, reddish and white clays of the deeper plains alluvium, also outcropping in coastal cliffs.
	Qpa	High level slope deposits High level alluvial flats, mottled sands and clays cemented by kunkar where associated with calcareous bedrock.
TERTIARY	Tpf	Freshwater gravels and sandstones occuring as remnant outliers on dismembered high level erosion surfaces (frequently laterised).
	Tp	Marine whitish limestone.
	T	Unconsolidated medium to fine grained white quartz sands partly redistributed in the upper McLaren Vale area; undifferentiated Tertiary
	Te-m	PORT WILLUNGA FMN. : Bryozoal sands and limestones.
	Te	BLANCHE POINT FMN. : Marls and sands with Turritella etc., including locally lignitic sands and clays (Upper Lignite).
	Teg	TORTACHILLA FMN. : Richly fossiliferous glauconitic limestone. South Maslin Sands : Dark green to purplish blue glauconitic with rounded grains of limonite.
	Tes	NORTH MASLIN SANDS : White and brown quartz sands becoming gravelly or lignitic landward (Lower Lignite).
CAMBRIAN PRE-CAMBRIAN	▨	Basement rock around southern, eastern and northern margin of basin.

FIG. 6

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

WILLUNGA BASIN GROUNDWATER INVESTIGATION

GEOLOGICAL PLAN

COMPILED J.W.B.
DRN M.H.R. CKD
SCALE 1 . 50,000
DATE SEPT 1978
PLAN NUMBER
78-769

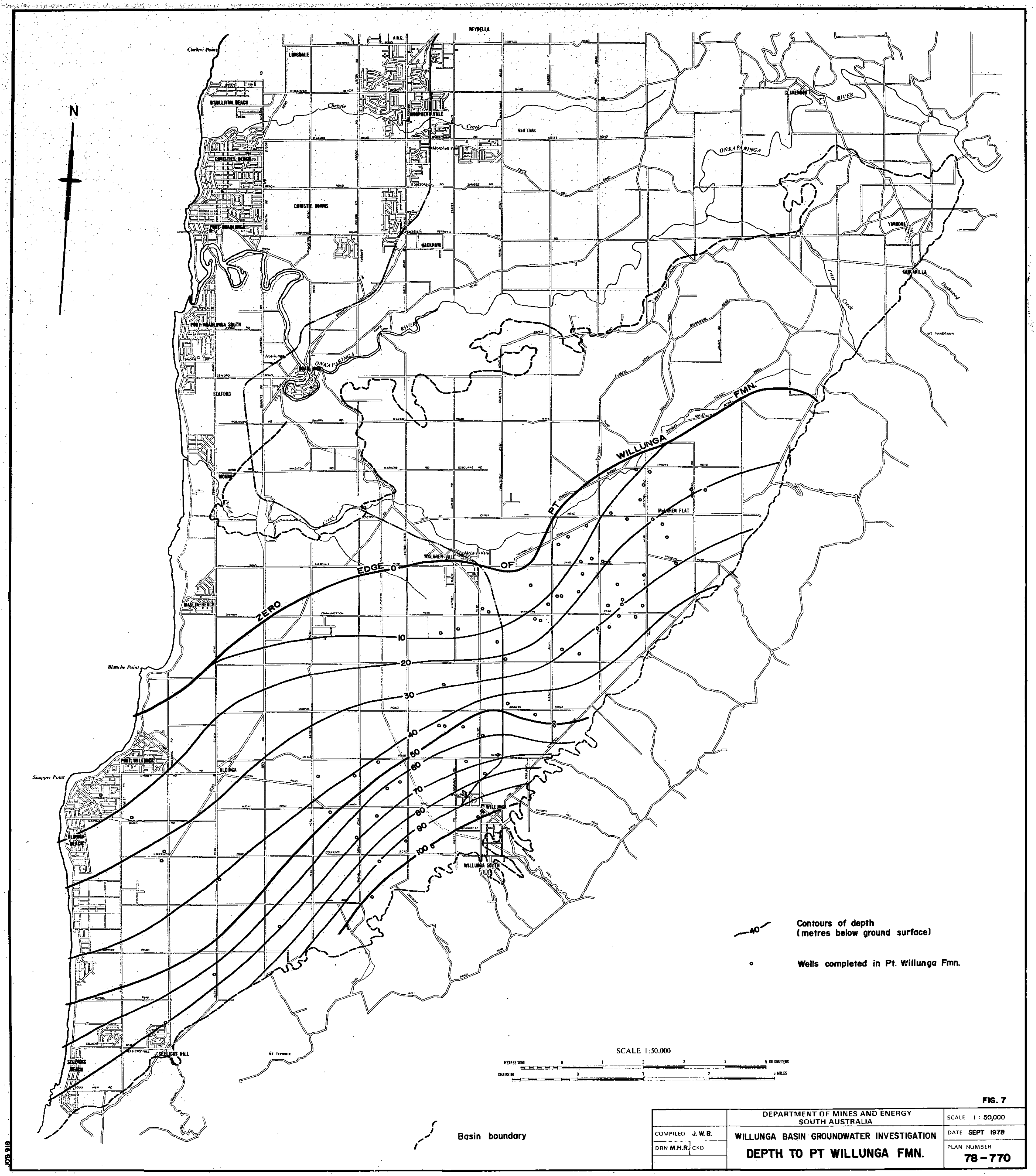


FIG. 7

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE 1 : 50,000
COMPILED J. W. B. — WILLUNGA BASIN GROUNDWATER INVESTIGATION	DATE SEPT 1978
DRN M.H.R. CKD — DEPTH TO PT WILLUNGA FMN.	PLAN NUMBER 78-770

JOB 919

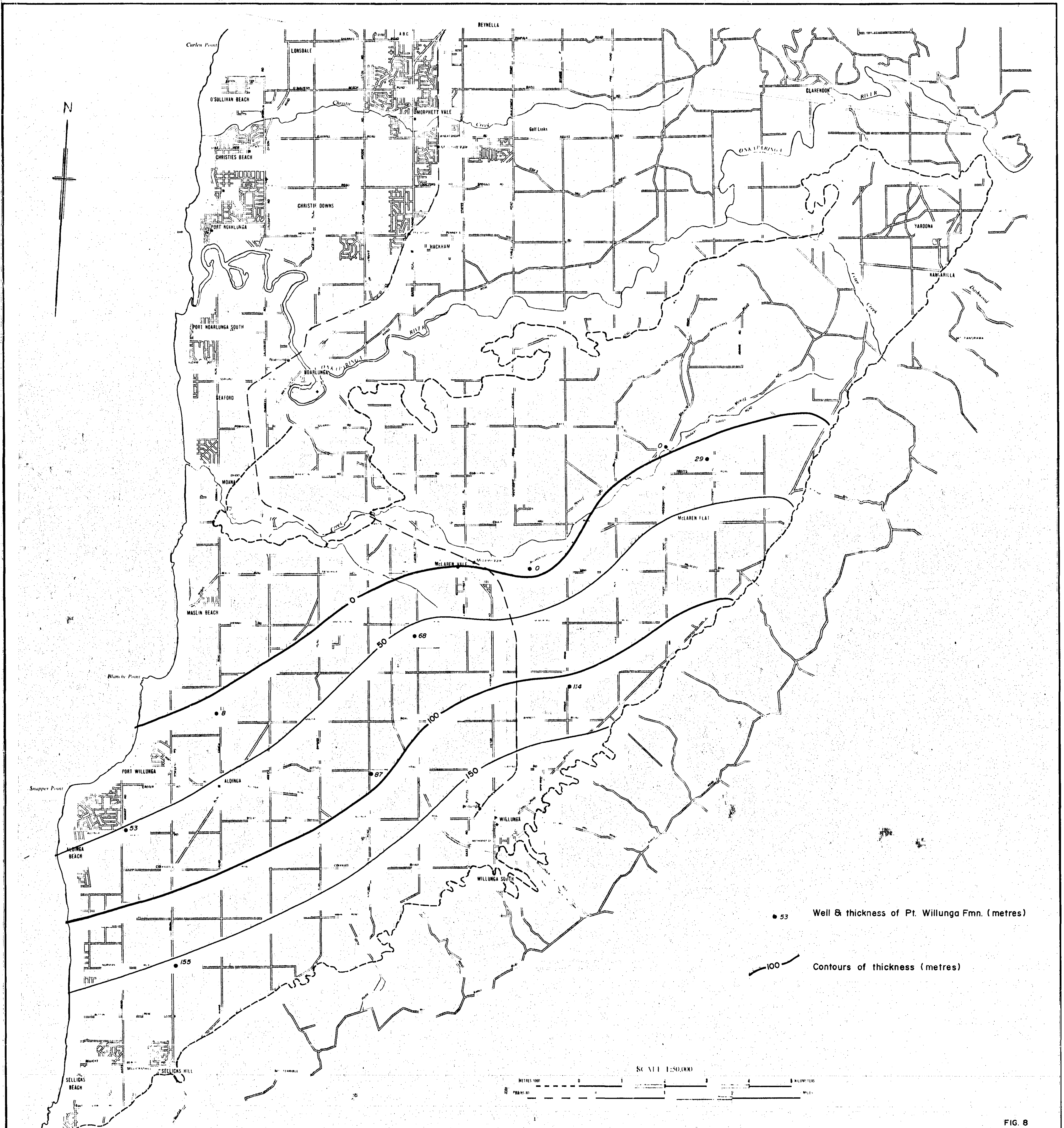


FIG. 8

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

WILLUNGA BASIN GROUNDWATER INVESTIGATION

ISOPACHS OF PT WILLUNGA FMN.

