DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

GEOLOGICAL SURVEY

WATER USE IN SOUTH AUSTRALIA

by

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Rept.Bk.No. 78/113
G.S. No. 6079
D.M. No. 115/76
Eng. No. 78/49

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ABSTRACT

It is estimated that total annual consumption of water in South Australia exceeds 1 million megalitres of which 65% is derived from surface sources and 35% from groundwater. Most water is used for irrigation (63%) but reticulated water supplies including water for industry accounts for about 27%. The remaining 10% is used by stock, of which approximately 7.5% is lost from flowing wells in the Great Artesian Basin.

Groundwater forms about 35% of irrigation supplies, mainly from aquifers of the Murray and Otway Basins, but there is significant use for this purpose in the St. Vincent Basin and Mt. Lofty Ranges.

Although it forms only about 8% of the quantity used for public water supplies, groundwater is an important resource in the South East and on Eyre Peninsula. These two areas together account for approximately 90% of groundwater used for town water supplies, exceeding 19 000 Ml in 1976/77.

INTRODUCTION

This review of water use has been prepared to illustrate the contribution which groundwater makes to the State's water resources. In an area so dependent on the River Murray for water supply, it is important to know how much groundwater is currently in use and where it is obtained. Groundwater probably represents the only component of water supply which is under used and in many areas supplies are capable of immediate expansion.

Most public water supplies in South Australia originate from reservoirs in the Mt. Lofty and Flinders Ranges and on Eyre Peninsula, and from the River Murray. These sources provide an estimated 92% of reticulated supplies, with groundwater supplying the remaining 8%. However, in drought years the

TABLE 1

SOUTH AUSTRALIA

ESTIMATED AVERAGE ANNUAL WATER CONSUMPTION

USE	SURFACE WATER (Ml/YEAR)	%	GROUNDWATER (Ml/YEAR)	%	COMBINED SURFACE WATER AND GROUND-WATER (Ml/YEAR)	% OF TOTAL WATER USE	SURFACE WATER COMPONENT %	GROUND WATER COMPONENT %
PUBLIC WATER SUPPLIES	230 000	34.8	20 000	5.6	250 000	24.6	22.6	2.0
IRRIGATION	418 000	63.3	227 000	63.5	645 000	63.5	41.1	22.3
INDUSTRY	*		21 000	5.9	21 000	2.1		2.1
STOCK	12 500	1.9	12 500	3.5	25 000	2.4	1.2	1.2
G.A.B. (FLOWING WELLS)	-	-	77 000	21.5	77 000	7.5	-	7.5
TOTALS	660 500+	100	357 500	100	1 018 000	100	64.9	35.1

* Surface water supplies used by industry are included in the total of public water supplies.

\+ River Murray contribution averaged approximately 450 000 Ml/year for the period 1972-1976

groundwater contribution may be considerably greater: for example, in the drought year of 1967/68, groundwater consumption was almost 33 000 Ml, or approximately 19% of the total used for public water supply.

Irrigation represents the largest component of water use. Most irrigation takes place along the Murray, but significant quantities of groundwater are used for this purpose in the South East, the Adelaide Plains, and in the Mt. Lofty Ranges. Groundwater also contributes significantly to water use by stock and industry.

Estimates of the various quantities and percentages have been summarised in Table I, and are shown diagrammatically in Figs. 1 and 2.

IRRIGATION SUPPLIES

According to the Australian Bureau of Statistics (1977), the total area irrigated in South Australia during 1975-76 was 77 894 hectares over 5 741 holdings, with an average area of approximately 13.5 hectares. From this total, 42 918 ha were irrigated from Government irrigation schemes, rivers, creeks and farm dams; the remaining 34 976 ha were irrigated with groundwater (TABLE 3).

The following table shows estimated rates of application in some irrigation areas.

TABLE 2
Irrigation Areas and Estimated Rates of Application

AREA	AREA IRRIGATED (ha)	VOLUME APPLIED (Ml/year)	RATE OF APPLICATION (m/year)	SOURCE OF DATA
MURRAY IRRIGATION	35103	375601	1.07	Aust. Bureau of Statistics. S.A., Irrigation Season 1975/76
ANGAS-BREMER	2500	25000	1.0	WATERHOUSE J.D.
NORTHERN ADELAIDE PLAINS	3200	21000	0.66	SHEPHERD R.G.
BOOBOROWIE VALLEY	70	400	0.57	COBB M.A. & SMITH P.C.
PICCADILLY VALLEY	1170	1640	0.15	WAKE-DYSTER J.D.

TABLE 3

WATER USE FOR IRRIGATION IN STATISTICAL DIVISIONS

BASED ON STATISTICS FOR 1975-76

STATISTICAL DIVISION	SURFACE WATER			GROUNDWATER		
	Area Irrigated (Ha)	Estimated Application (m/year)	Estimated Volume (Ml/year)	Area Irrigated (Ha)	Estimated Application (m/year)	Estimated Volume (Ml/year)
ADELAIDE	1 594	0.7	11 158	4 207	0.7	29 499
CENTRAL	78	0.7	546	783	0.7	5 841
MT. LOFTY RANGES	5 367	0.35	18 785	7 579	0.35	26 527
KANGAROO ISLAND	24	0.6	144	2	0.6	12
MURRAY	35 131	1.07	375 601	424	1.07	4 537
SOUTH EAST	321	0.7	2 247	21 460	0.7	150 220
EYRE	10	0.75	75	34	0.75	255
NORTHERN	272	1.0	2 720	486	1.0	4 860
FAR NORTH	121	1.0	1 210	1	1.0	10
TOTALS	*42 918		412 486	34 976		221 711

*Includes 805 ha irrigated from Town and Country reticulated supply.

