CONTENTS ENVELOPE 4535

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CALPERUM MANAGEMENT STUDY

- DRAFT -

Land Resource Management Division

Department of Lands

South Australia

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SECURITY

This document represents the complete study defining the land uses of the Calperum area. Comments on this Draft are invited and should be addressed to:

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Department of Lands
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BERRI 5343

or

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Comments will be received until Friday 14th May, 1982.

CALPERUM MANAGEMENT STUDY

- DRAFT -

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INTRODUCTION

The Calperum Land Management Study Area consists of approximately 7,500 hectares of land between Berri and Renmark, in South Australia's Riverland (see map 1). The study area contains approximately 5,500 hectares of mallee highland and 2,000 hectares of floodplain, with the Sturt Highway separating the two land units.

Much of the study area was surrendered from the Calperum Pastoral Lease in 1979. The land was of little use to the lessees due to its poor grazing potential and the problems town dogs posed to sheep. There was some confusion about tenure in the area, and it was to the Government's advantage to excise an area from the pastoral lease so that a thorough study could be made of the numerous activities that were then occuring in, or were proposed for, the study area - particularly near the Sturt Highway. The sum of $38,000-00 was paid for the improvements on the land. The rest of the study area was either Crown land, reserved land or land held under terminating tenure. Freehold and perpetual leasehold land have not been considered.

This study has examined the physical attributes of the area, the uses that have been proposed for the area, the suitability of the land for such uses, and the desirability of having such land uses in the area. Objectives for future management have been developed and future land uses, tenure and management conditions, have been proposed as guidelines for the area's development.

Adoption of this plan should result in the best long term use of the land by the community, together with some financial return to the Government, via freeholding and lease rentals, in the short term. The proposed availability of mineral resources and land for Government purposes will also result in savings to Local and State Governments, and thus to the community as a whole.

Detail of the study area is shown in Maps 2 and 3. Map 2 shows the survey detail at the time the study commenced, and many public submissions refer to the section numbers on that map, in particular 989 (the floodplain) and 1003 (the mallee area). While the study has been in progress, many of the sections have been renumbered (reflecting the change in tenure from Pastoral Lease to Crown Land) and the present situation is shown on Map 3.

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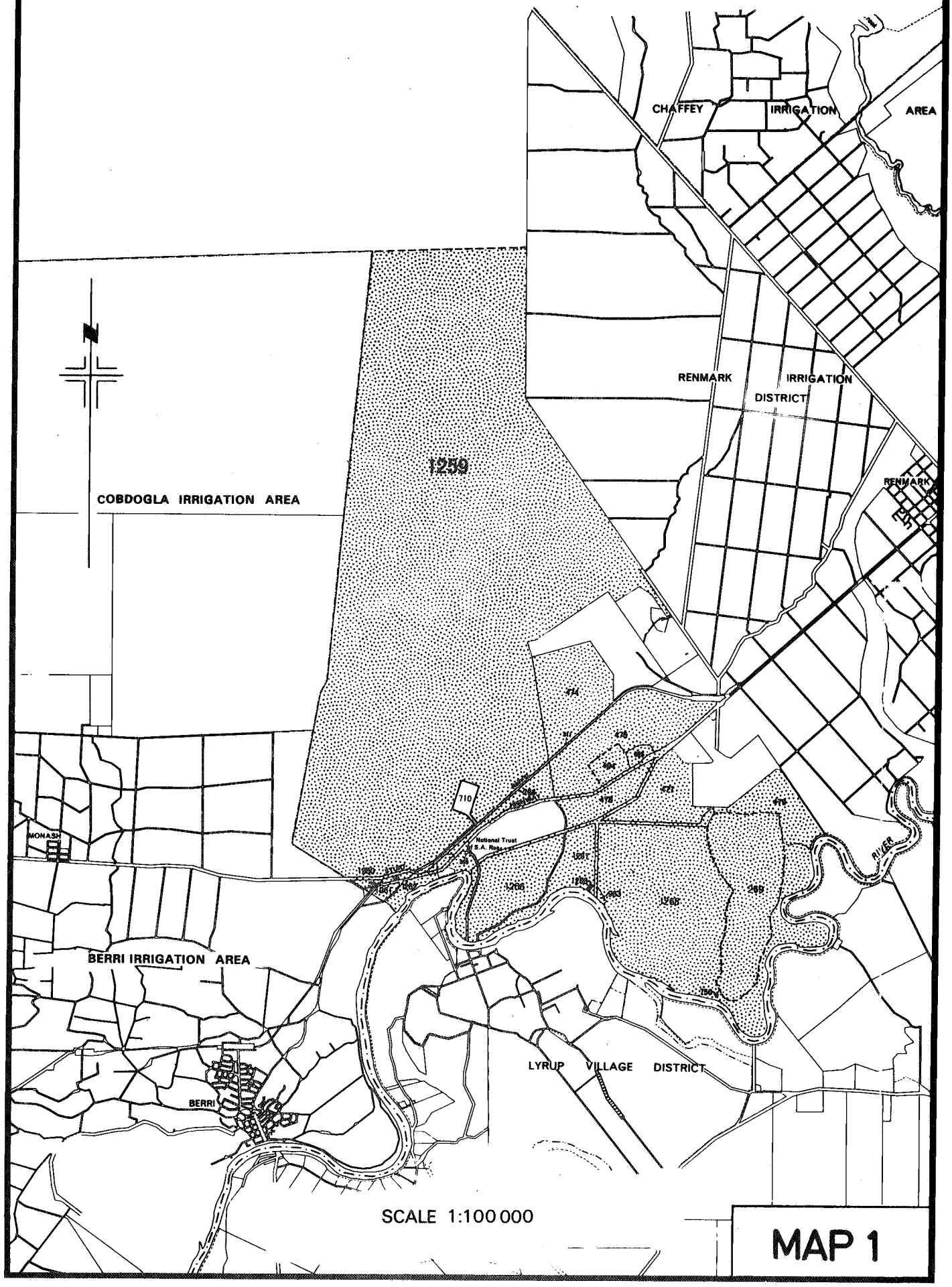
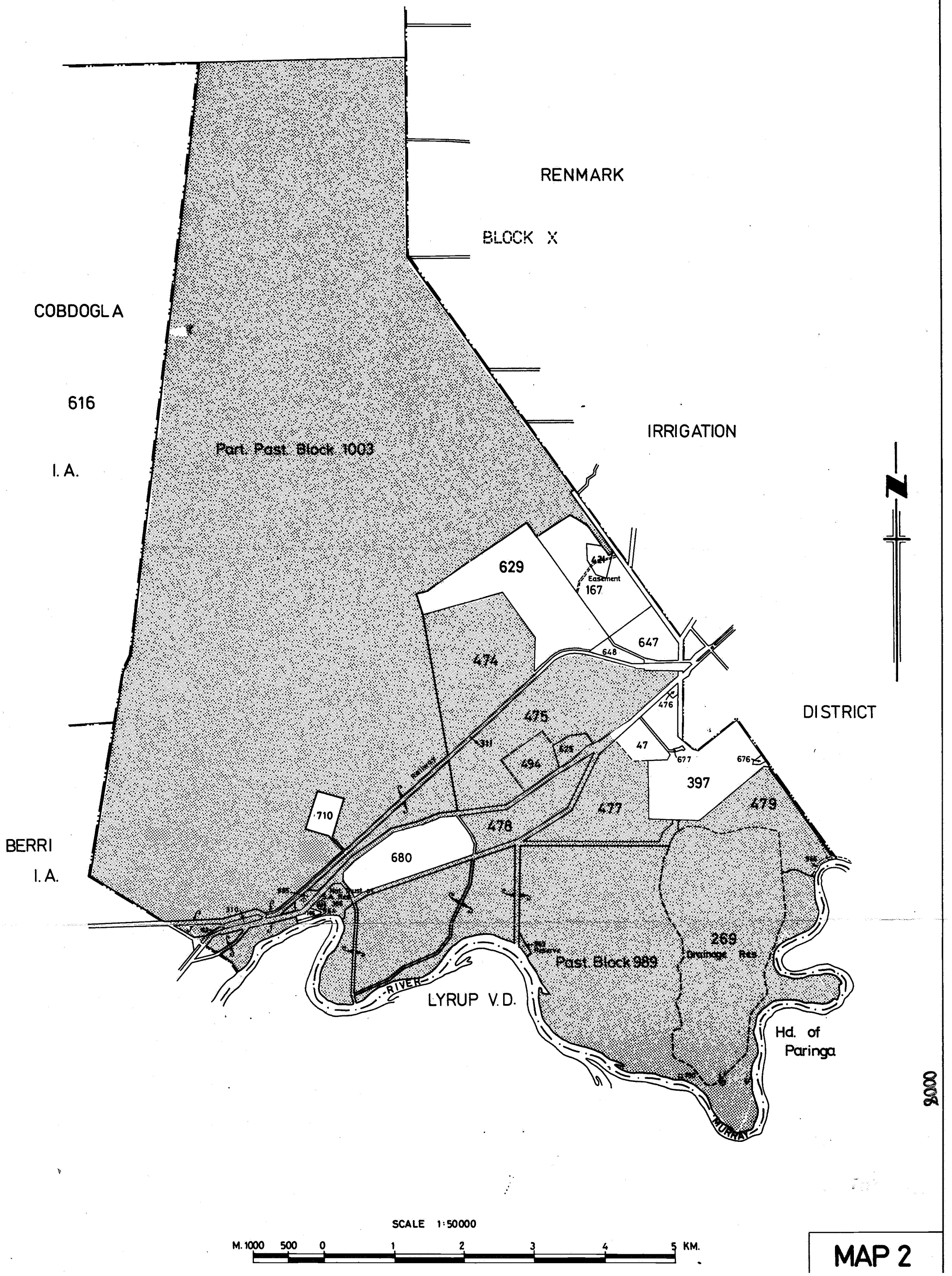
CALPERUM STUDY AREA