MPILED J. W. B.
M.H.R.

SCALE 1 50,000
DATE SEPT 1978
PLAN NUMBER
78-771

JOB 919

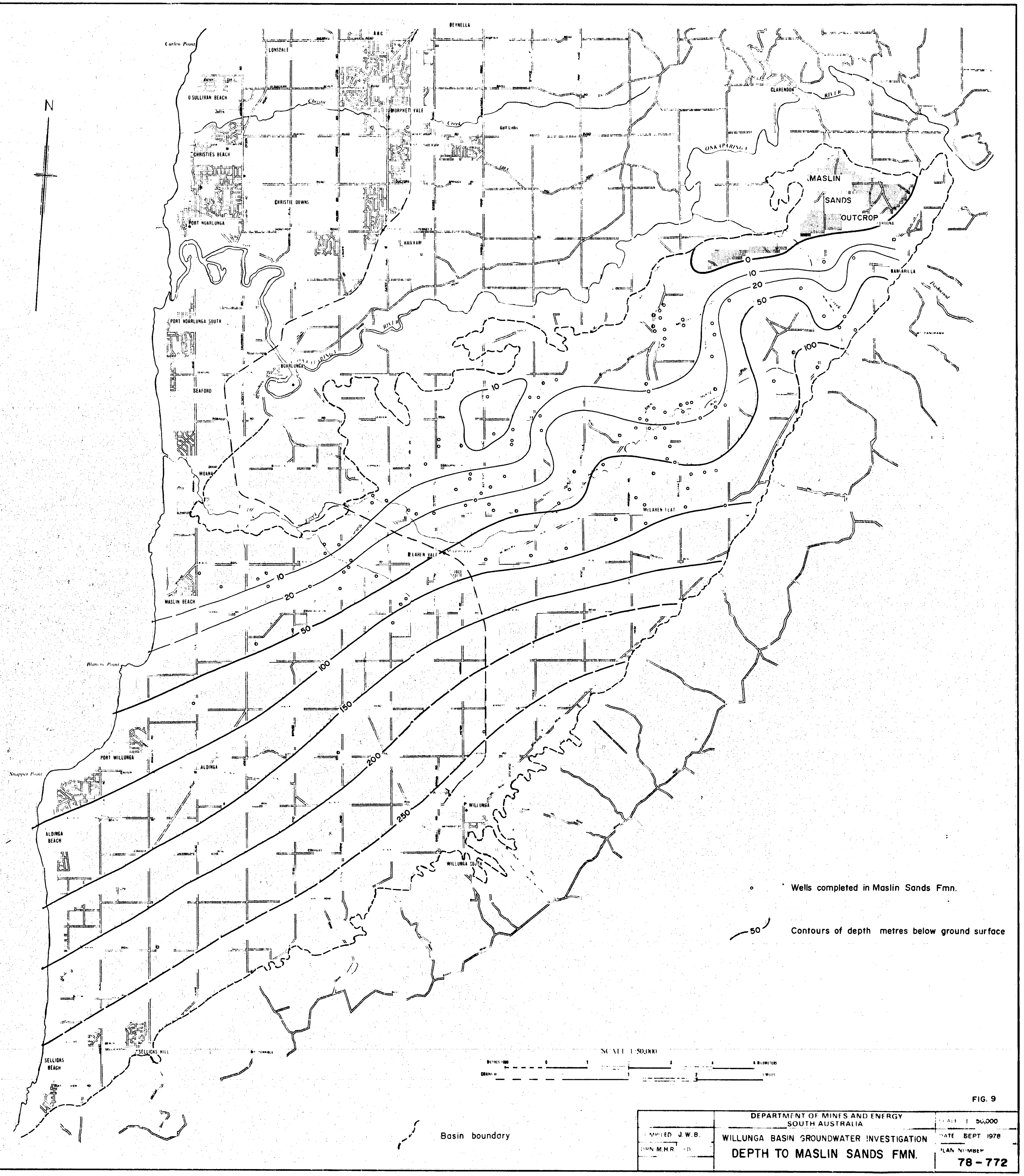


FIG. 9

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

COMPILED J. W. B.
DRN M.H.R.

WILLUNGA BASIN GROUNDWATER INVESTIGATION

DEPTH TO MASLIN SANDS FMN.

SCALE 1 50,000
DATE SEPT 1978
PLAN NUMBER
78 - 772

JOB 919

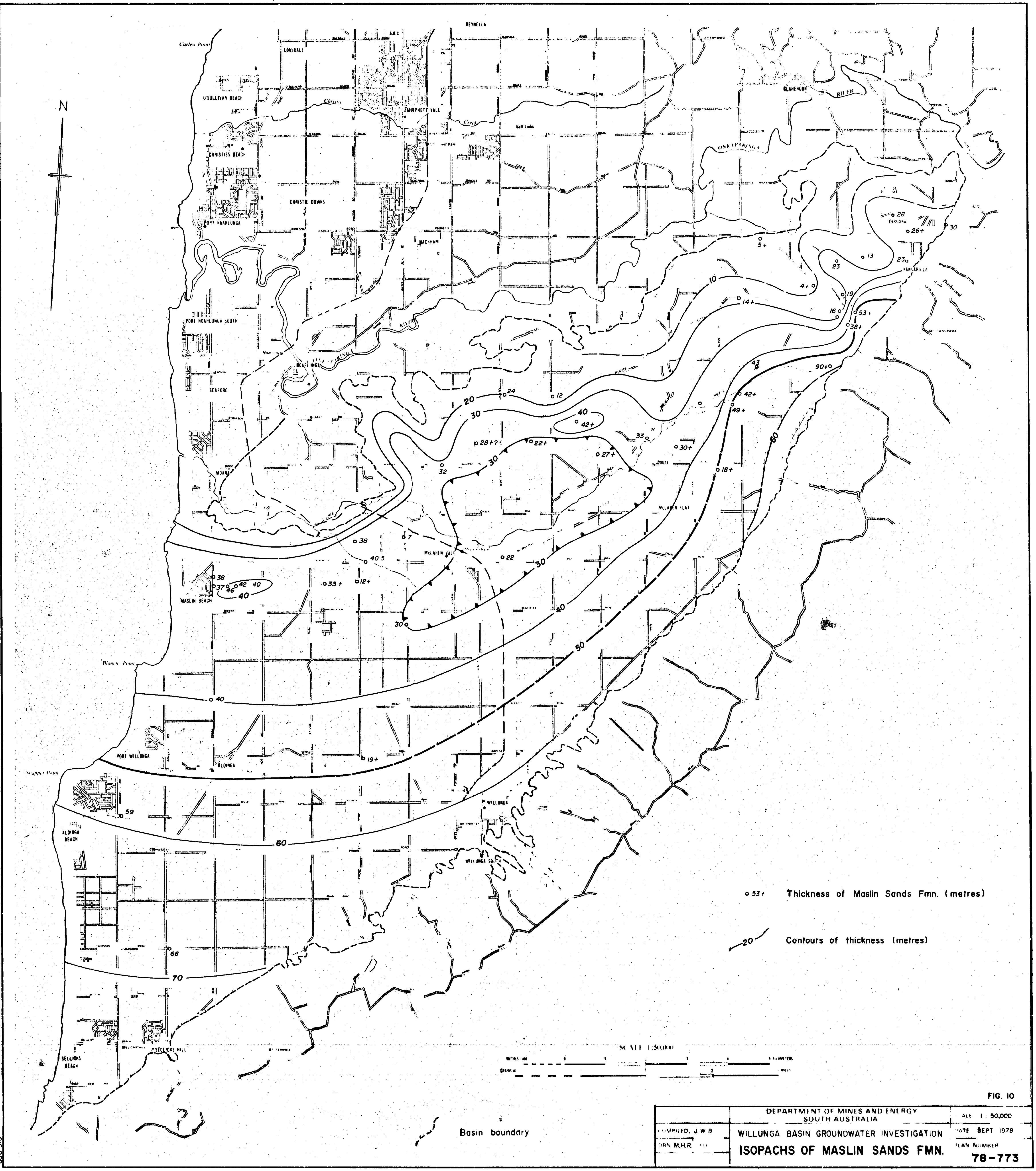


FIG. 10

	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE 1 : 50,000
COMPILED. J. W. B	WILLUNGA BASIN GROUNDWATER INVESTIGATION	DATE SEPT 1978
DRN M.H.R.	**ISOPACHS OF MASLIN SANDS FMN.**	PLAN NUMBER **78-773**