Irrigation in areas of relatively low rainfall is expected to be at a similar rate to the Murray irrigation areas and the Angas-Bremer area. These would include the Napperby-Nelshaby area near Port Pirie and the southern Willochra Basin.

Irrigation in the higher rainfall areas of the Mt. Lofty Ranges is at a much lower rate as shown by the Piccadilly Valley data. In this area the contribution from rainfall is estimated to be 1.08 metres per year, which is much greater than any other irrigation area in the State.

On the basis of the known rates, estimates are made of application rates for the various statistical divisions of the State (Table 3, Fig 3). Areas irrigated in each of these divisions is available (Aust. Bureau of Statistics, 1977) and it is possible to calculate the approximate volume of water used. On the basis of the assumed application rates it is estimated that a total of 634 197 Ml were used for irrigation in 1975-76, in the proportion of 65% for surface water and 35% for groundwater.

According to the statistics, over a 5 year period the average area under irrigation was 79 000 ha and this figure is adopted in determining the average usage of surface water and groundwater. The statistics show that an average of 55% of the area is irrigated with surface water and 45% with groundwater. In the average situation this would amount to 43 450 ha and 35 550 ha, respectively.

It is estimated that for an average of 79 000 ha under irrigation the volume of water used annually is 643 000 Ml of which 418 000 Ml is surface water and 225 000 Ml is groundwater.

The watering of golf links and some ovals in the Metropolitan area is done in part with groundwater. For golf links it is estimated that annual use is 700 Ml per year and for ovals

approximately 300 Ml per year. In addition there are 94 Schools throughout the State which rely on groundwater for the watering of ovals. Based on an average pumping rate of 25 m^3/hour for 20 hours per week it is estimated that consumption is approximately 1000 Ml/year, assuming pumping continues for about 20 weeks.

Total use of water for irrigation is estimated as follows:-

SURFACE WATER (Ml/year)	GROUNDWATER (Ml/year)
375 600 Murray River	225 000 South East, Adelaide area, etc.
42 400 Remainder of State	700 Golf Links
	300 Ovals
	1 000 Schools
418 000 Ml	227 000 Ml

PUBLIC WATER SUPPLIES

The total water consumption through Engineering and Water Supply Dept. mains during 1975-76 was 255 100 Ml (South Australian Year Book, 1977).

In addition, the Engineering and Water Supply Dept. and Woods and Forests Dept. have provided data for 1976/77 on groundwater use for towns throughout the State (Appendix 1). The various components of public water supplies for the period 1975-1977 are considered to be as follows:-

SOURCE	VOLUME (Ml/year)	PERCENTAGE
RIVER MURRAY	86 200	34
METROPOLITAN AND COUNTRY RESERVOIRS	148 480	58
GROUNDWATER	20 420	8
TOTAL	255 100	100

The proportions of water from the different sources varies annually but the maximum recorded use of groundwater for public water supplies was in 1967-68. In that year the groundwater

contribution was 32 860 Ml of which 10 470 Ml (32%) was pumped into mains in the Adelaide Metropolitan area. Total consumption for that year was 174 229 Ml of which the groundwater component formed approximately 19%. It is considered that in a year of average rainfall and with adequate storage in the reservoirs the groundwater component would be approximately 20 000 Ml or about 8% of the total.

For Public Water Supplies the proportions of River Murray water to other sources for the years 1972/73 to 1975/76 are shown in the following table:-

SOURCE	1972/73		1973/74		1974/75		1975/76	
	Ml	%	Ml	%	Ml	%	Ml	%
RIVER MURRAY	96 100	42	61 800	29	55 400	24	86 200	34
RESERVOIRS & GROUNDWATER	133 300	58	150 600	71	177 900	76	168 900	66
TOTAL	229 400	100	212 400	100	233 300	100	255 100	100

Approximately 50 towns and districts are fully or partly dependent on groundwater for public water supplies (Appendix 1, Fig. 6). This includes South Eastern towns and the Eyre Peninsula system where the groundwater component is large, rising to more than 90% of consumption in 1976/77. The South East and Eyre Peninsula accounted for 8078 and 10883 Ml, respectively during 1976/77, or 40% and 53% of groundwater used for all town supplies in that year. For estimation purposes it is considered that average consumption of surface water for public water supplies is 230 000 Ml per year and groundwater contributes an additional 20 000 Ml per year.

STOCK USE

Water used by stock is a relatively minor proportion of the total. However, very large quantities of groundwater flow from generally uncontrolled artesian wells in the Great Artesian Basin.

These wells, which were drilled for stock water supplies, are estimated to flow at 77 000 Ml per year; only a very small proportion, probably less than 1%, is actually consumed by stock.

In 1976 there were approximately 17.3 million sheep in the State and 1.9 million cattle. These numbers fluctuate considerably depending on occurrence of drought years. For example, from 1970 to 1976 sheep numbers ranged from 19.75 million in 1970 down to 15.65 million in 1973.

For estimation purposes the average number of sheep are taken to be 16 million. Sheep normally drink 4-4.5 litres per head per day during summer but very little in the winter. For purposes of estimation it is considered that sheep drink 4 litres per day for about 200 days per year and consumption for the remainder of the year is negligible. On this basis total consumption by sheep would be 12 800 Ml per year.

Cattle normally consume about 22 litres per head per day during summer and about 11 litres per day during winter. If average consumption is taken to be 17 litres per head per day then the total quantity used by cattle would be approximately 12 000 Ml/ assuming numbers remain constant at about 1.9 million.