MAP 1

CALPERUM

LAND MANAGEMENT STUDY AREA
AT THE TIME OF SURRENDER

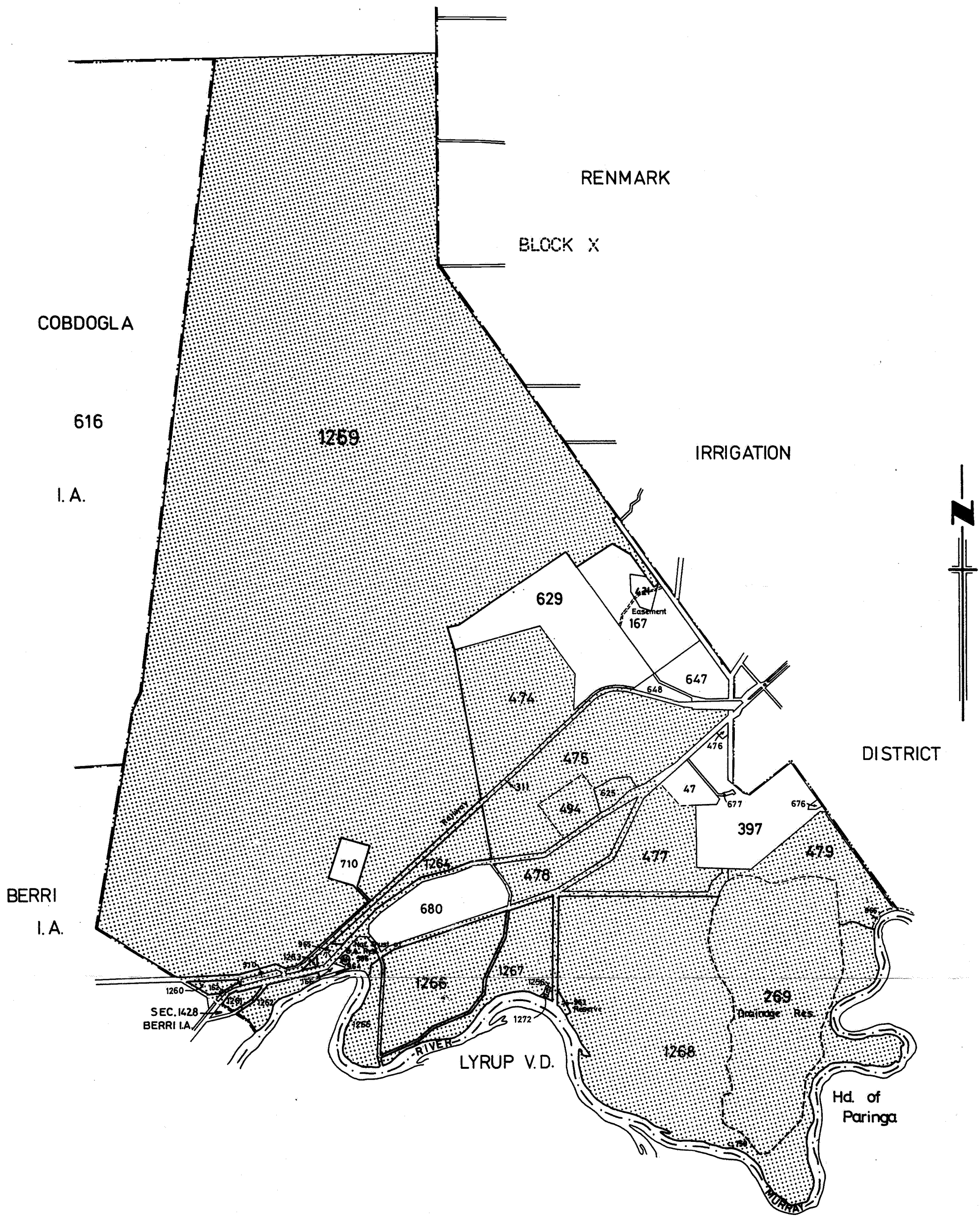


MAP 2

CALPERUM

LAND MANAGEMENT STUDY AREA

CURRENT SURVEY DETAIL



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M. 1000 500 0 1 2 3 4 5 KM.

MAP 3

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PHYSICAL FEATURES

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1. GEOLOGY

Geology as defined by Whitten and Brooks (1972) is "The study of the Earth as a whole, its origin, structure, composition, and history and the nature of the processes which have given rise to its present state....". Implicit in this definition is the requirement to fully comprehend the physical structure of the area under consideration. A geological description enables a better understanding of the physical features, geomorphology and soils, to a lesser extent the vegetation and fauna, and so contributes to an appropriate interpretation of the land's capabilities.

1.1 MURRAY BASIN

The Murray Basin according to Firman (1973) comprises approximately 300 metres of Tertiary sediments. The basin was shaped and these sediments deposited during the Cainozoic. Consequently most importance will be placed on detailing the sequences of this age. However, as the basin overlies Mesozoic and Palaeozoic deposits, these will also be discussed.

Figure 1.2 outlines the stratigraphy of the Murray Basin.

1.1.1 Palaeozoic Era

The Waitpingan subsidence marked the commencement of a succession of tectonic events at the beginning of the Palaeozoic and resulted in the formation of the Kanmantoo Trough (see Figure 1.1). Compensating upward movements occurred to the north and west of this trough and eroded material from this area formed the source of the sediments now known as the Kanmantoo Group. Finally, a tectonic event, the Delamerian Orogeny, folded the materials of the Kanmantoo Trough and the Adelaide Geosyncline to produce a complex folded belt extending from the Southern Ocean to the northern border of the State.

These folded rocks of the Adelaide Geosyncline and the Kanmantoo Group mark the western margin of the basin and constituted one source of material accumulating in the basin. It is suggested that sediments from the southern portion of the State were also deposited within the Murray Basin.

Marine and fluvio-glacial deposits were laid down in the Murray Basin during the Permian. The Renmark Trough, which extends between Monash and Renmark, was formed during this time.

1.1.2 Mesozoic Era

Stable tectonic conditions prevailed over most of the State during the Triassic and Jurassic periods. During this time all the land now known as South Australia was above sea level and consequently the sedimentary deposits of this time were terrestrial fluviatile and lacustrine.

These relatively stable conditions ended early in the Cretaceous when large scale downwarping of the earth's crust occurred. Consequently, marine sediments (siltstones and dark grey marine shale) were deposited during most of the Cretaceous. However, by the late

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Cretaceous, due to continual sedimentation in the Murray Basin, the depositional environment changed to fluvio-lacustrine.

1.1.3 Cainozoic Era

(a) Tertiary Period

At the beginning of the Tertiary, tectonic activity resulted in the formation of the Murray Basin.

Non-marine to paralic conditions prevailed during the early Tertiary and the resultant deposits, known as the Renmark Beds, are widely distributed throughout the Murray Basin.

A marine transgression occurred in the Oligocene during which glauconitic and calcarenitic marls known as the Ettrick Formation were laid down. The Padthaway Ridge acted as a natural barrier to the marine transgression during the Eocene and once the Oligocene marine transgression had taken place the Ridge provided a barrier, behind which sedimentation of mid-Tertiary limestones occurred.

A warm, shallow marine environment persisted during deposition of the Mannum Formation and Morgan Limestone both of which are of Miocene age.

According to Ludbrook (1969) tectonic activity during the middle to upper Miocene elevated the Murray Basin and led to regression of the sea. The marine environment returned to the Murray Basin during the early Pliocene and as a consequence the Bookpurnong Beds, containing carbonaceous and glauconitic marls and micaceous sands, were laid down. Estuarine conditions prevailed during the late lower Pliocene and Loxton Sands, which are widespread throughout the basin, were deposited. The Norwest Bend Formation was also formed under estuarine conditions and exists in a tract between Tailem Bend and Waikerie (Firman, 1973). Parilla Sand, a fine to medium quartz sand, was deposited eastward of and adjacent the Norwest Bend Formation under a fluvio-lacustrine environment.

(b) Quaternary Period

Clastic material in the Quaternary sediments have been derived from mainly local reworking of older sediments. However, the Mount Lofty - Olary Ranges, basement highs along the Padthaway Ridge, and the Great Dividing Range have also acted as provenence areas (Firman 1973).

Blanchetown Clay and Bungunnia Limestone are the two main deposits of the early Pleistocene Epoch. ".... The area of distribution of Bungunnia Limestone is similar to that of the Blanchetown Clay and serves to mark the boundary between the fluvio-lacustrine environment in which the clay was deposited and the gravelly piedmont environment of the

adjoining ranges ....." (Firman 1973). The distribution of the Blanchetown Clay and the lacustrine Bungunnia Limestone was associated with a series of middle Pleistocene valley lakes collectively known as Lake Bungunnia. This area of "valley lakes" was to the north of the Marmon Jabuk Fault.

Bakara Soil is a common deposit within the Murray Basin and although its origin is not clearly understood it is thought to have been formed by the reworking of local Tertiary deposits mixed with deposits of calcareous loess originating from the continental shelf. The oldest calcrete layer of this soil is known as Ripon Calcrete, an indurated layer which acts as a geological divider between the younger aeolian deposits and the older pre-Ripon Calcrete rocks.

The Woorinen Formation was deposited during the upper Pleistocene and is thought to have been formed by the removal and consequent aeolian deposition of the surface horizon from the Bakara Soil. Within this formation a distinctive soil unit known as Loveday Soil was developed. This Loveday Soil is characterized by soft, platy or nodular calcuim carbonate layers. The Woorinen Formation is widespread throughout the Murray Basin.

Periodic transportation of gypsum from lake floors to lee-side dunes within the Murray Basin, occurred during the Recent Epoch. This deposition is known as the Yamba Formation.

Within the river valley, deposition of alluvial clays, silts and coarse sands known as the Monoman Formation, began with the rise of the Flandrian Sea during the Recent Epoch (Firman 1973). In certain areas within the Murray Basin, red Bunyip Sand and yellow Molineaux Sand were deposited over portions of this Monoman Formation. These sands and the Monoman Formation were then overlain by fluviatile clays, silts and sands known as the Coonambidgal Formation. "Modern deposition in and adjacent to the present stream channels are not differentiated from Coonambidgal Formation." (Firman 1973).