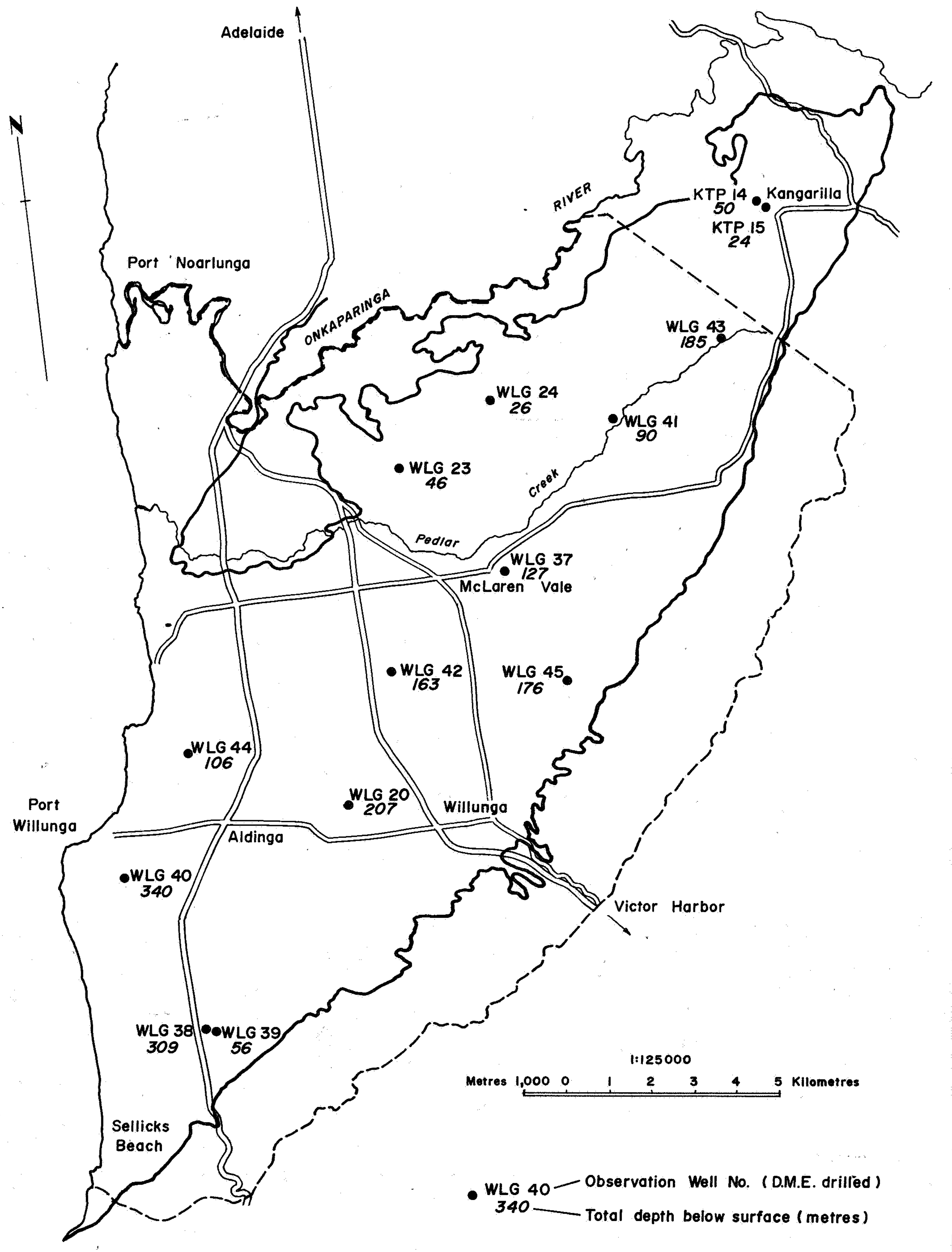


FIG. 11

DEPARTMENT OF MINES – SOUTH AUSTRALIA

WILLUNGA BASIN GROUNDWATER INVESTIGATION

D.M.E. DRILLED WELLS

COMPILED J. W. B.

DRN M.H.R. CKD

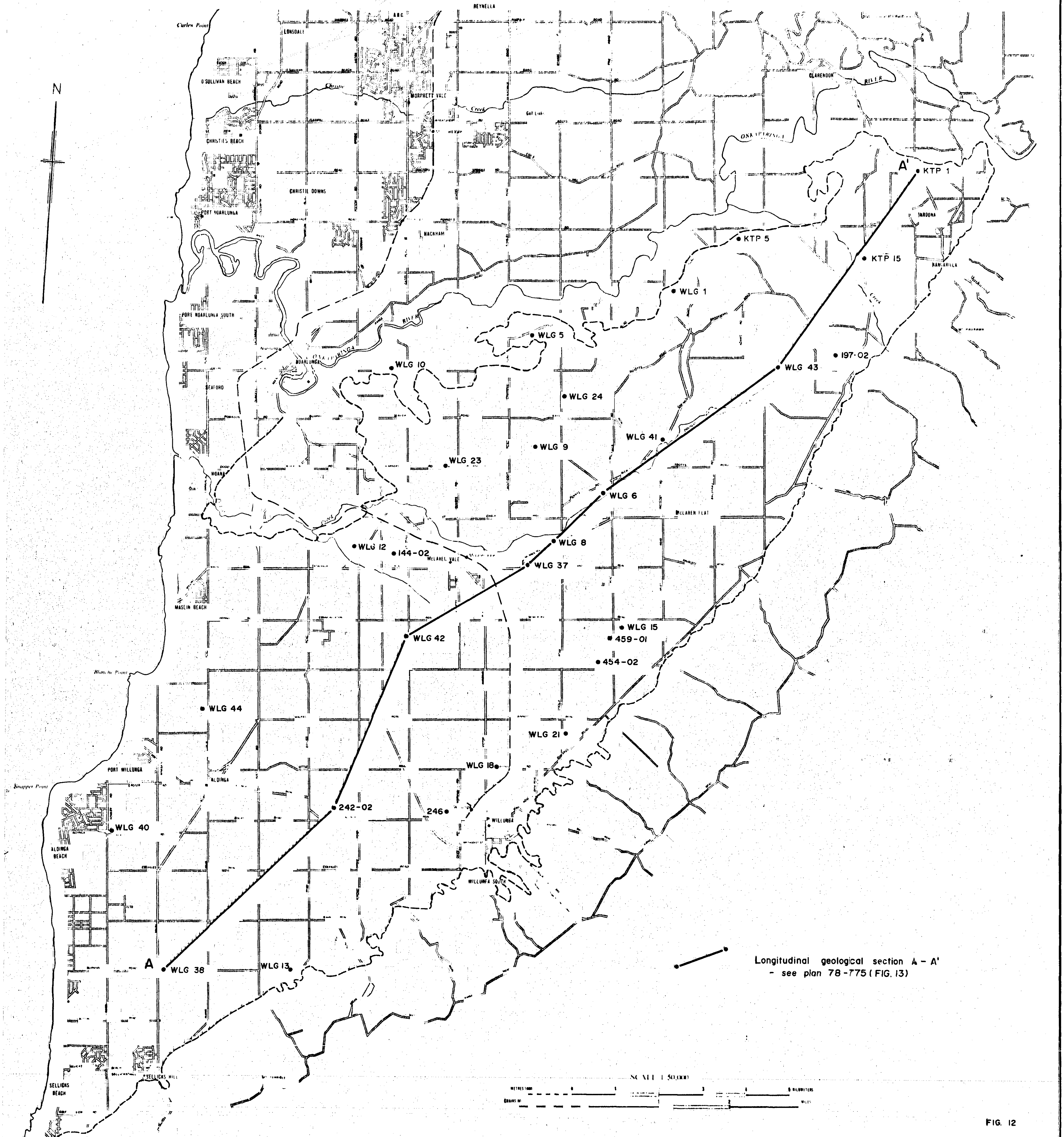
SCALE 1: 25,000

DATE NOV. 1978

PLAN NUMBER

S 13798

JOB 919



Longitudinal geological section A - A'
- see plan 78-775 (FIG. 13)