Sheep and cattle together therefore use approximately 24 800 Ml per year. All other stock are in relatively small numbers and would not add significantly to the total. It is considered that total use for stock is 25 000 Ml per year, of which it is estimated that 50% is derived from groundwater.

Total groundwater use for stock purposes is therefore estimated to be 89 500 Ml per year, including 77 000 Ml per year flowing from artesian wells.

INDUSTRIAL USE

The quantity used by industries dependent on water supplied

by the Engineering and Water Supply Dept. are already included in the totals for Public Water Supplies. This would include such large industries as the steel works at Whyalla and many heavy industries in the Adelaide metropolitan area. There are, however, a number of industries which rely partly or entirely on groundwater. It is estimated that for the South East a total of approximately 18 000 Ml per year are withdrawn for industrial use. The major users of water are Apcel Ltd. (9 000 Ml/year) and Cellulose Aust. Ltd. (13 000 Ml/year). For the latter, it has been estimated that 20% (2600 Ml) is obtained by direct pumping from wells; the remaining 80% (10400 Ml) is withdrawn from Snuggery Drain, the flow in which is derived in part from springs - the actual proportion of groundwater in the drain is unknown but is considered to be at least 50% of the flow.

In the Adelaide area there are several major users of groundwater including I.C.I. (Dry Creek), 1140 Ml per year, and SAMCOR, 1060 Ml per year. The former accounts for approximately 5% of total withdrawals in the Proclaimed Region of the Northern Adelaide Plains. Other industries in the Adelaide area are estimated to use approximately 800 Ml per year of groundwater, one of the principal users being Coca Cola Ltd. where consumption of groundwater is estimated to be 100 Ml per year.

Estimated use of groundwater for industrial purposes is as follows:-

Area	Average Annual Quantity (Ml)
South East	18 000
Adelaide Area	3 000
TOTAL	21 000 Ml

DISCUSSION

The use of groundwater for all purposes has been estimated

for the various sedimentary basins and hard rocks (Appendix 2, Figs. 4, 5). Greatest use of groundwater is in the Gambier Embayment (Otway Basin) where it is estimated that 150 000 Ml are pumped annually or flow from artesian wells. The total estimated groundwater use is 357 500 Ml which is approximately 35% of all water used in the State. When considering the source of our water supplies, statistics show that the River Murray contributes almost half of our present requirements. Surface water derived from reservoirs and dams accounts for approximately 20% of the water used.

Groundwater is considered to be capable of further exploitation, particularly in the Murray and Otway Basins. Further work is required to determine the safe yield of many basins in which at present there is no indication of excessive withdrawals. Although further exploitation of groundwater is possible it is important that supplies be conserved. This applies particularly to flowing wells of the Great Artesian Basin where it is estimated the flow is approximately 7.5% of the total water used in the State.

28th August, 1978.
RGS:RS

R.G. Shepherd

R.G. SHEPHERD
SENIOR GEOLOGIST
GROUNDWATER

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APPENDIX I

GROUNDWATER USAGE FOR PUBLIC WATER SUPPLIES 1976/77

Data supplied by Engineering and Water Supply Department and Woods and Forests Department

LOCATION	USAGE IN 1976/77 (Ml)	MAXIMUM RECORDED USAGE (Ml)	YEAR
Adelaide Metropolitan Area, including Salisbury,	-	10 470	1967/68
Beachport	98	115	1976/76
Bordertown	637	645	1975/76
Burra	-	205	1959/60
Coober Pedy	134	134	1976/77
Coonalpyn	-	123	1963/64
Elliston	50	50	1976/77
Eyre Peninsula System			
Lincoln Basin	3 385	3 385	1976/77
Polda Basin	2 495	2 495	1976/77
Uley-South Basin	2 302	2 302	1976/77
Uley-Wanilla Basin	2 651	2 796	1961/62
Geranium	32	32	1976/77
Hawker	101	101	1976/77
Karoonda	83	92	1967/68
Keith	-	134	1969/70
Kingston (S.E.)	297	342	1973/74
Lameroo	191	193	1967/78
Lucindale	44	44	1976/77
Marree	26	29	1972/73
Melrose	75	75	1976/77
Millicent	715	821	1972/73
Moorlands	-	32	1967/68
Mount Gambier			
Blue Lake	3 788	4 347	1975/76
Water Wells	-	68	1969/70
Mount Burr	295	295	1976/77
Nangwarry	370	370	1976/77
Naracoorte	845	973	1972/73
Oodnadatta	84	92	1970/71
Orroroo	69	155	1971/72
Parilla	14	18	1967/68
Penola	200	243	1975/76
Peterborough	56	136	1969/70
Pinnaroo	216	231	1967/68
Port MacDonnell	126	146	1976/76
Quorn	191	191	1976/77
Robe	159	159	1976/77
St. Kilda	6	7	1972/73
Streaky Bay	300	300	1972/73
Tarpeena	33	33	1976/77
Tintinara	-	70	1967/68
Warooka	186	192	1975/76
Willowie & Coonatto	25	48	1974/75
Wilmington	57	81	1974/75
Woolundunga-Saltia	25	32	1969/70
TOTAL	20 361	32 802	