The more recent aeolian deposits of Bunyip Sand and Molineaux Sand were deposited at similar times. However, their distribution is different. Both resulted from reworking of the Woorinen Formation but in some places Molineaux Sand is derived directly from Loxton Sands and other units in some places.

1.2 CALPERUM LAND MANAGEMENT AREA

The geology of the Calperum Land Management Area is discussed in relation to the regional setting outlined above. The description is based on Department of Mines and Energy and the Engineering and Water Supply Department bore hole data.

Figure 1.3 in conjunction with Figure 1.4 reveals the surface stratigraphy of

the study area as described by Martins (1981). Three geological units have been mapped as surface expressions for this area, namely, the Woorinen Formation, Bakara Soil and the Coonambidgal Formation. Bore holes have been drilled mainly within the Woorinen Formation but bore hole number 153 has been drilled within the Bakara Soil unit. The geology of the first two of these units will be considered initially.

Figure 1.4 shows the maximum depth, for bore holes within the Woorinen - Bakara area, is 45.72 metres. Holes of this depth penetrate to the Upper-Middle Tertiary and consequently only the geology from this time onwards can be discussed.

Examination of the three Department of Mines and Energy bore holes reveals Pliocene sands are common throughout the area. The Renmark Geological Survey Sheet shows Pliocene sands underlie most of the area.

Blanchetown Clay is the next more recent geological unit and it is found in all bore holes except one, R.W. 16, however the depth and thickness of the Blanchetown Clay differs. This observation supports the explanation offered by Thomson (1974) who suggests the post-Tertiary Surface is erosional. Further drillings would be necessary for mapping the Blanchetown Clay throughout the area but it is assumed Blanchetown Clay is intermittent in the area.

The Coonambidgal Formation is found on most of the land south of the Sturt Highway. No drilling has been done in this part but is is expected Monoman Formation would underlie Coonambidgal Formation.

Structure and distribution of sediments are explained in the next section - Geomorphology.

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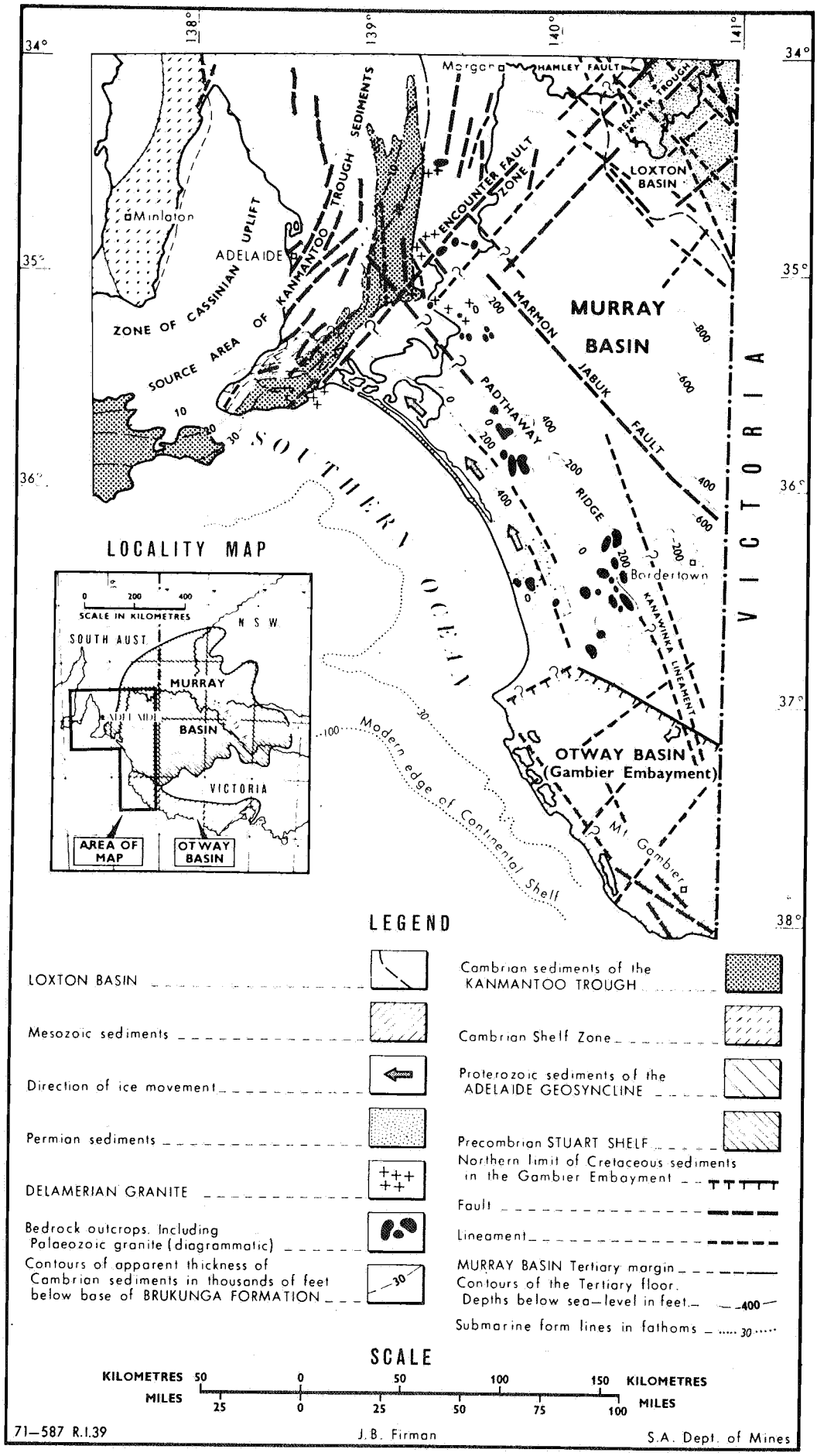
138°
139°
140°
141°
34°
35°
36°
37°
38°
Morgan
HAMLEY FAULT
DENMARK TROUGH
LOXTON BASIN
ENCOUNTER FAULT ZONE
KANMANTOO TROUGH SEDIMENTS
Minlaton
ADELAIDE
ZONE OF CASSINIAN UPLIFT
SOURCE AREA OF
MURRAY BASIN
MARMON
JABUK FAULT
PADTHAWAY RIDGE
SOUTHERN OCEAN
VICTORIA
Bordertown
KANAWINKA LINEAMENT
OTWAY BASIN
(Gambier Embayment)
Mt Gambier
Modern edge of Continental Shelf
LOCALITY MAP
SCALE IN KILOMETRES
N S W
SOUTH AUST
MURRAY BASIN
VICTORIA
AREA OF MAP
OTWAY BASIN
LEGEND
LOXTON BASIN
Mesozoic sediments
Direction of ice movement
Permian sediments
DELAMERIAN GRANITE
Bedrock outcrops. Including Palaeozoic granite (diagrammatic)
Contours of apparent thickness of Cambrian sediments in thousands of feet below base of BRUKUNGA FORMATION
Cambrian sediments of the KANMANTOO TROUGH
Cambrian Shelf Zone
Proterozoic sediments of the ADELAIDE GEOSYNCLINE
Precombrian STUART SHELF
Northern limit of Cretaceous sediments in the Gambier Embayment
Fault
Lineament
MURRAY BASIN Tertiary margin
Contours of the Tertiary floor. Depths below sea-level in feet.
Submarine form lines in fathoms
SCALE
KILOMETRES 50 0 50 100 150 KILOMETRES
MILES 25 0 25 50 75 100 MILES
71—587 R.I.39
J.B. Firman
S.A. Dept. of Mines

FIG. 1·1

FIG 1.2

STRATIGRAPHY OF MURRAY BASIN SEDIMENTS

Era	Period	Epoch	Rocks & Structures	Approx.Age (Million years)
Cainozoic	Quaternary	Recent	Coonambidgal Formation Bunyip and Molineaux Sand Monoman Formation Yamba Formation	0.01
		Pleistocene	Woorinen Formation Bakara Soil Ripon Calcrete Bungunnia Limestone Blanchetown Clay Karoonda Surface	
	Tertiary	Pliocene	Norwest Bend Formation	10
			Parilla Sand Loxton Sand Bookpurnong Beds	11
		Miocene	Morgan Limestone Mannum Formation	25
		Oligocene	Ettrick Formation	40
		Eocene		60
		Palaeocene	Renmark Beds	70
Mesozoic	Cretaceous		Grey marine shales Non-marine sandstones	135
	Jurassic		Otway Basin Deposits	180
	Triassic			225
Palaeozoic	Permian		Renmark Trough	270
	Carboniferous			350
	Devonian			400
	Silurian			440
	Ordovician		Delamerian Orogeny	500
	Cambrian		Kanmantoo Group	600

Source: Department of Lands (1979) "Lake Bonney Management Project".