Basin boundary

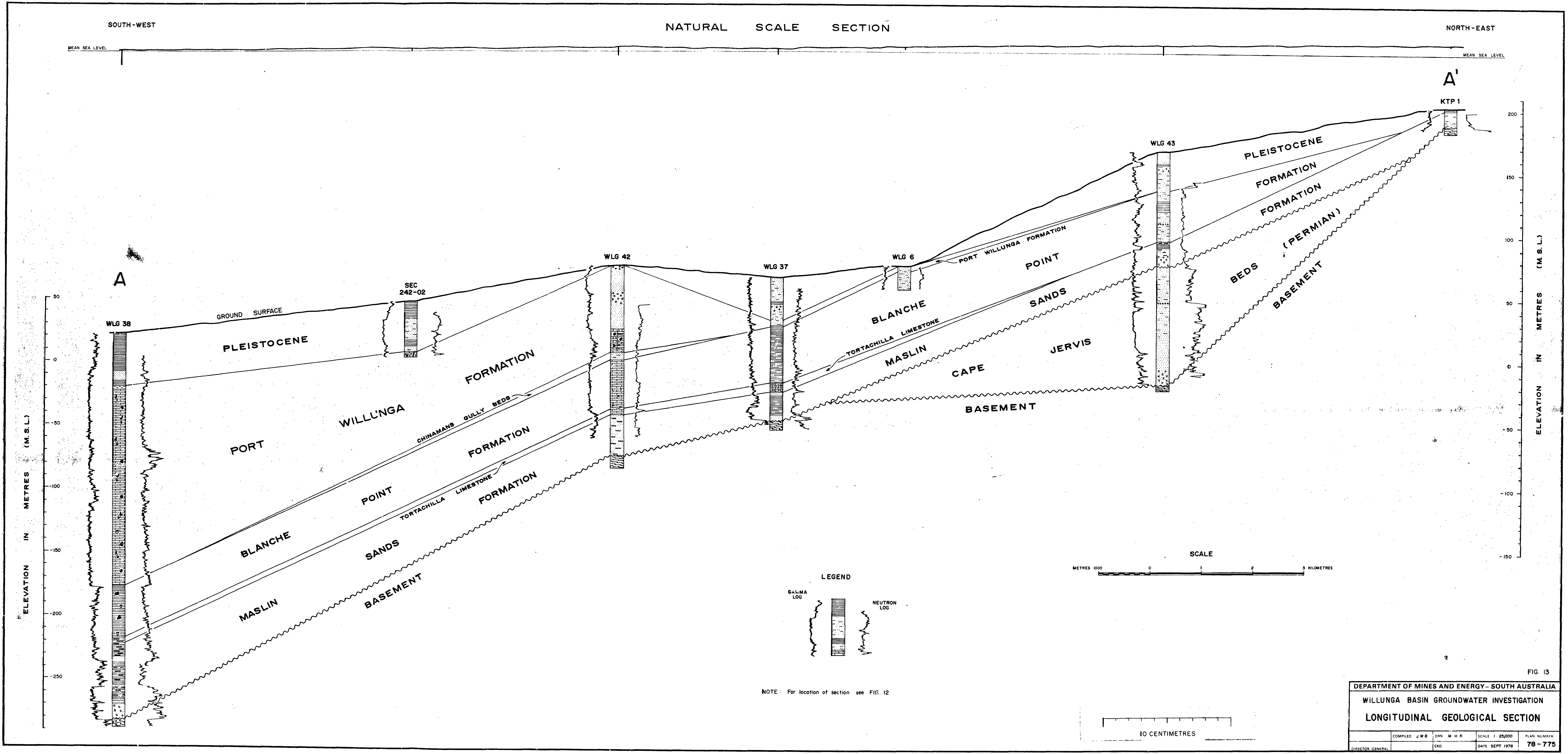
FIG. 12

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

COMPILED J. W. B.
DRN M.H.R.

WILLUNGA BASIN GROUNDWATER INVESTIGATION
GEOPHYSICALLY LOGGED WELLS

SCALE 1 : 50,000
DATE SEPT 1978
PLAN NUMBER
78-774



NOTE : For location of section see FIG. 12

FIG. 13

DEPARTMENT OF MINES AND ENERGY– SOUTH AUSTRALIA

WILLUNGA BASIN GROUNDWATER INVESTIGATION

LONGITUDINAL GEOLOGICAL SECTION

	COMPILED J W B	DRN M H R	SCALE 1 : 25,000	PLAN NUMBER
DIRECTOR GENERAL		CKD	DATE SEPT 1978	78 – 775

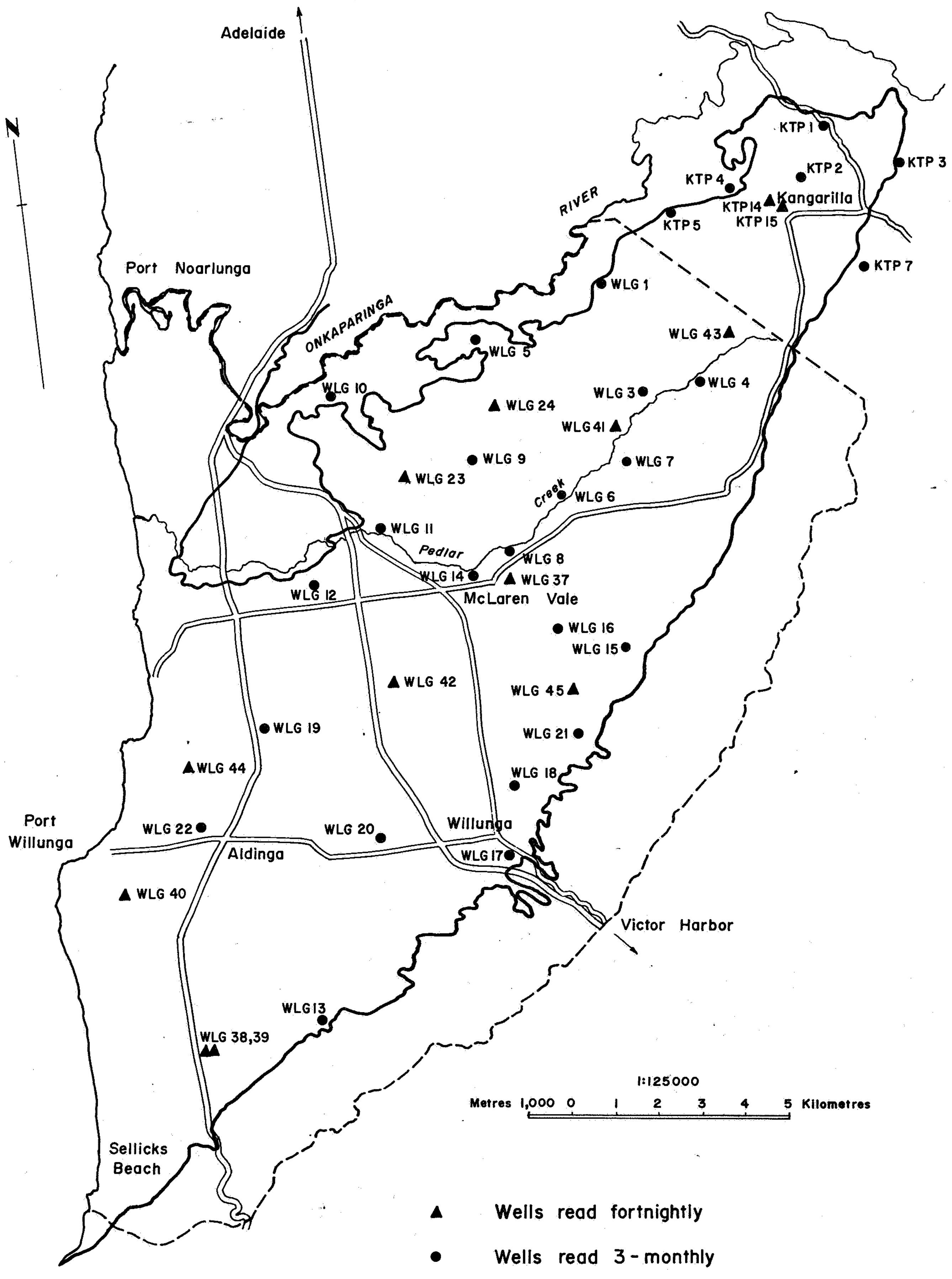


FIG. 14

DEPARTMENT OF MINES – SOUTH AUSTRALIA

SCALE 1 : 25,000

COMPILED J. W. B.