Estimates of usage for the following towns are as follows:-

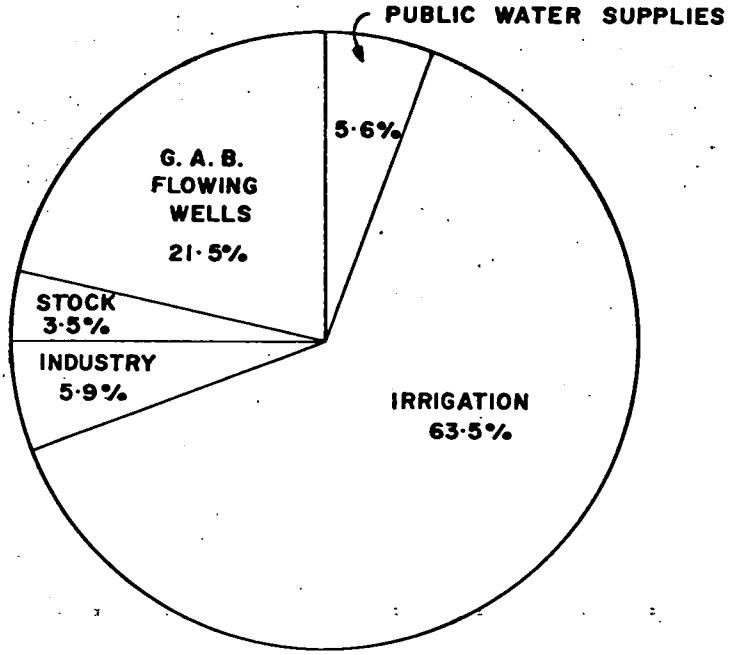
Andamooka	6
Blinman	10
Cook	8
Ooldea	5
Padthaway East	10
Peake	10
Peebinga	10
Total for 1976/77	20 420

APPENDIX 2

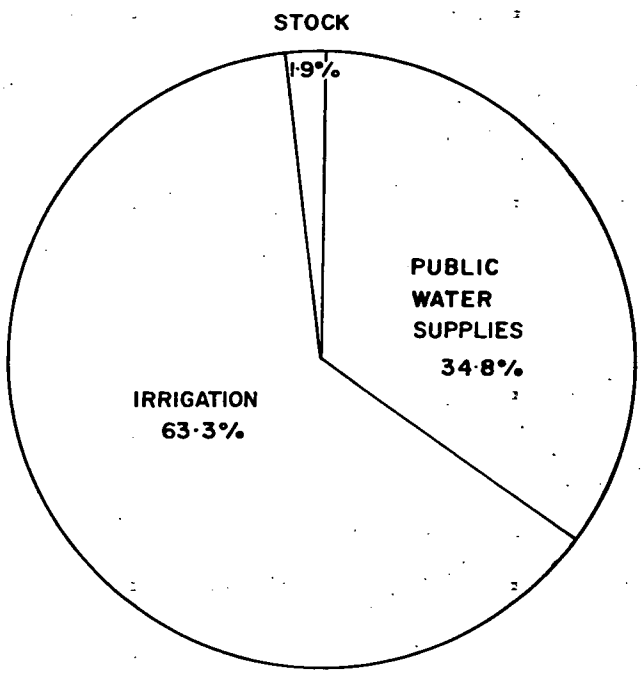
Groundwater Basins of South Australia

Estimated Annual Withdrawal

AREA OR BASIN	Estimated Annual Withdrawal (Ml)	%
MT. LOFTY-FLINDERS RANGES		
Fractured Rocks	13 000	
Hindmarsh Tiers	2 000	
Myponga Basin	1 570	
Willochra Basin	350	
Walloway Basin	300	
Barossa Valley	3 000	
Booborowie Valley	400	
Pirie-Torrens Basin	500	
Yorke Peninsula and Kangaroo Island	300	
Sub-Total	21 420	6.0
EYRE PENINSULA BASINS		
Lincoln Basin) Uley-Wanilla Basin) Uley South Basin) Polda Basin) Robinson Basin) Elliston T.W.S.)	8 500	
Eyre Peninsula, general	380	
Sub-Total	8 880	2.5
ST. VINCENT BASIN		
Northern Adelaide Plains	21 000	
Adelaide Metropolitan Area	4 400	
Willunga Embayment	4 000	
Northern St. Vincent Basin	500	
Noarlunga Embayment	300	
Sub-Total	30 200	8.4
OTWAY BASIN		
Gambier Embayment	126 000	
South East Artesian Area	24 000	
Sub-Total	150 000	42.0
GREAT ARTESIAN BASIN		
Flowing Wells	77 000	21.5
EUCLA & OFFICER BASINS	0.6	
MURRAY BASIN		
Angas-Bremer Irrigation	25 000	
Padthaway Irrigation Area	24 000	
Murray Basin, general	11 000	
County Buckingham	10 000	
Sub-Total	70 000	19.6
STATE TOTAL	357 000	100