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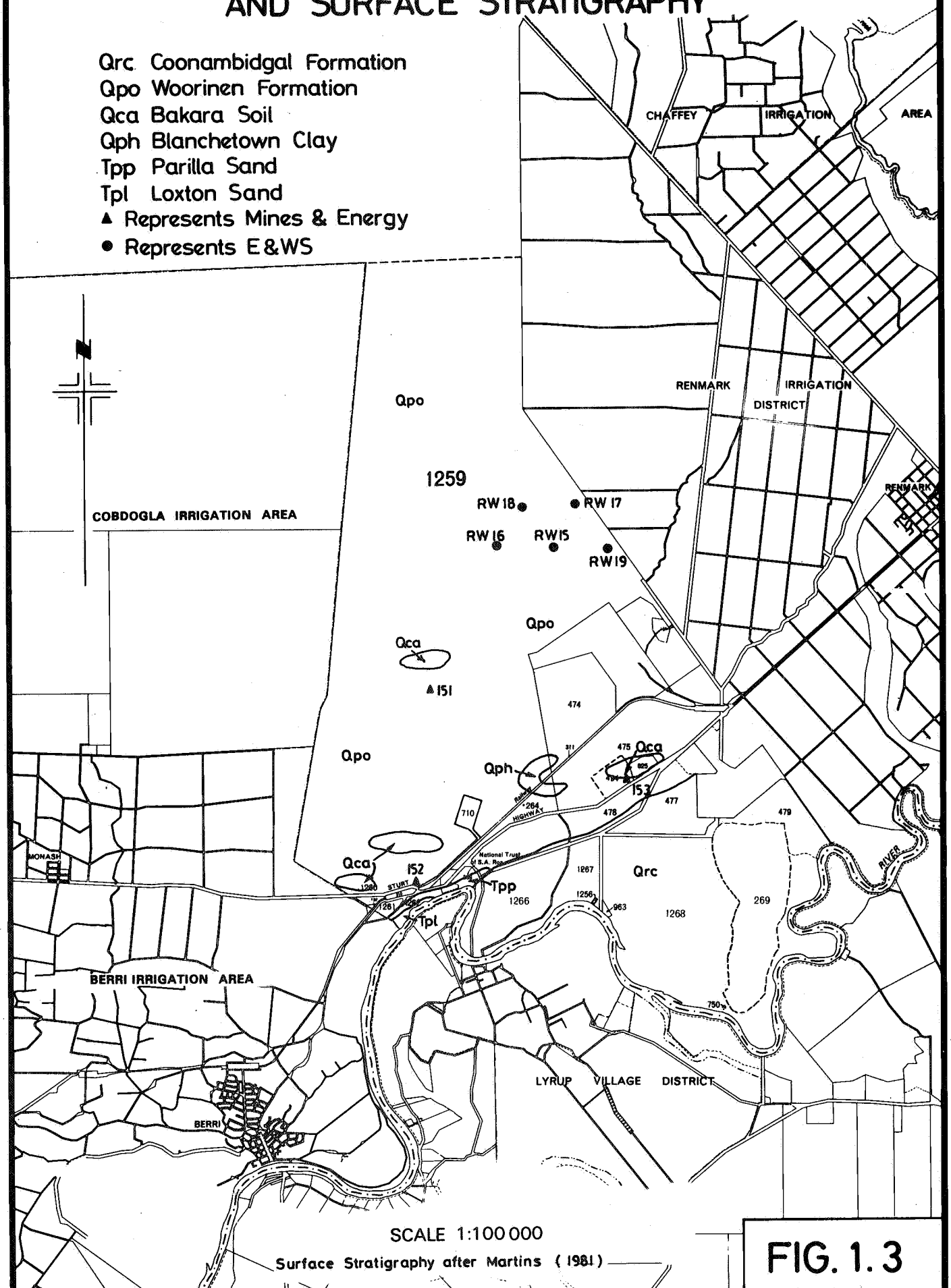
BORE HOLE LOCATION MAP AND SURFACE STRATIGRAPHY

Qrc Coonambidgal Formation
Qpo Woorinen Formation
Qca Bakara Soil
Qph Blanchetown Clay
Tpp Parilla Sand
Tpl Loxton Sand
▲ Represents Mines & Energy
● Represents E&WS



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Surface Stratigraphy after Martins (1981)

FIG. 1.3

FIGURE 1.4

Bore Hole Information - Calperum Land Management Area

NOTE: Figure 1.3 shows the location of each Bore Hole.

Bore 151	0 - 2.44 m	Woorinen Formation
	2.44 - 5.49m	Blanchetown Clay
	5.49 - 45.42m	Pliocene Sands
Bore 152	0 - 3.05m	Woorinen Formation
	3.05 - 6.1m	Limestone and Blanchetown Clay
	6.1 - 45.72m	Pliocene Sands
Bore 153	0-1.83m	Bakara Soil
	1.83 - 7.93m	Blanchetown Clay
	7.93 - 45.72m	Pliocene Sands
R.W. 15	0 - 4.02m	Not defined
	4.02 - 6.52m	Blanchetown Clay
R.W. 16		No Blanchetown Clay
R.W. 17	0 - 5.99m	Not defined
	5.99 - 9.49m	Blanchetown Clay
R.W. 18	0 - 3.53m	Not defined
	3.53 - 8.03m	Blanchetown Clay
R.W. 19	0 - 3.51m	Not defined
	3.51 - 9.51m	Blanchetown Clay

Source: Logs of the Department of Mines and Energy Bore holes and the Logs of the Engineering and Water Supply Department Bore holes.

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2. GEOMORPHOLOGY

By describing and interpreting the many and varied landforms of the earth a better understanding of the origin of landforms and their reaction to different land use can be gained. Description and interpretation of landforms at Calperum should therefore aid the identification of land use suitable for the area.

There are two major land units contained within the study area, the Highland and the Old River Valley (Figure 2.1). Both units and the minor variations within them are described, followed by an interpretation of the origin of the landforms at Calperum.

2.1 DESCRIPTION OF LANDFORMS

2.1.1 Land forms within Highland unit

The highland unit occupies 75% of the area at Calperum. It comprises chiefly an east-west trending dune system, the Woorinen Formation. The dune pattern is occasionally interupted by the minor landforms.

A large, U-shaped, low-lying flat (see Figure 2.2) and other smaller, low-lying flats are also present.

Two primary sinkholes, of varying sizes, have been identified.

Secondary sinkholes occur in the area, and one is located at Eremophila Flat.

The dunes of the Woorinen Formation in the study area are of three types, the locations of which are shown in Figure 2.3. They are:-

(a) Regularly spaced dunes, steep in nature with relatively wide interdunal swales.

(b) Regularly spaced dunes, very steep in nature with relatively narrow interdunal swales.

(c) Irregularly spaced dunes, gently sloping dunes with very wide interdunal swales.

2.1.2 Land Forms within Old River Valley unit

The old river valley contains the River Murray and was formed by the initial incision by the ancestral River Murray. The extent of the old river valley is shown in Figure 2.1.

Within this river valley, six different landforms occur (Figure 2.2). Colluvium, defined by Whitten and Brooks (1972) as "Weathered material transported by gravity .....", is one type of landform.The high river terrace, previously part of the ancestral river floodplain, is not now succeptible to inundation. Land of this type is used for horticultural purposes throughout the Renmark area. The high river terrace in the Calperum Land Management Area is of small area and is presently used for grazing as it has been in the past.

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Pieces of a remnant terrace form an island system on the high plain, hence its name.

The high floodplain is the most extensive landform of this unit. It is that land inundated only during times of severe flooding of the present river. The 1956 flood level was used to define the upper extent of the high floodplain.

In contrast there is also a low floodplain, particularly prone to inundation and presently dissected by the built-up Lyrup Ferry Road. The 1973 and 1974 flood levels were used to define the boundary between high and low river floodplain.

2.2 INTERPRETATION OF LAND FORMS

2.2.1 Land Forms within Highland Unit

It should be noted that before a complete explanation of the origin of these landforms can be offered, more study is necessary. The explanation below is an interpretation by authors of this study and may need revision when extra information is available.

Blanchetown Clay is thought to be a major factor of landform variation in the highland area. It is also thought that Blanchetown Clay expresses its sub-surface occurrence surficially and consequently its distribution can be determined and its effects on the general land form understood.

The origin of the Woorinen Formation supports these opinions. As previously mentioned in para. 1.1.3 (b) the Woorinen Formation is thought to have resulted from the re-working and subsequent aeolian deposition of the surface horizon of the Bakara Soil. However as the Woorinen Formation is a transported sediment (wind driven) its present distribution would chiefly reflect the transport processes and not the source of the dune material.

The Bakara Soil may not underlie the Woorinen Formation throughout the Calperum area, but only in part, and Figure 1.4 shows the Bakara Soil is not continuous in the study area.

It is possible Woorinen Formation was deposited on any of three surfaces - Bakara Soil, Blanchetown Clay and Pliocene Sands.

In bore hole 151, Blanchetown Clay underlies Woorinen Formation (Figure 1.4). The post-Tertiary surface of Blanchetown Clay is thought to be erosional. If so, the clay would have been exposed at the surface and probably will not be continuous throughout the area. In bore hole RW16 no Blanchetown Clay was encountered.

Pliocene Sands underlie Blanchetown Clay and are common throughout the area.

According to Mabbutt (1979) "An essential feature of longitudinal dunes is the downwind constrast in surface character between swale and ridge, which provides the important formative mechanism ....". He suggests the greater the contrast in surface texture between the source material and the depositional surface, the wider the resultant swale.

It is therefore suggested the texture contrasts, between the deposited material and the three depositional surfaces, have played a major role in the evolution of the Highland unit.

Figures 2.4 and 2.5 refer to holes drilled in an attempt to verify this interpretation of the highland unit. This information, in conjunction with Figure 1.4, shows wherever Blanchetown Clay is found, the dunal formation is non existent. The large, U-shaped, low-lying flat is thus thought to be due to the sub-surface occurrence of Blanchetown Clay. The clay surface is of sufficient contrast in texture to the sandy depositional material, that only minimal accumulation of the Bakara soil is possible on this clay surface. The dunal sequence is subsequently halted and remains so until the clay sub-surface ceases. Hence no Woorinen Formation exists in this area. The other low-lying, flat areas can also be explained by the sub-surface occurrence of Blanchetown Clay. Differences in the extent and shape of these flat areas may be due to depth and distribution differences of the Blanchetown Clay, however, this cannot be proven without further study.

The existence of three landform types in the Woorinen Formation can also be explained by this surface texture contrast. The regularly spaced dunes, very steep in slope with relatively narrow interdunal swales are thought to be due to the similarity in textures of the two units concerned. In this area the Woorinen Formation has been deposited directly onto the Pliocene Sands. The depth of sand in this area indicates that the source was larger or materials of similar textures tend to accumulate around each other.

The wider swales associated with the regularly spaced dunes in the southern portion of the highland area could be due to the existence of the Bakara Soil surface. The accumulation of a weak calcrete layer during deposition could have also had an effect. The texture of these calcrete layers may have been sufficiently different to that of the depositional material to cause an increase in width of the interdunal swales. Layers of calcrete occur in this area and cause variations to this dunal trend.

Finally, the irregularly spaced dunes with very wide interdunal swales can be partly explained by the calcrete occurrence. If the calcrete was already present sub-surface, dunal spacing can be expected to be large, whereas if calcrete had accumulated within the depositional material, the interdunal swale width should be smaller. The time of formation and nature of the calcrete would also be expected to affect the dune-swale relationship. A modifying effect due to the occurrence of Blanchetown Clay could also partly explain the irregularity in the dunal sequence.