WILLUNGA BASIN GROUNDWATER INVESTIGATION

DATE AUGUST 1978

DRN M.H.R. CKD

OBSERVATION WELL NETWORK
AS AT JUNE 1978

PLAN NUMBER
S 13699

OB 919

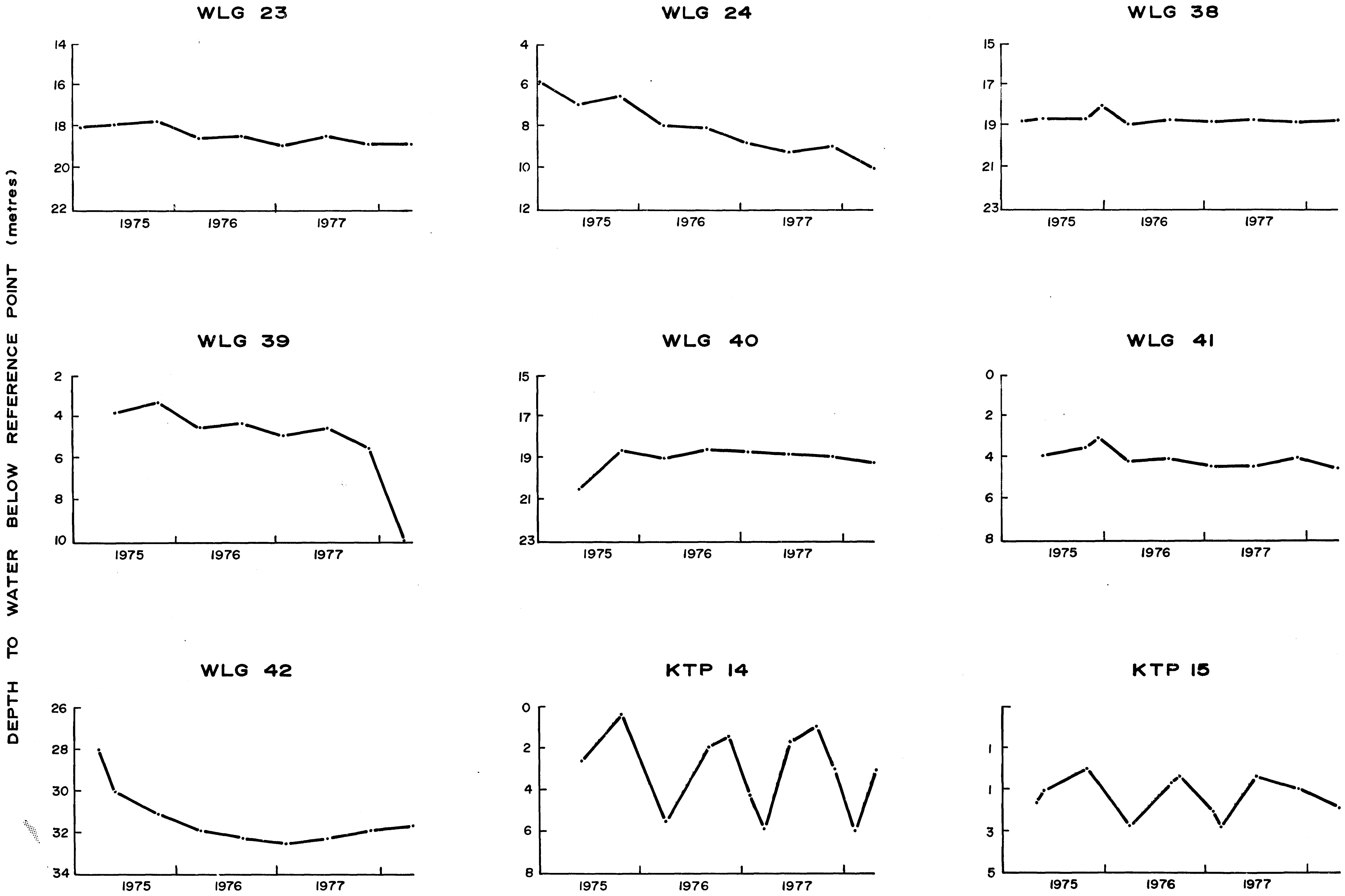
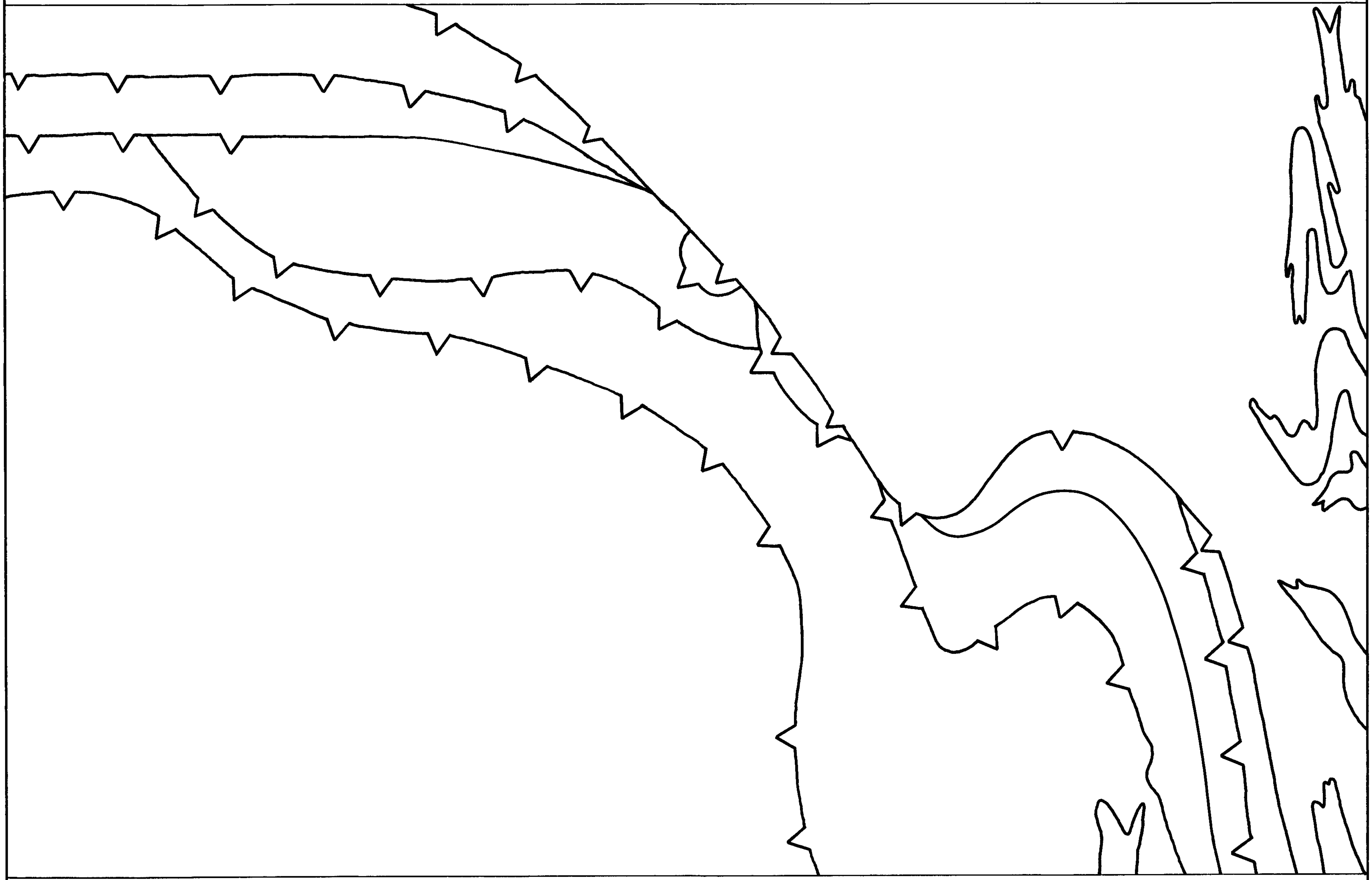


FIG. 15

	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE —
COMPILED J.W.B.	WILLUNGA BASIN GROUNDWATER INVESTIGATION	DATE AUGUST 1978
DRN M.H.R. CKD	FORTNIGHTLY HYDROGRAPHS	PLAN NUMBER 78 - 779

KANMANTOO TROUGH



CAMBRIAN–ORDOVICIAN

Granite, gneiss etc. ☐

CAMBRIAN

Kanmantoo Group ☐

Normanville Group ☐

PRECAMBRIAN

Wilpena Group ☐

Umberatana Group ☐

Burra Group ☐

Barossa Complex ☐

Drn G.B.