GROUNDWATER USE – Total approximately 357,500 Ml/year



SURFACE WATER USE – Total approximately 660,500 Ml/year FIG.1

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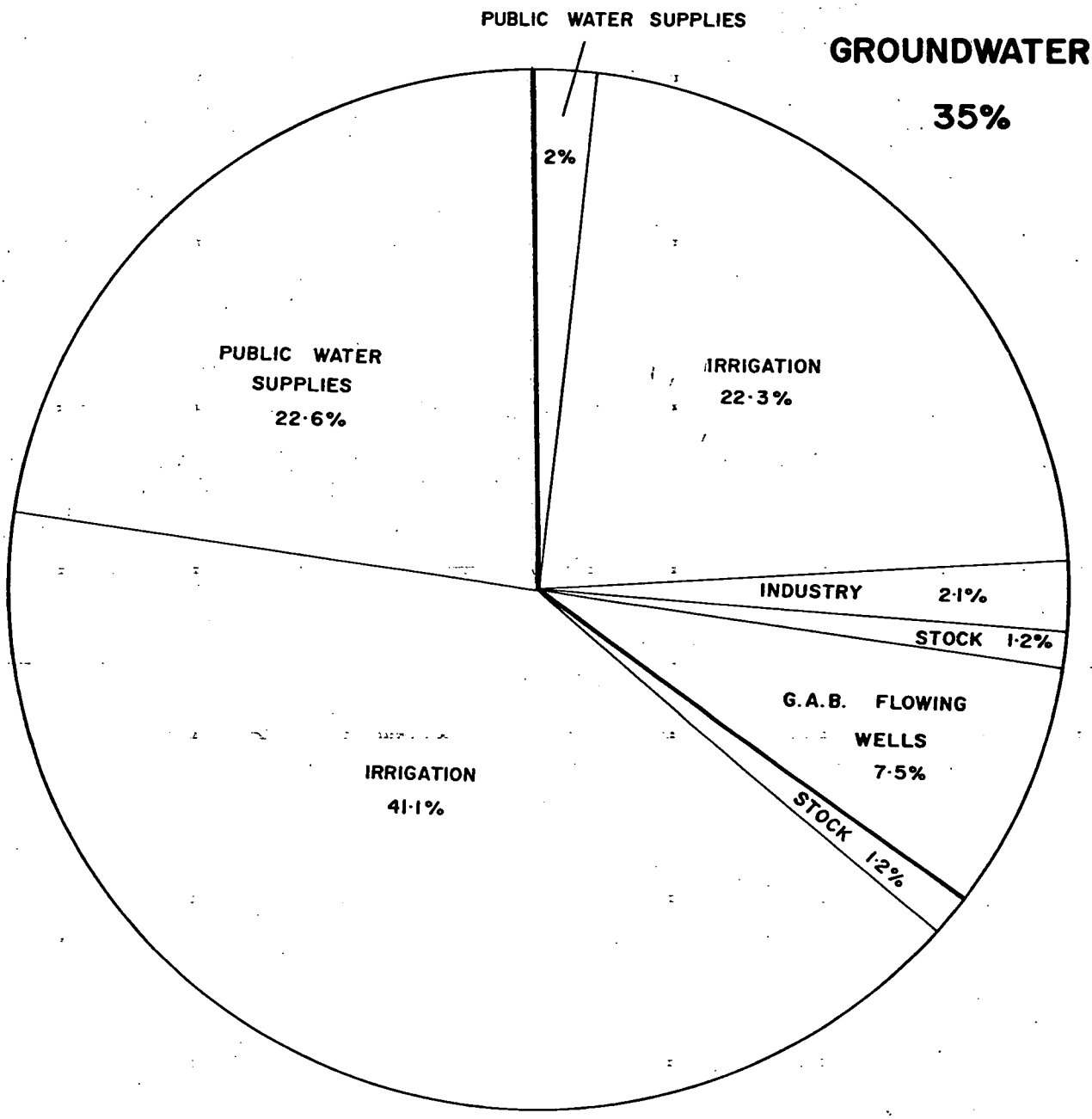

FIG. 2

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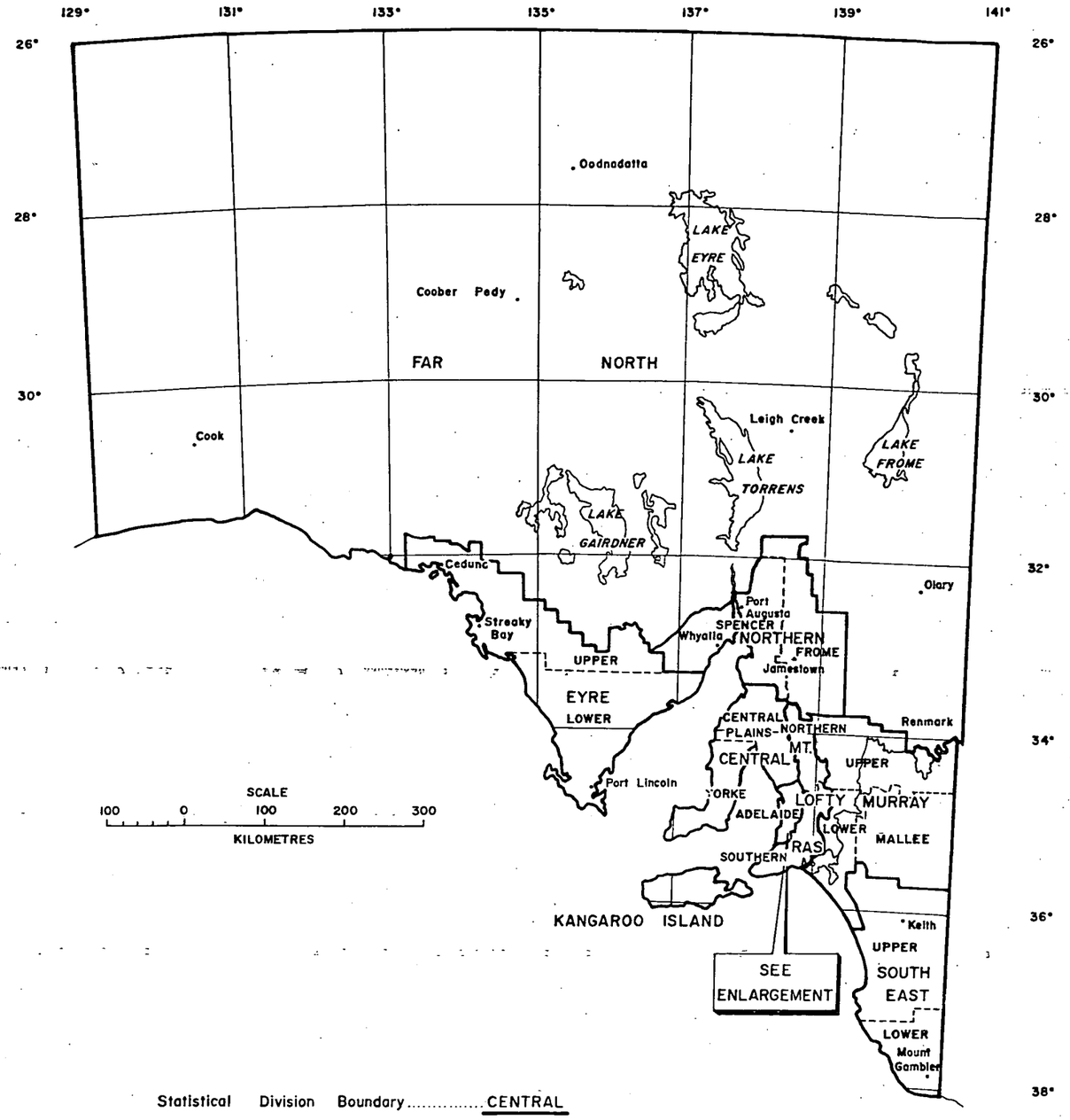