The general relationship between swale width and dune structure appears to be the greater the swale width the wider and flatter the dune shape. A possible reason for this relationship could be that the depositional surface whose texture differs markedly from the depositional material requires a greater area over which to stabilise the depositional material.

Thomson (1974) considers the primary sinkholes are due to the collapse of caprock which underlies Blanchetown Clay within this area. It is also Thomson's opinion that these primary sinkholes are solution features, their shape being associated with fault lines present in the sub-surface stratigraphy. Dunal disruption due to the presence of these primary sinkholes does occur.

2.2.2 Land Forms within the Old River Valley unit

The first land form to consider is the colluvium, the origin of which is related to both the ancestral River Murray and the highland unit. When the ancestral River Murray incised its way through the Mallee surface, the primary slopes, now masked by this colluvial material, were formed. As time passed, weathered material associated with the highland unit was deposited over these slopes. That material which was not subsequently eroded remained and the colluvium land form was established.

The high river terrace is an erosional terrace formed by the migration of the river down the valley. Depositional material related to the highland unit has allowed land within this land form to be successfully used for horticultural purposes in the Renmark area.

The remnant terrace is a depositional terrace. As the ancestral River Murray changed course within the old river valley, certain parcels of land became separated from the erosional effects of the river. Consequently, material deposited was allowed to remain whilst soil elsewhere within the river valley was subjected to the erosional forces of the river. Thus the remnant terrace land form evolved. The soil composition of this terrace indicates aeolian deposition from the highland land unit. The material has remained intact because this land is not part of the present river regime.

The high floodplain is by definition within the present river regime. Fluvial deposition has been sufficiently extensive to allow this land to remain untouched by most floods. Fluvial erosion forces, however, have created parcels of land of varying heights within this land form. The erosional, depositional and directional properties of the river have created this present land form.

The low floodplain also owes its origin to the ancestral River Murray. However on the low floodplain, erosion has outweighed deposition and created a low-lying piece of land prone to inundation.

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CALPERUM STUDY AREA
MAJOR LAND UNITS

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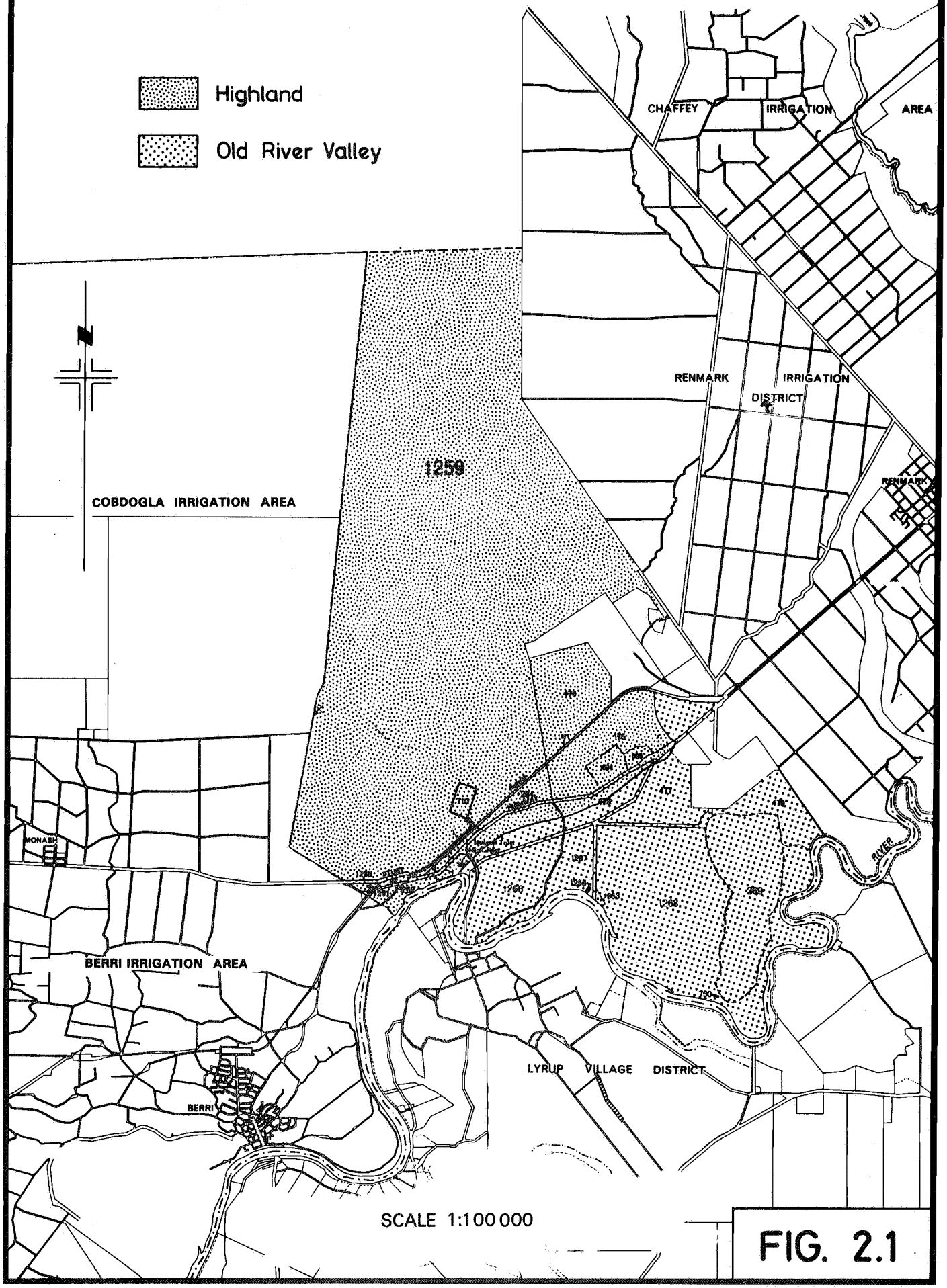

FIG. 2.1

CALPERUM

LAND MANAGEMENT STUDY AREA

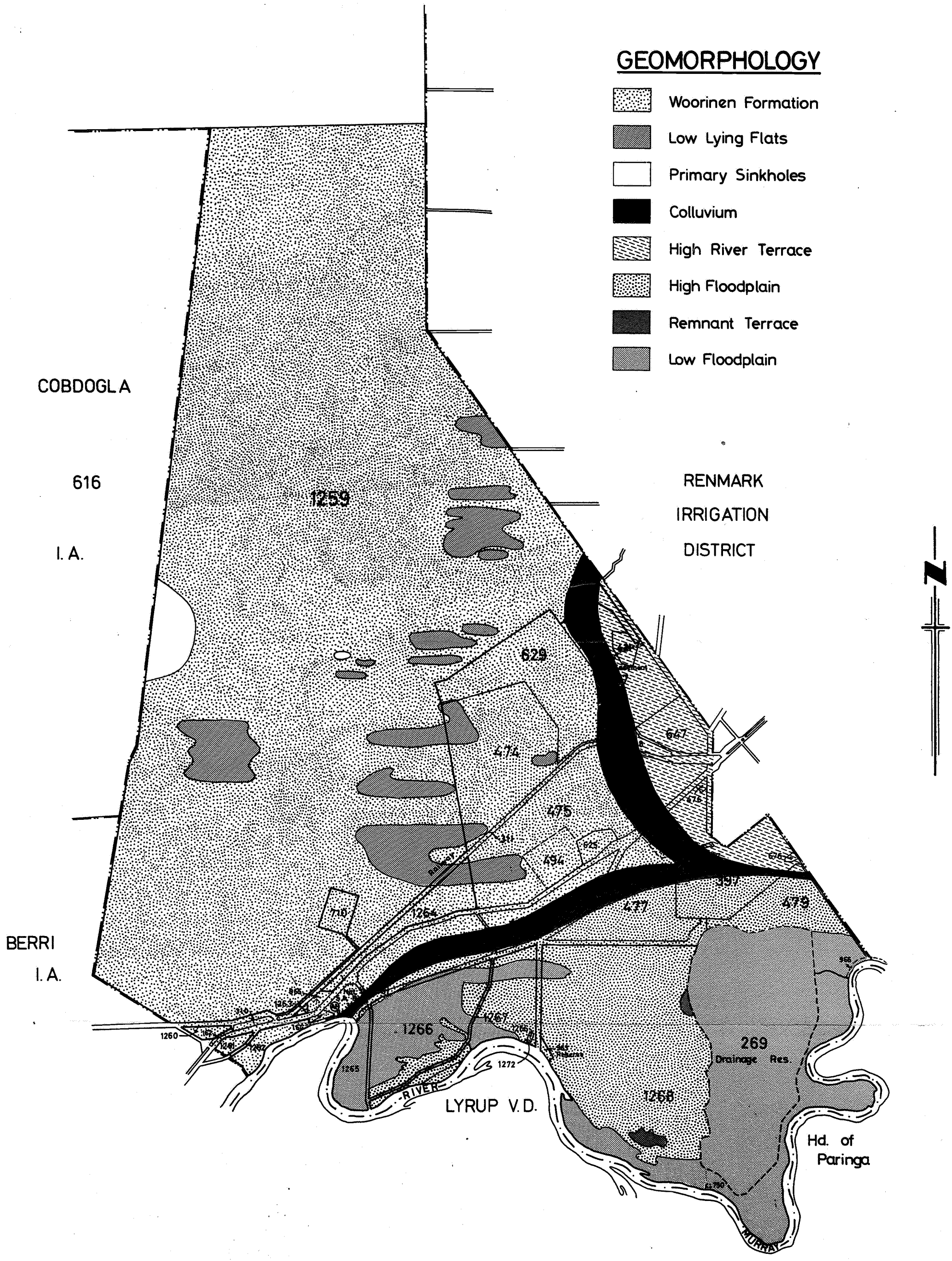

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FIG. 2.2

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SUBGROUPS OF THE WOORINEN FORMATION