78–780 S.A. Department of Mines and Energy

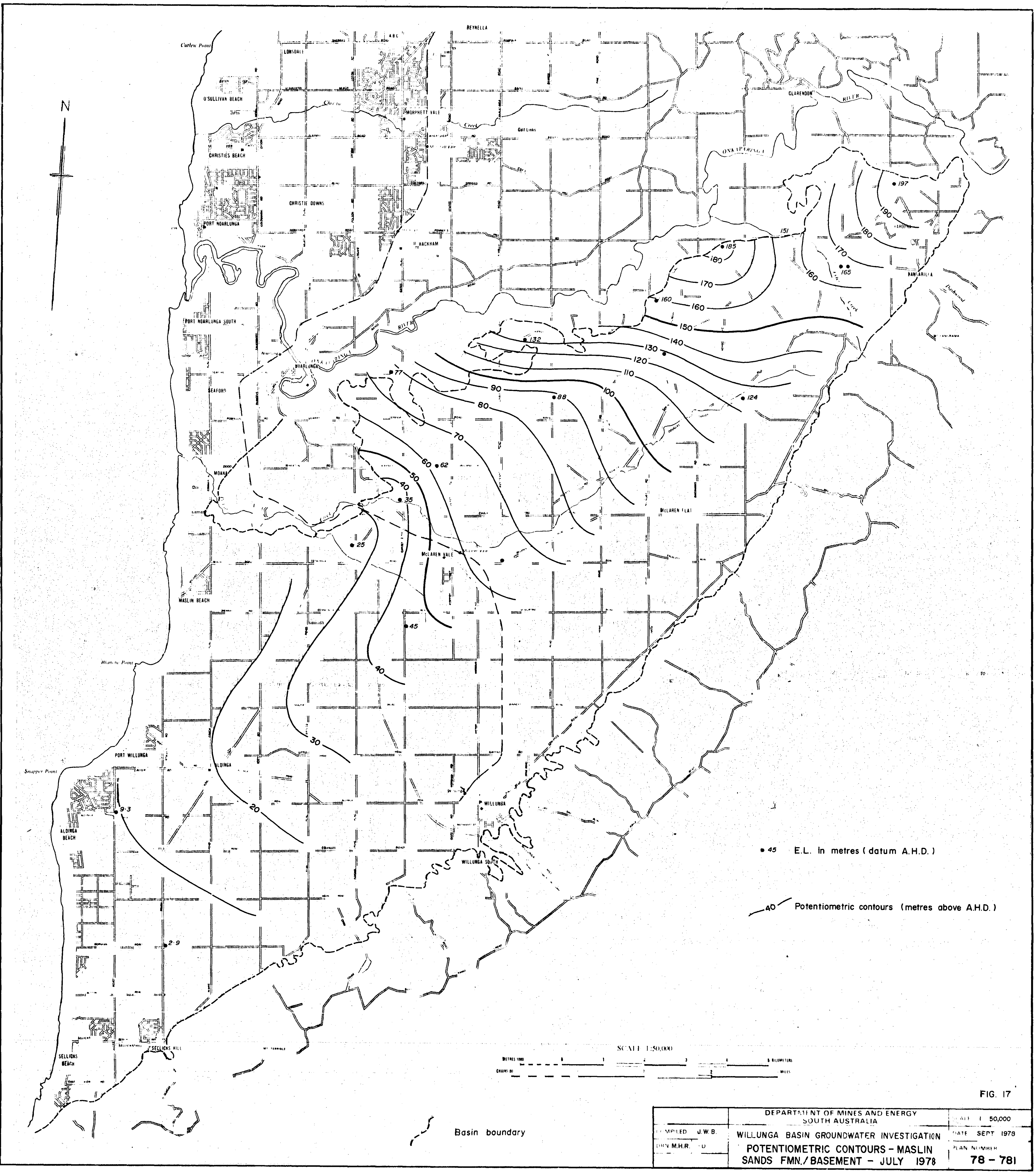


FIG. 17

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

COMPILED J.W.B.
DRN M.H.R. D

WILLUNGA BASIN GROUNDWATER INVESTIGATION

POTENTIOMETRIC CONTOURS - MASLIN SANDS FMN./BASEMENT - JULY 1978

SCALE 1 : 50,000
DATE SEPT 1978
PLAN NUMBER
78 - 781

JOB 916

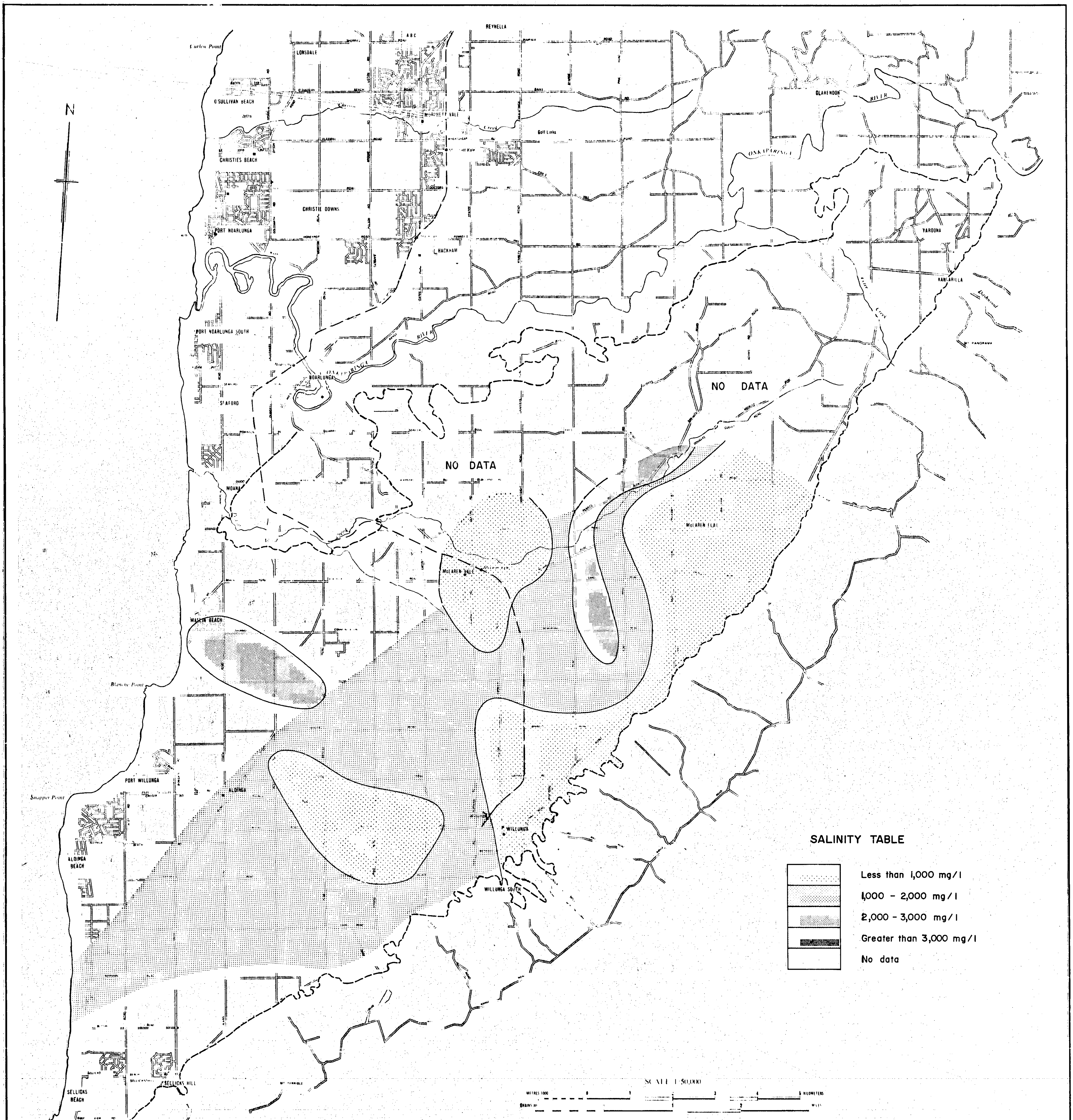


FIG. 18

	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE 1 : 50,000
COMPILED J.W.B.	WILLUNGA BASIN GROUNDWATER INVESTIGATION	DATE SEPT 1978
DRN M.H.R.	GROUNDWATER SALINITY ZONES SHALLOW AQUIFERS	PLAN NUMBER 78-776

JOB 919

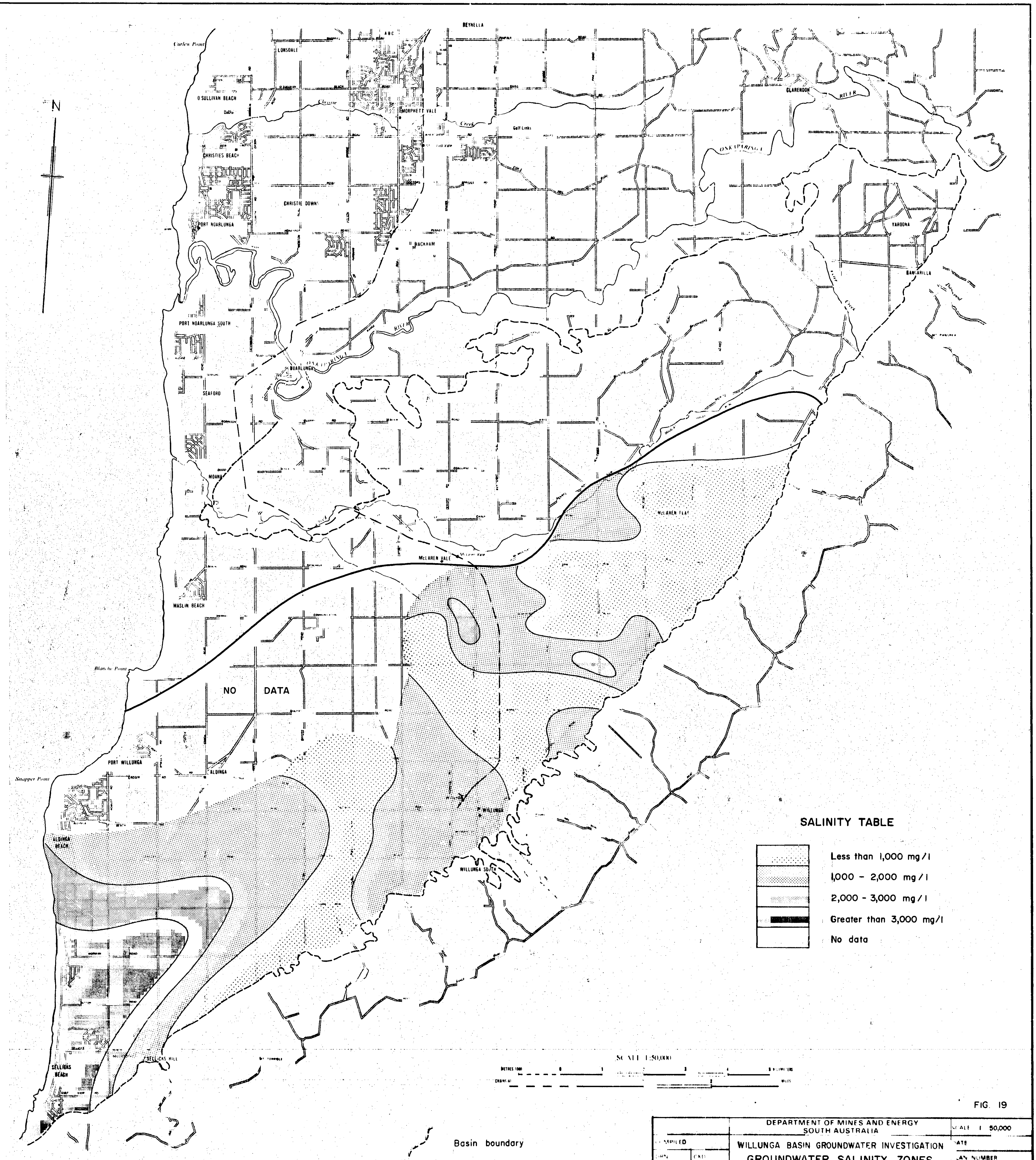


FIG. 19

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

WILLUNGA BASIN GROUNDWATER INVESTIGATION

GROUNDWATER SALINITY ZONES
PT WILLUNGA FMN.