Statistical Division Boundary..... CENTRAL

Statistical Subdivision Boundary..... YORKE

ENLARGEMENT

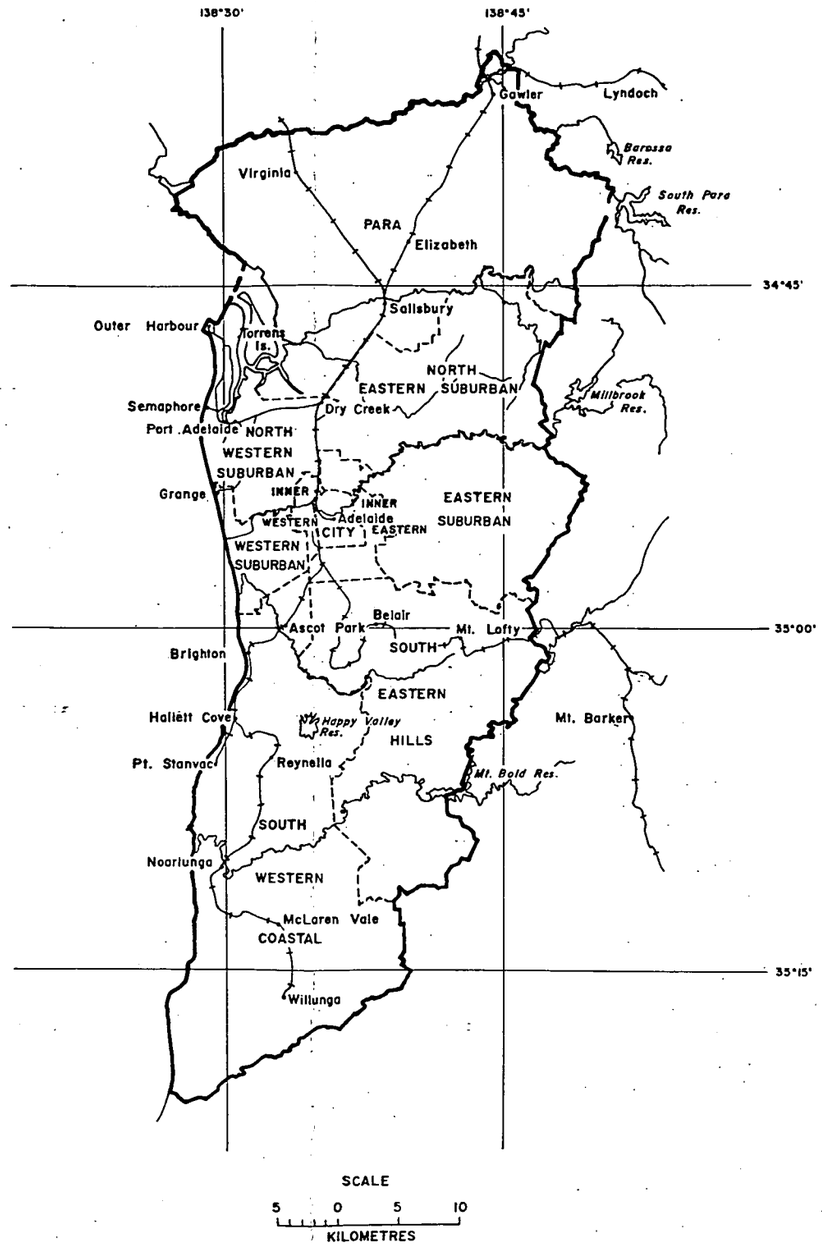

FIG. 3

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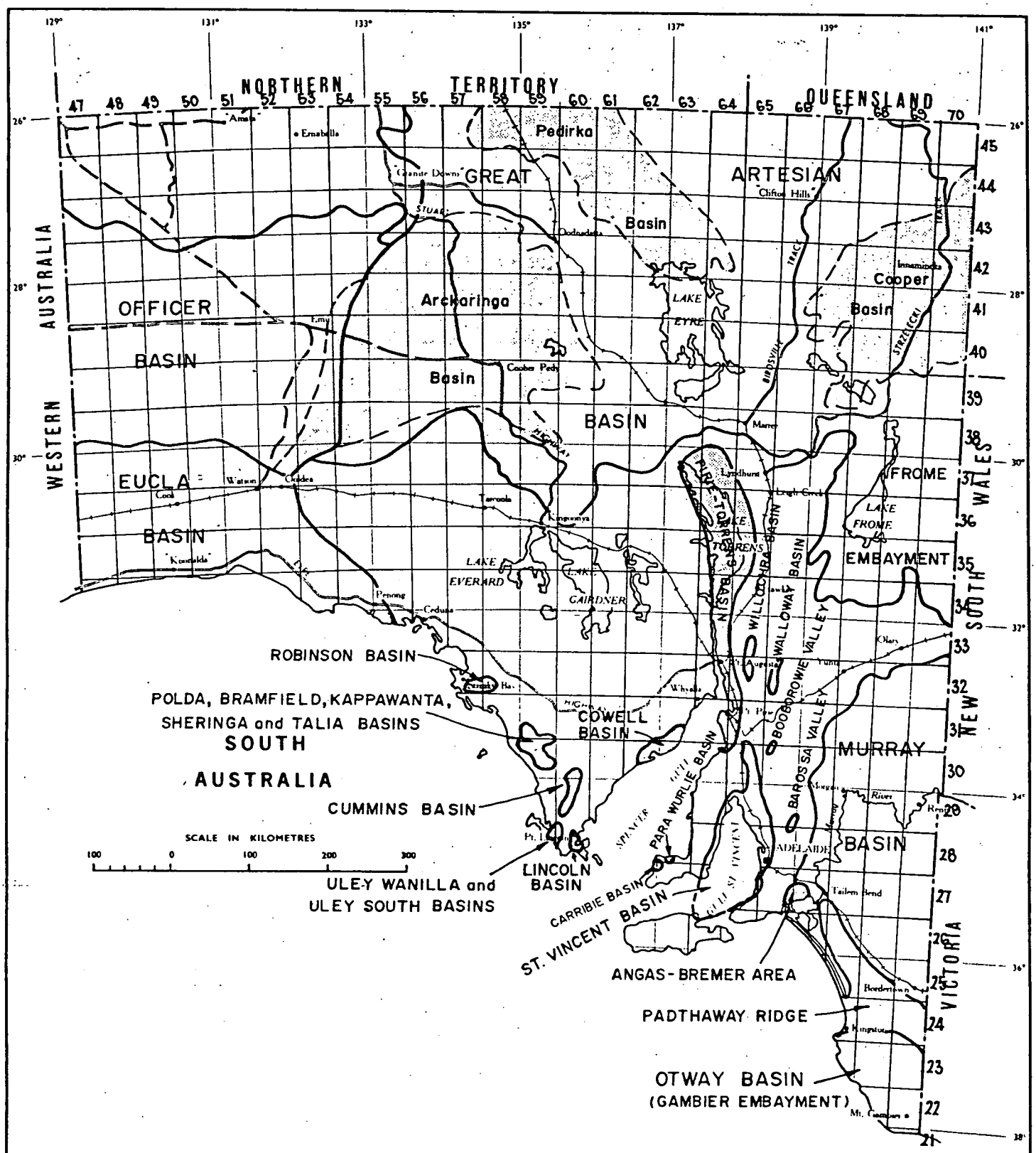