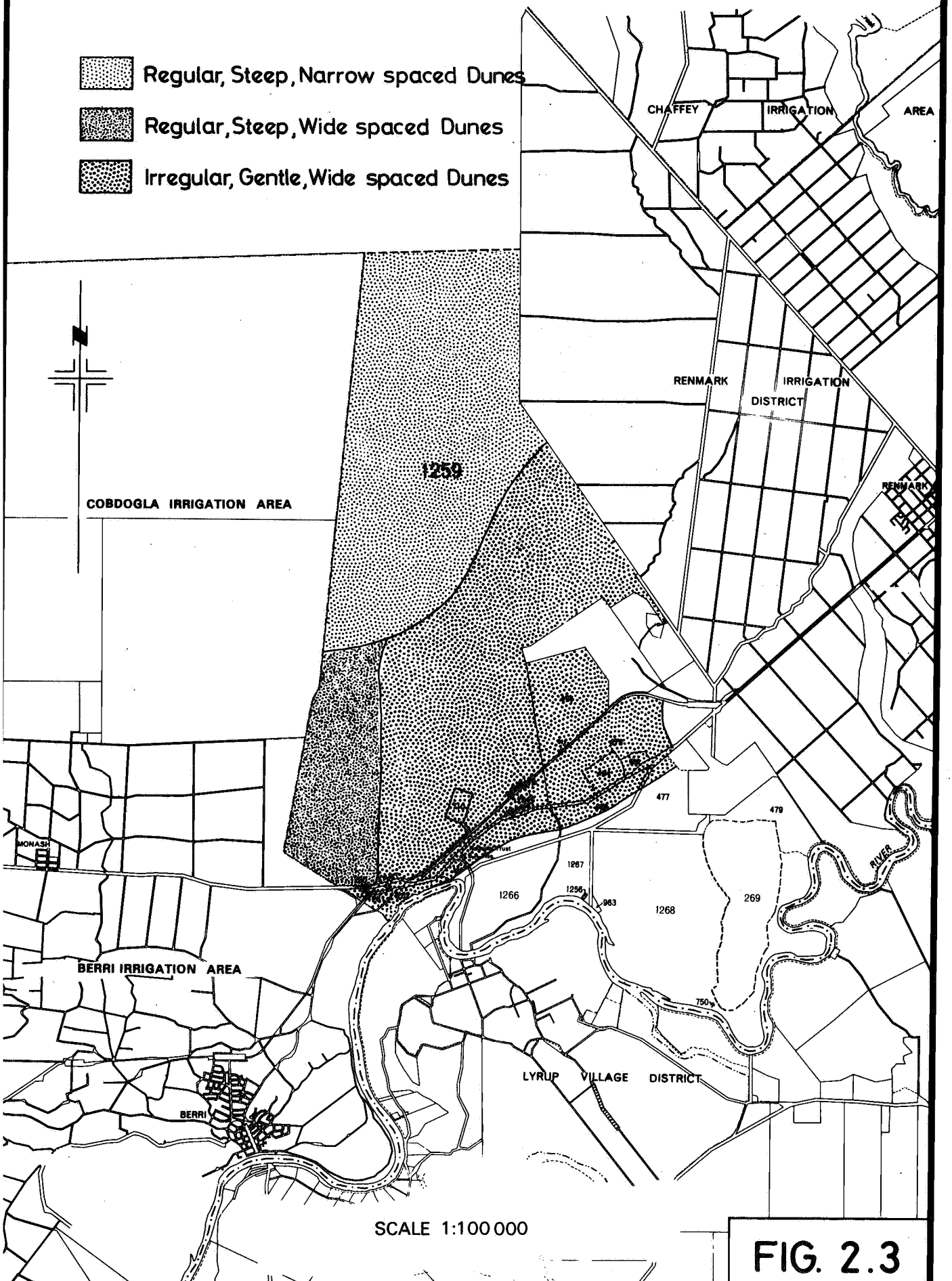

FIG. 2.3

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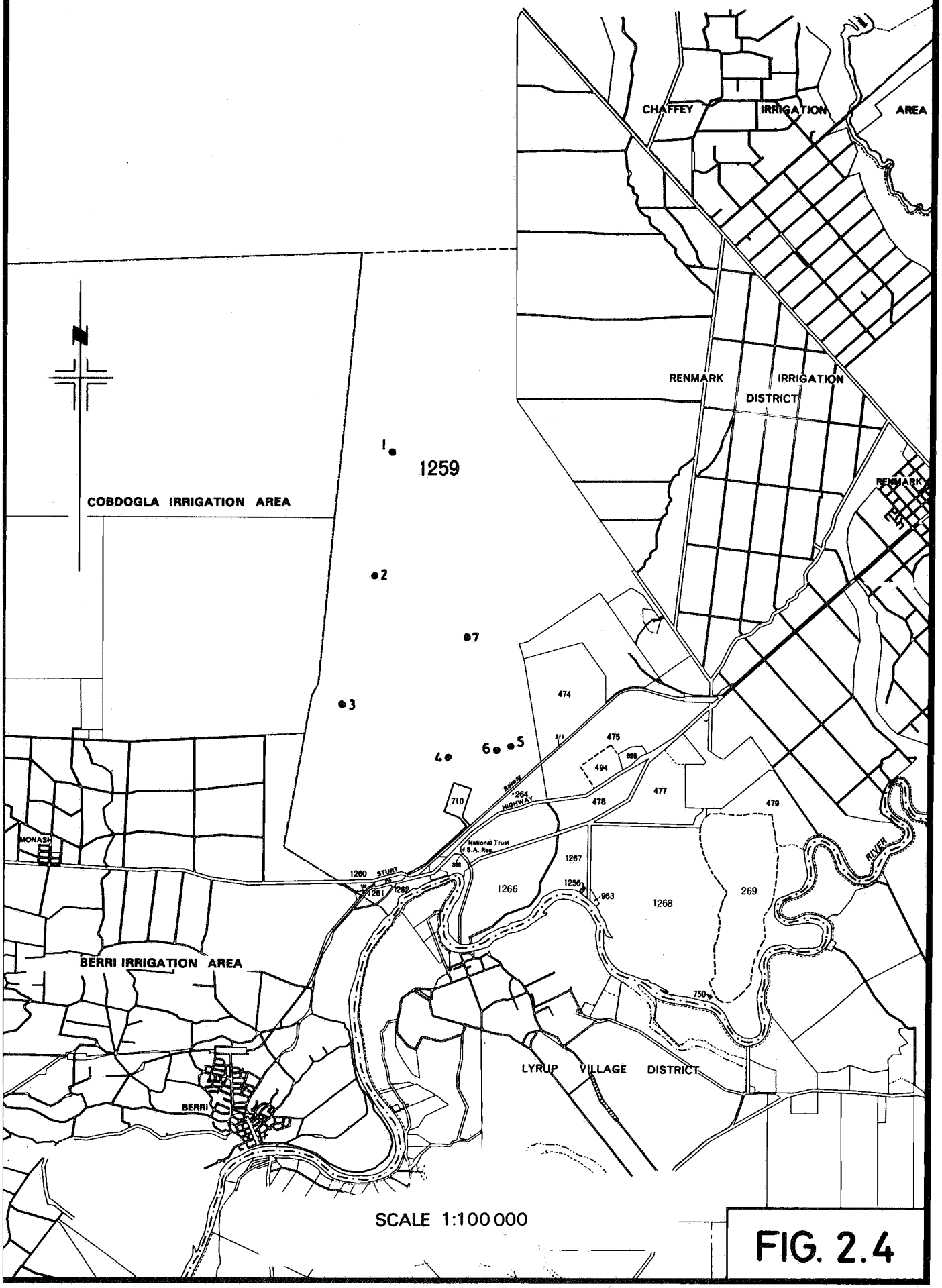
LOCATION OF PROLINE DRILL HOLES



SCALE 1:100 000

FIG. 2.4

FIG. 2.5

Proline drill holes - Geomorphological Interpretation

Drill hole 1	0 - 6'	Sandy Clay Loam to Sandy Loam
	6 - 15'	Loamy Sand with very fine Calcretions
	Approx. 15'	Lime cemented Sand
Drill hole 2	0 - 2'	Sandy Clay Loam
	2 - 6'	Lime layer
	6 - 9'	Blanchetown Clay
	*	
Drill hole 3	0 - 3'	Sandy Clay Loam
	3 - 5'	Light brown Clay Loam
	5 -10'	White Sandy Clay
	10'	Probable Loxton Sand
	*	
Drill hole 4	0 - 2'	Red Loamy Sand
	2 - 3'	Very hard lime layer (nodule type formation at the top)
	*	
Drill hole 5	0 - 1.5'	Light red brown Sandy Clay Loam
	1.5 - 4'	Limey Clay Loam
	4 - 9'	Green heavy clay) Blanchetown
	9 - 14'	Blue heavy clay) Clay
Drill hole 6	0 - 2.5'	Sandy Clay Loam
	2.5 - 7'	Sandy Clay
	7 - 10'	Reddish Blue Clay
	10'	Greenish Blue Clay
Drill hole 7	0 - 5'	Light red brown Sandy Clay Loam (NOTE: more clay as you go down)
	5 - 9'	Red Clay

NOTE: Refer to Figure 2.4 for location of each drill hole.

* Impossible to drill deeper

000029

3. SOIL

A discussion of soils complements information given in previous sections. The soil types present and their properties will be described and related to various land practices employed in the area or proposed for Calperum.

Soils of the area can be related to the two major land units - the Highland unit and the Old River Valley unit.

3.1 HIGHLAND UNIT

3.1.1 Northern portion

The soil of the northern portion of the highland comprises red sand on the dunes and sandy loam in the interdunal swales. In the interdunal swales a very weak calcareous horizon is encountered at a depth of approximately two metres.

Specht (1972) described the soils associated with a "hummock grass" understorey, which comprises a large portion of this area, as relatively infertile. With a mean annual rainfall of 230mm and a relative frequency of approximately 20%, for dry spells exceeding 12 months (Meteorological Bureau, 1955), the land is of uncertain value for cropping. This soil type is also susceptible to erosion if the vegetation cover is removed.