COMPILED	SCALE 1 50,000
DRN	CKD
DATE	
PLAN NUMBER	78-777

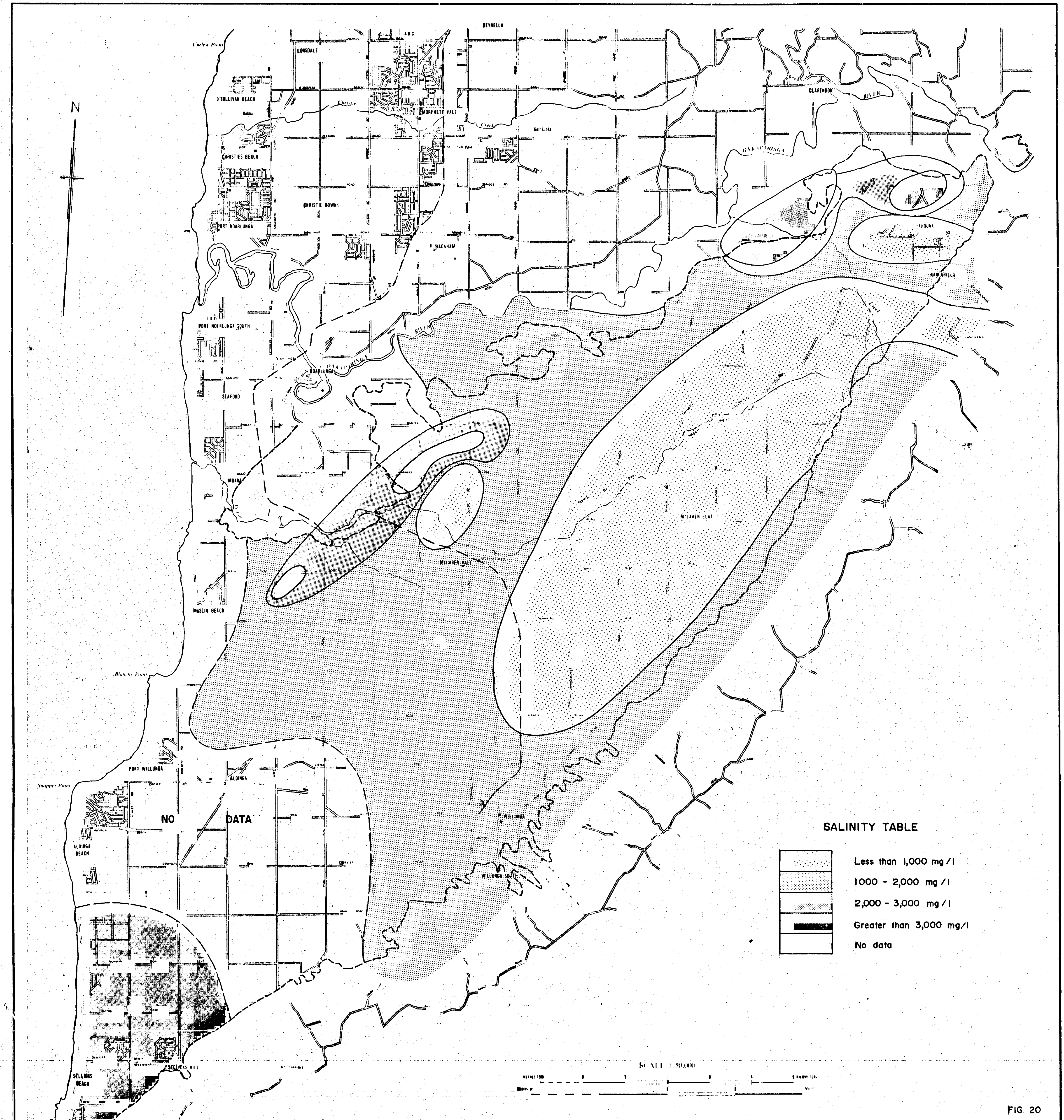


FIG. 20

Basin boundary

MPILED J.W.B N M.H.R.	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE 1 : 50.000
	WILLUNGA BASIN GROUNDWATER INVESTIGATION	DATE SEPT 1978
	GROUNDWATER SALINITY ZONES MASLIN SANDS FMN./BASEMENT	PLAN NUMBER 78-778

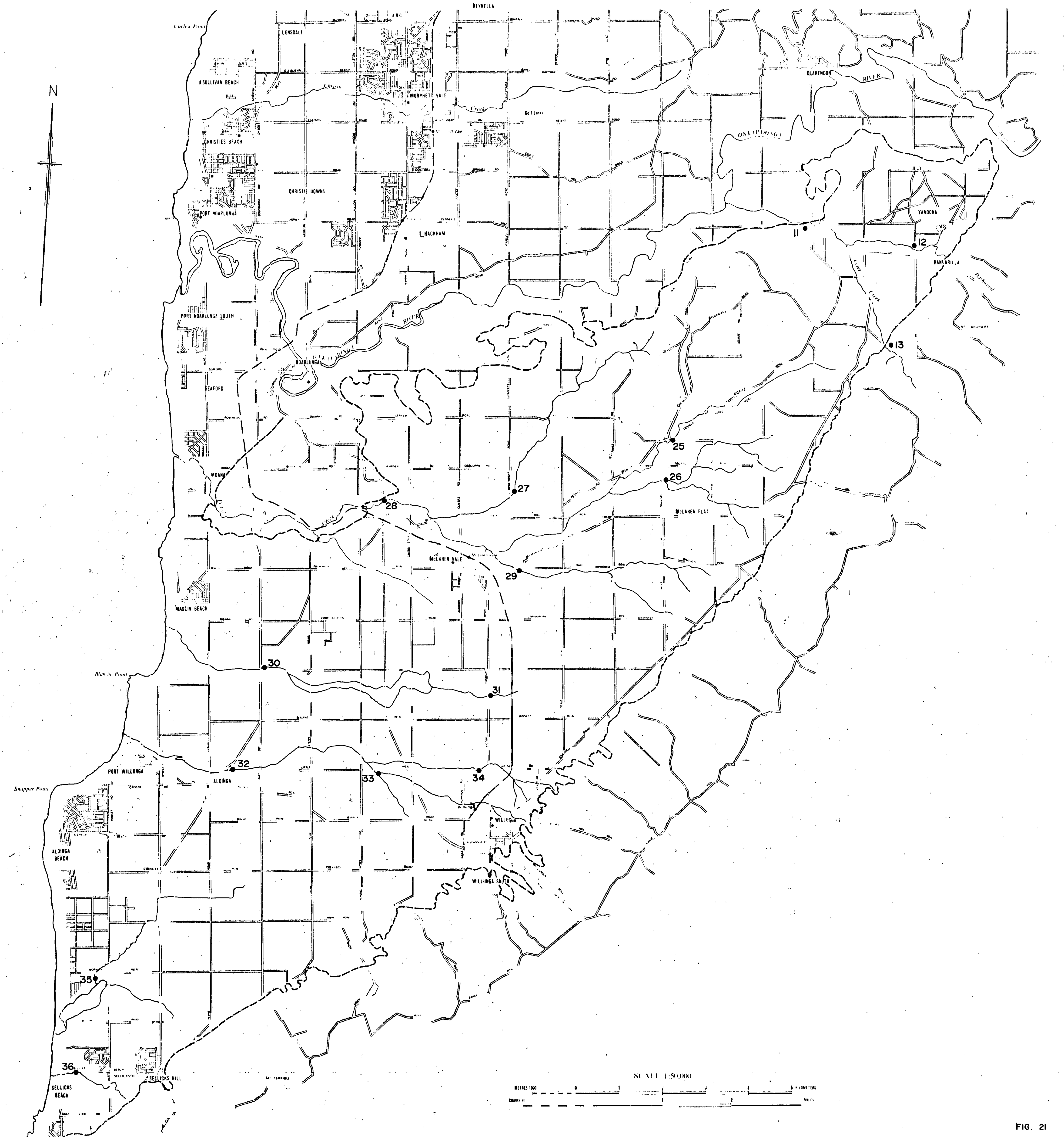


FIG. 21

Basin boundary

COMPILED J. W. B.	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE 1 : 50,000
DRN. M.H.R.	WILLUNGA BASIN GROUNDWATER INVESTIGATION	DATE SEPT. 1978
	SURFACE WATER SAMPLING POINTS	PLAN NUMBER 78 – 782