FIG. 4

DEPARTMENT OF MINES — SOUTH AUSTRALIA

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P.F. No. 55850 994.2

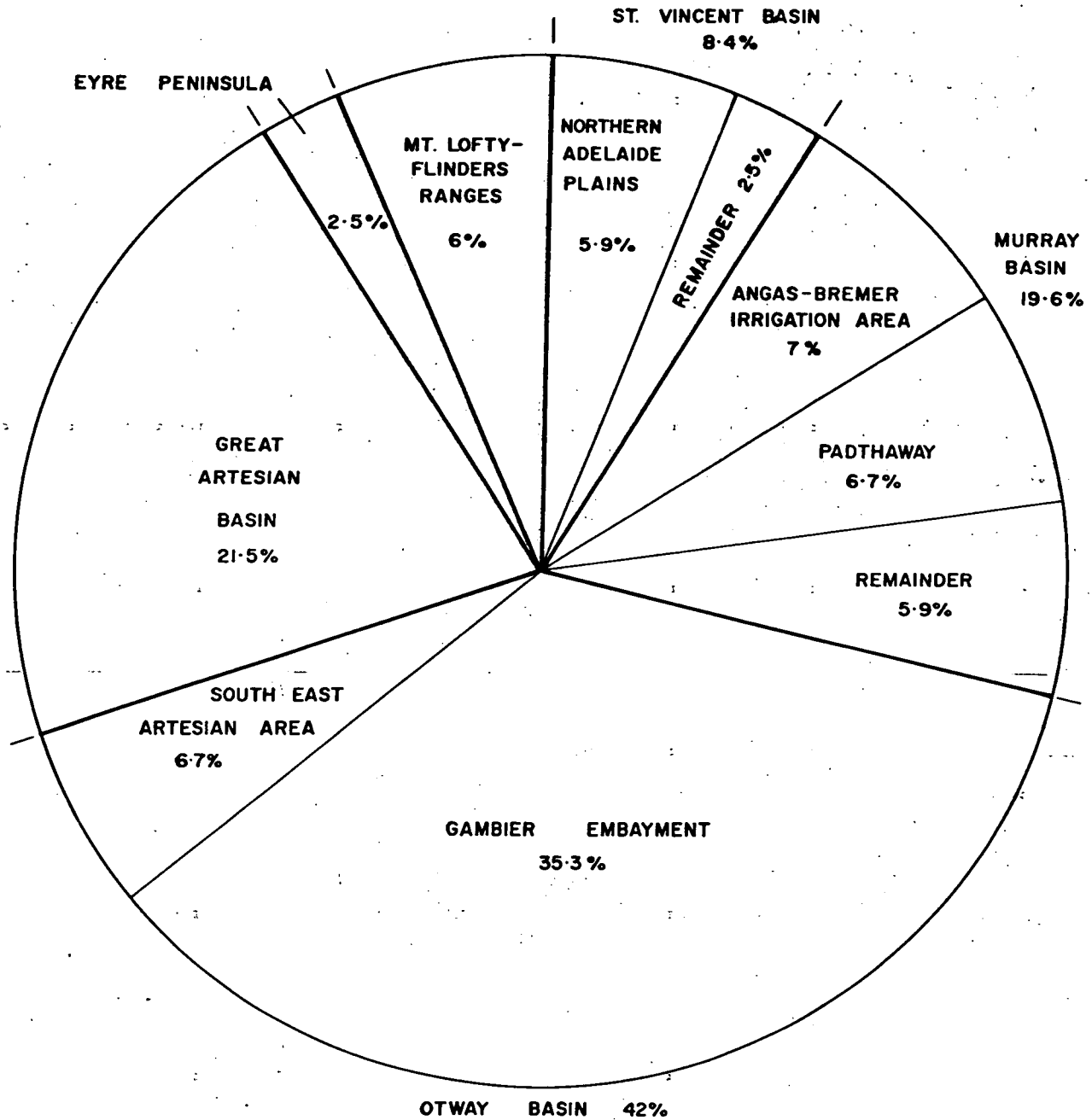

FIG. 5

	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE: —