3.1.2 South-Western portion

The south-western portion of the highland contains a similar soil pattern to that found in the northern portion, however, the interdunal swales have heavier textured soils and layers of calcrete occur within the soil profile. In some areas calcrete layers occur close to the surface and some of these have been quarried for construction purposes (Figure 3.1). Depending on the extent and occurrence of these calcrete layers, mining could definitely be a land use suited to this area. Whether this type of land use is compatible with the theme of the overall management plan will be determined at a later stage in the development of the plan.

3.1.3 South-Eastern portion

The south-eastern portion of the highland unit contains various soil types. The geomorphological map (Figure 2.2) shows the distribution of each soil unit.

The sandy clay loam soil associated with the interdunal swales is a major soil unit within this area. Calcrete accumulations and layers occur in this soil profile. Sandy rises are less frequent.

Large, low-lying flats as depicted by Figure 2.2 occur throughout this south-eastern portion. These areas are often characterized by a thick layer of Blanchetown Clay close to the surface, which is overlain by a thin veneer of sandy clay loam. Any land use relying heavily on good soil drainage should be prohibited in these flats. Also overgrazing, should it occur, could cause erosion problems.

000030

3.1.4 Bottom south-western portion

The bottom south-western corner, is that land south of the Sturt Highway. The soil of the higher northern portion of this area is described as a stony mallee soil, due to the extent of the calcretions near or at the surface. However, closer to the River Murray cliff face the topsoil changes to a reddish sandy loam. A calcareous horizon occurs under this topsoil but the depth at which it is found varies, due to the inconsistent heights in this area. A thick layer of Pliocene Sands underlies this entire area and the sand is being mined, where exposed in a cliff face.

Erosion is a problem in this corner due to the relief of the area. Gully erosion is occurring and has been encouraged and initiated by the man made tracks in this area. Due to the slope of the land all water run-off is directed toward the river. Consequently any access tracks for this area should be designed so erosion does not eventuate.

3.1.5 pH

The topsoil of the northern portion of this land unit, generally, is slightly acidic. However, closer to the Sturt Highway the pH of the topsoil becomes alkaline. This occurrence can be linked to the depth at which the lime horizon is encountered. The closer the calcrete accumulations or layers are to the surface, the greater the likelihood the topsoil will be alkaline. All B horizons of highland unit profiles were alkaline.

3.2 RIVER VALLEY

The soil types of this land unit vary according to the location of the soil with respect to the present river regime. The geomorphological map (Figure 2.2) gives an indication of the soil type distribution.

A common soil layer contained in this unit is the light grey, silty clay of the Coonambidgal Formation. The depth to this clay layer varies, being dependent on the height of the particular piece of land above river level.

3.2.1 Colluvium

Towards the highland extremities of the Old River Valley unit, within the colluvium or "valley-face", the depth of soil overlying this light silty clay is greatest. Weathered material associated with the highland unit has been deposited over the original cliff formation and has created a soil profile characteristic of the source material. Consequently, a red sandy loam soil is found close to the highland extremities.

A variation in soil profile between the colluvium facing easterly to that facing southerly does occur. The soil of the easterly facing colluvium extends over a large area indicating a prevailing wind direction acting as a vertical vector in conjunction with colluvial depositional. The soil of this locality comprises a sandy loam topsoil overlying a weak, lime B horizon. The colour of the B horizon is a pale

000031

brown, small calcretions are present and the soil texture changes to sandy clay loam. A Loveday type soil has developed in this colluvial material. The soil profile of the southerly facing colluvium has a greater depth of sand loam topsoil. No weak calcareous B horizon was encountered up to 100 cm depth.

The soils of this colluvium land form require careful management due to the steepness of the slopes. Water and wind erosion could cause severe problems if the removal of vegetation occurs. The colluvium facing easterly could suffer from both wind and water erosion whilst the colluvium facing southerly due to its aspect and steeper slope is more likely to suffer from the effects of water erosion.

3.2.2 River Terraces

The river terraces depicted in Figure 2.2 mainly comprise a red clay loam topsoil overlying a reddish-grey, clay B horizon. The red colouration is derived from the mixing of wind blown sands from the highland unit.

Natural vegetation should not be removed from the terraces as the loss of binding effect could result in large, scalded areas. If vegetation is removed it should be replaced by vegetation of a perennial nature e.g. in the Renmark Irrigation Area vines are planted on the high river terraces.

3.2.3 Flood plains

Soils of the floodplains vary considerably, ranging from a soil comprising a red sandy clay topsoil overlying a light grey silty clay sub-soil to a type with a light grey silty topsoil, as on a large portion of low floodplain to the white sandy soil abutting the river downstream from the Lyrup Ferry.

Scalded areas along the river bank already exist and could expand if traffic over this land increases. To prevent the expansion of these areas, activities should be concentrated in specific areas away from the river bank. This necessitates an evaluation of the area concerning the activities for which the area is used, identification of areas suitable for activity concentration and the need for maintenance programs.

Vegetation around these scalded areas binds the grey, clayey, sandy topsoil and the retention of this vegetation is vital to soil stability.

The stability of the soil along the river bank down stream from the Lyrup Ferry is also of importance. This white, sandy topsoil is prone to erosion by water and wind action. Phragmites australis along the river bank have stablized certain areas but soil lacking ground cover does exist. The continued use of this and other parts of the floodplain demands stabilization of scalded and eroded areas which requires a commitment, possibly permanent, by a responsible body.

000032

3.2.4 pH

The soils contained in the Old River Valley unit vary from alkaline closer to the highland extremities to acidic in the low floodplain east of the Lyrup Ferry road.

3.3 CONCLUSION

In the mallee area the topsoils are chiefly sandy though in the swales soils are heavier in texture in some areas. Some calcrete layers are present in the soil profile and are quarried for construction purposes.

In the river valley the soil types are variable ranging from clay loams to sands. As in the mallee area, removal of vegetation and creation of tracks on slopes could initiate erosion problems. Scalded areas presently exist, especially near the river banks.

Land uses requiring or causing vegetation removal should not, in general, be permitted with the exception being quarrying in parts of the mallee. Continued recreational use of the floodplain, causing and aiding erosion problems, may require a maintenance program if halting and reparation of the scalded areas is desired.

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2. Specht R.L. (1972) "The Vegetation of South Australia." (Second Ed.) Government Printer, Adelaide.

CALPERUM

000033

SURFACE LANDS FORMS AND QUARRY AREAS

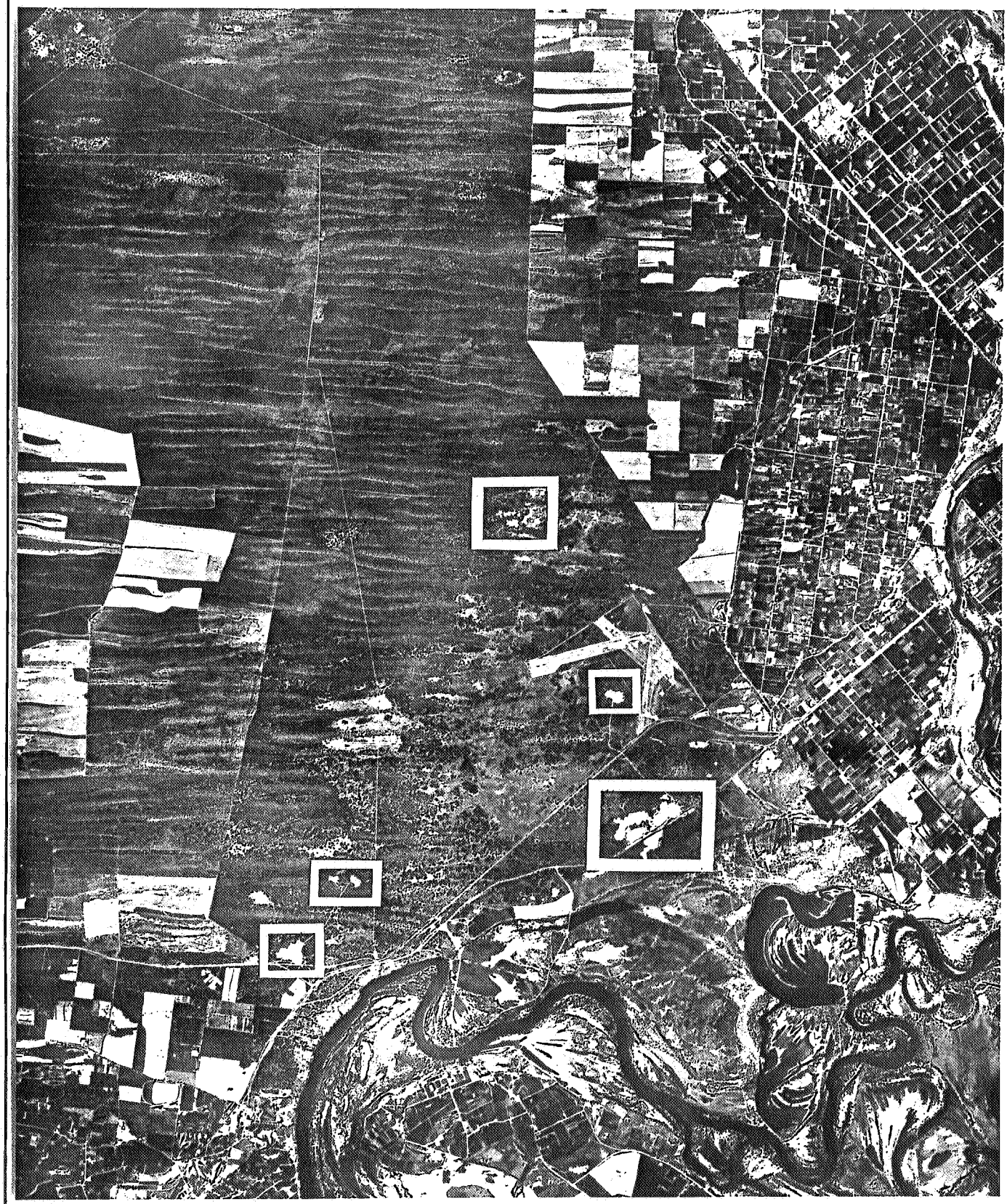

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FIG. 3.1

000034

4. VEGETATION

The vegetation of the Calperum Land Management Area has been mapped into ten different vegetation units (see Figure 4.1) and a plant species list is attached (Figure 4.2). Each of the units will be described and an attempt will be made to interpret their distribution. Factors which could have affected the present vegetation status (e.g. fires) will also be discussed. Finally the relevance the different vegetation units to possible land use options is discussed.