JOB 919

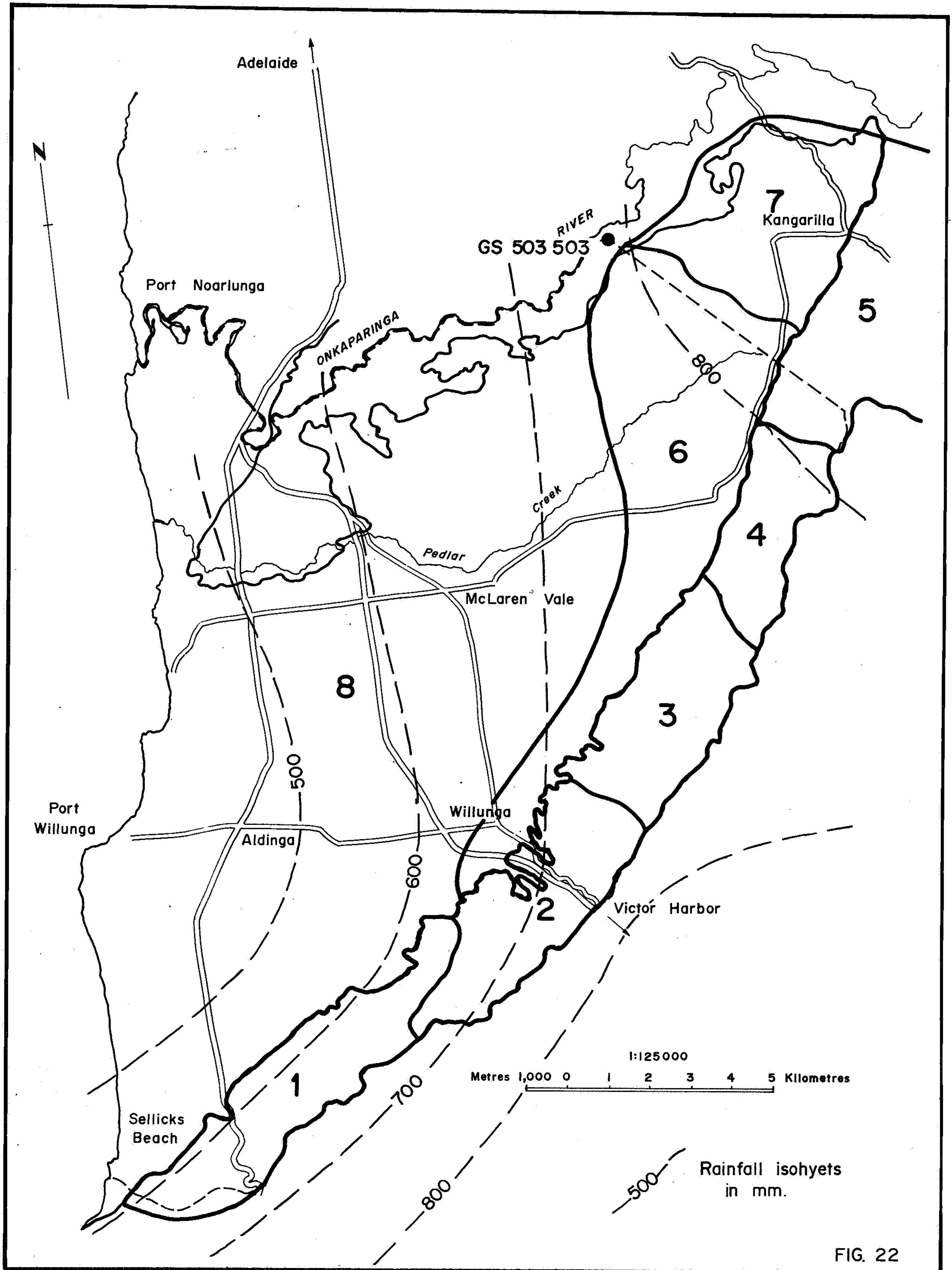


FIG. 22

	DEPARTMENT OF MINES – SOUTH AUSTRALIA	SCALE 1 : 125,000
COMPILED J. W. B.	WILLUNGA BASIN GROUNDWATER INVESTIGATION	DATE OCT. 1978
DRN M.H.R. CKD	REPRESENTATIVE CATCHMENT AREAS	PLAN NUMBER S 13700

JOB 919

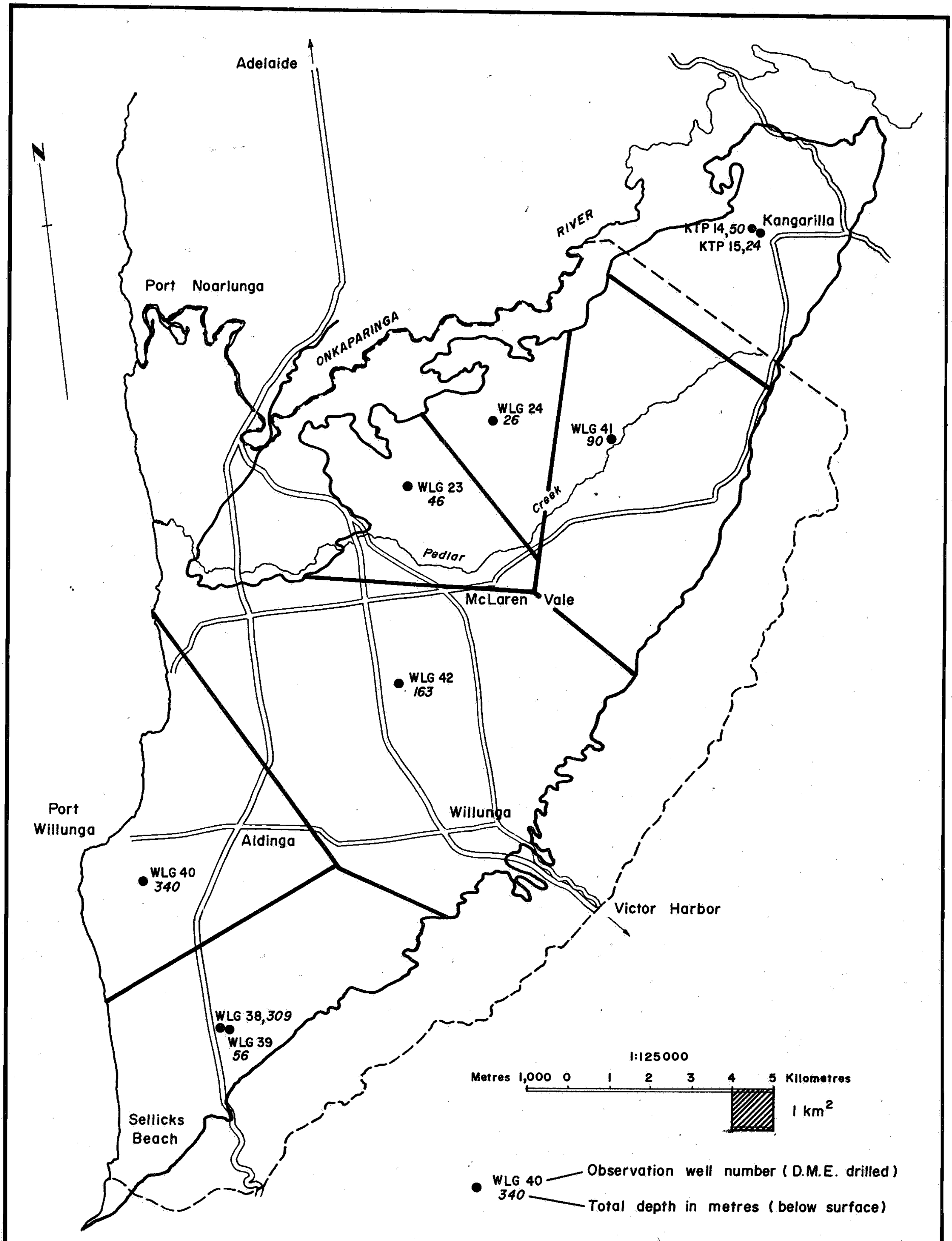


FIG. 23

DEPARTMENT OF MINES – SOUTH AUSTRALIA

SCALE 1 : 25,000

COMPILED J. W. B.

WILLUNGA BASIN GROUNDWATER INVESTIGATION

DATE AUGUST 1978

DRN M.H.R. CKD

OBSERVATION WELLS WITH HYDROGRAPHS AND THEIR REPRESENTATIVE AREAS

PLAN NUMBER

S 13701

Plate 1. A general view across the Willunga Basin looking south toward Willunga Range. Negative No. 30399

Plate 2. Vineyards in the Seaview area, Willunga Basin. Negative No. 30398

Plate 3. Spray irrigation of pasture in the Kangarilla district. Slide No. 14123

Plate 4. A typical drip irrigation system used in vineyards in the Willunga Basin. Slide No. 14124

Plate 5. Uppermost exposure of Port Willunga Formation, overlain by Pleistocene sediments-Sellicks Beach. Negative No. 24329

Plate 6. An exposure of Maslin Sands in the ABM Noarlunga Quarry near Maslin Bay. Negative No. 24332

Plate 7. Pedlar Creek in flood - 1973. Slide No. 14125

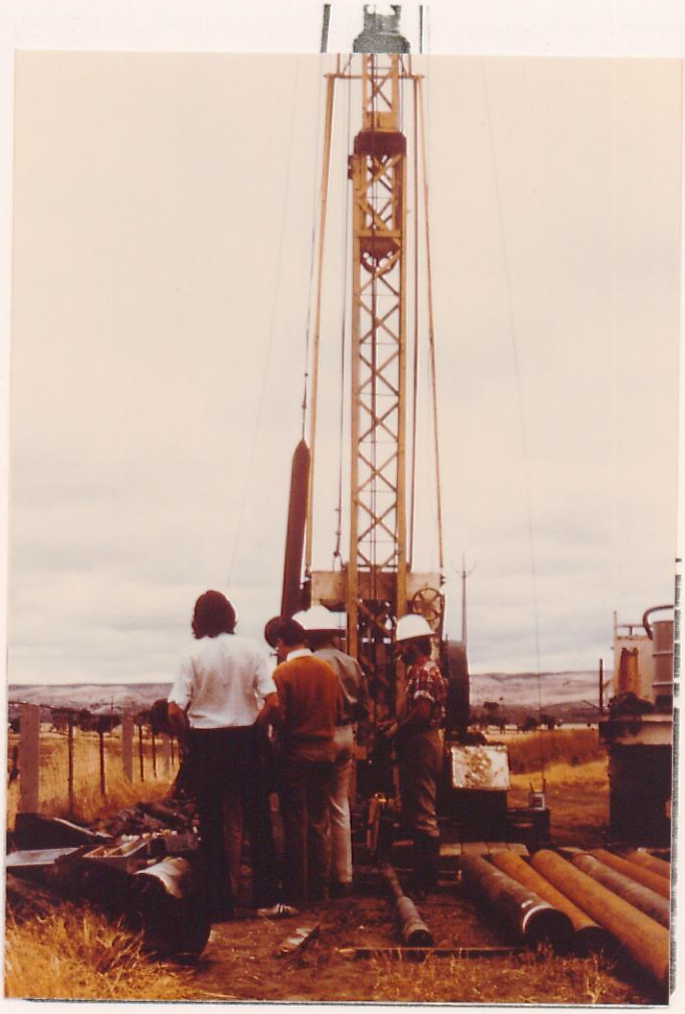


Plate 8. Drilling a Department of Mines and Energy investigation well WLG40. Slide No. 14126