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DRN: TE / CKD:		PLAN NUMBER
	PROPORTIONS OF GROUNDWATER USE	S 13517

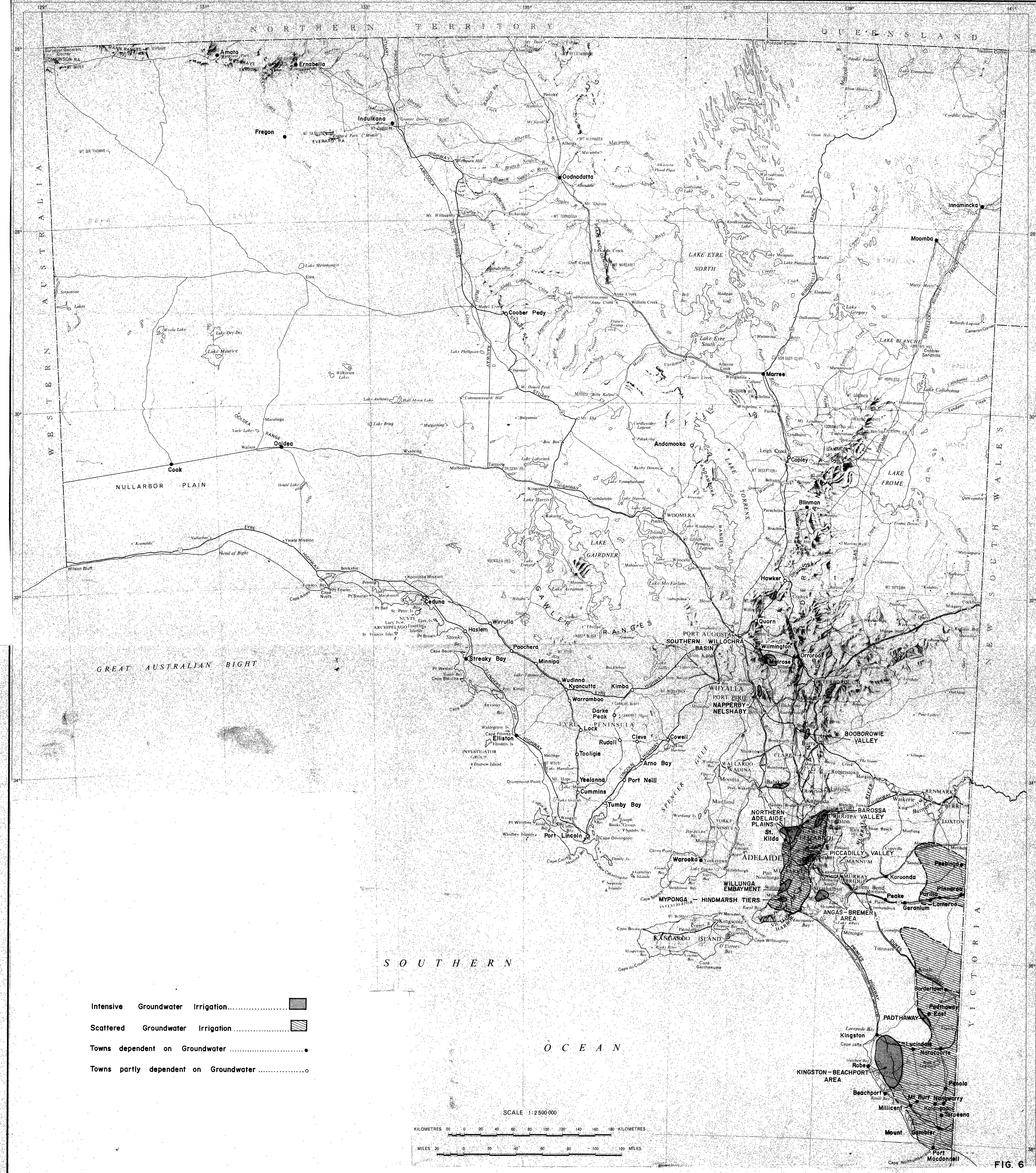

FIG. 6

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DRN: T. E. CKD:	IRRIGATION AREAS AND TOWNS DEPENDENT ON GROUNDWATER	PLAN NUMBER 78-581