4.1 DESCRIPTION AND INTERPRETATION

Time limitations necessitated the use of a simplistic vegetation sampling techniques. The identification and mapping of vegetation units was initially determined using aerial photography and verified or revised following field inspection. No quantitative appraisal of vegetation was made.

The ten vegetation units are described below.

4.1.1 Mallee Vegetation Unit A

This vegetation unit comprises an upper stratum dominated by Eucalyptus socialis (Red Mallee), E. incrassata (Ridge Fruited Mallee) and E. foecunda (Slender Leaved Red Mallee) and an understorey of Triodia irritans (Porcupine grass). A number of shrubs also occur with various Cassia and Acacia sp. being the most prominent. E. gracilis (Yorrell), E. dumosa (White Mallee) and E. anceps (White Mallee) were also identified in the upper stratum but occurred significantly less frequently than the eucalypt species previously mentioned.

E. incrassata is most commonly found on the sandy rises, but is also found in the interdunal swales possessing appreciable sandy soil. E. socialis and E. foecunda occur equally on the dunes and in the swales. Triodia irritans is the prominent understorey species of both dune and swale, which may reflect the depth of sandy topsoil.

Figure 4.3 is an east-west topographic cross-section through the study area and shows the area encompassing Mallee Vegetation Unit A is a depression. However, the soils within this vegetation unit are deep and sandy thereby indicating that faulting within the study area landscape has occurred. The eastern boundary of this vegetation unit approximates the fifty metre contour line and therefore most likely approximates the sub-surface fault line. The southern boundary of this vegetation unit also approximates this fifty metre contour line.

4.1.2 Mallee Vegetation Unit B

Eucalyptus socialis, E. incrassata and E. gracilis dominate the upper stratum of this unit and Triodia irritans is the major understorey species. As with Mallee Vegetation Unit A a number of Cassia and Acacia species are found in this vegetation unit.

The chief difference between Mallee Vegetation Units A and B is the replacement of E. foecunda by E. gracilis in Unit B. This could be due to the marginally heavier soils found in Unit B, as in the northern part of this unit where the swales are heavier textured the replacement is

most pronounced. The distribution of E. incrassata, seems similarly affected. In this unit it is restricted to the crest of the dunes indicating less sand content and depth compared with swales in Unit A.

4.1.3 Mallee Vegetation Unit C

Eucalpytus socialis, E. incrassata and E. cyanophylla were the main species encountered in the upper stratum of this narrow, banded vegetation unit. The understorey comprises mainly Triodia irritans with Cassia and Acacia species also present. The presence of E. cyanophylla and the absence of E. gracilis and E. foecunda distingush this unit from others.

E. incrassata occurs only on the ridge of the dunes, similar to its distribution in Mallee Vegetation Units A and B. Again it seems that the depth of sand is an important factor controlling the distribution of this species. The distribution of E. cyanophylla, as it is found on the slopes and crests of dunes, also appears dependent on the extent of the dunes.

4.1.4 Mallee Vegetation Unit D

Eucalyptus socialis, E. cyanophylla and E. oleosa (Red Mallee) dominate the upper stratum of this vegetation unit. E. gracilis, Exocarpus aphyllus (Jointed Cherry Tree), Heterodendrum oleifolium (Bullock Bush) and Myoporum platycarpum (False Sandalwood) also occur spasmodically throughout the upper stratum of this unit. The understorey comprises many different vegetation species. Triodia irritans is found on most dunal crests and Sclerolaena sp. (Bindyi), Zygophyllum sp., Maireana pyramidata (Black Blue Bush), and Chenopodium spp are some of the species occurring in the very wide interdunal swales. Dodonaea attenuata (Narrow Leaf Hopbush), various Cassia and Acacia species, Eremophila scoparia and Grevillea huegellii were the main shrub species identified.

The presence of E. oleosa in this unit profile is the major distinguishing feature. The appearance of E. oleosa is associated with the heavier interdunal swale soils. The appearance of Exocarpus aphyllus, Heterodendrum oleifolium and Myoporum platycarpum may also be associated with these heavier soils or possibly the increase in lime content of the soil.

4.1.5 Open Plain Vegetation Unit A

This unit is characterised by the absence of a tree or tall shrub stratum, the varying floristic composition, though Maireana platycarpum is prominent throughout, and an emergent species, Myoporum platycarpum.

Dodonaea attenuata, Eremophila maculata, Stipa sp. (Speargrass), Acacia colletioides (Wait-a-while), Rhagodia spinescens, and Sclerolaena sp. are plants found in this unit but are not of uniform distribution e.g. at Eremophila Flat, Eremophila maculata is the dominant species and Maireana pyramidata and Rhagodia spinescens are sub-dominant. E. maculata occurs only in certain parts of this unit and then with densities significantly less than at Eremophila Flat.

000036

Differences in soil types could possibly explain the variations of plant distributions. Much of this unit is thought to be underlain by Blanchetown Clay (see para. 2.2.1) and the depth and type of topsoil are offered as the factors controlling variation in floristic composition e.g. Dodonaea attenuata is generally absent in areas where a thin layer of topsoil overlies clay.

At Eremophila Flat, the topography may be influencing vegetation patterns. Being low lying, possibly a secondary sinkhole, it is acting as a sump which in conjuction with a thin layer of topsoil, has favoured Eremophila maculata

4.1.6 Open Plain Vegetation Unit B

Maireana pyramidata is the dominant plant species of this unit. In addition, Myoporum platycarpum and Heterodendrum oleifoium are scattered throughout the unit. Soils vary in depth through the unit and this variation together with past land use has probably influenced the presently observed plant distribution.

4.1.7 Open Plain Vegetation Unit C

Maireana pyramidata and Maireana sedifolia (Blue Bush) are the dominant species of this unit.

All parts of this unit are low-flying flats, presumably underlain by Blanchetown Clay, and characterised by M. sedifolia which is absent on higher ground. Depth of topsoil above Blanchetown Clay is considered the major factor of distribution of this species and hence the extent of this unit.

4.1.8 Open Plain Vegetation Unit D

Species of this unit comprise chiefly Maireana pyramidata, Atriplex vesicaria (Bladder Saltbush) and Atriplex nummularia (Old-man Saltbush), the latter two being the unit's identifying characteristic.

The landform of this unit is the high river terrace and the light, grey clays of Coonambidgal Formation which underlies the area, combined with the clayey topsoil create poor soil drainage which influences vegetation of the unit.

A number of low-lying depressions, abundantly covered by Atriplex nummularia, and outside the present river regime, are sites for water collection and retention. Eucalyptus largiflorens (River Box) grows on the edges of these depressions and as this species grows in heavier soils, occasionally waterlogged, the collection and retention of water in the soil is the chief influence on vegetation patterns within the unit.

Atriplex vesicaria and Maireana pyramidata occur equally over a large portion of the unit, but Atriplex vesicaria disappears with increase in elevation indicating depth of topsoil is another factor.

4.1.9 Cultural

Varying age citrus is the sole agricultural crop grown in this area. Depth of topsoil is suitable for this enterprise and with irrigation and appropriate tenure arrangement this commercial vegetation type was established.

4.1.10 Riverflat

The upper stratum of this unit contains Eucalyptus camaldulensis (River Red Gum), E. largiflorens, Melaleuca lanceolata (Dryland Tea-Tree) and Exocarpus strictus. River red gums chiefly line the river bank but also occur in depressions in the flats. Away from the banks Eucalyptus largiflorens becomes prominent on land subject to periodic flooding. Distribution of Melaleuca lanceolata and Exocarpus strictus is discrete, both inhabiting high ground east of the Lyrup Ferry, but still close to the river. Melaleuca lanceolata is much more extensively distributed than Exocarpus strictus.

The most noticeable understorey species are Atriplex nummularia, Phragmites australis and Muehlenbeckia sp. (Lignum). Much regenerating river box is also present.

Factors determing the distribution of species are complex and varied, with flooding being the chief factor. Soil, also affected by flooding (e.g. severity, duration of inundation, frequency), is an additional factor.

Eucalyptus largiflorens relies on periodic inundation for regeneration as does E. camaldulensis. Sandy, waterlogged soils are apparently preferred by Phragmites australis and so this species is generally found by the waters edge where sandy material accumulates. The depth of topsoil apparently determines the extent of Muehlenbeckia sp., which prefers areas of shallow topsoil, and Atriplex nummularia which prefers greater depths of topsoil. Without doubt all species in the Riverflat Unit are affected by the present river regime.

4.2 FACTORS AFFECTING PRESENT VEGETATION STATUS

4.2.1 Fire

Fires, started by man or lightning, have occurred in mallee areas and influence vegetation patterns. Some species appear dependent on fires for initiation of their regeneration e.g. Acacia species. Areas razed by fires are often invaded by colonizing species which grow prolifically but are eventually replaced by slower growing species until the original pattern reappears. The frequency of fires, if changed, could bring about changes in the existing pattern. These factors must be considered in assessing land use options as, in some season, the area could constitute a serious fire hazard yet the exclusion of fires would be contrary to conservation of the area.

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4.2.2 Grazing

Domestic, grazing animals alter the floristic composition of the understorey by consuming palatable species and initiating replacement by unpalatable species. This effect is concentrated at watering points (piosphere effect).

The introduction of ephemeral grass species results from grazing and has occurred e.g. around the Cooltong Dam.

4.2.3 Logging

Mallees of the southern portion of land north of the Sturt Highway were cut for many years; the wood being used as fuel for the engines which powered the pumps supplying water to the Berri Irrigation Area. This operation has ceased but the mallee vegetation has changed from "Bull" mallee with tall, thick stems to whipstick-like mallee.

4.2.4 Construction

The construction of the Lyrup Ferry road, with the lack of sufficient culverts, has created a hydrological inbalance and most river red gums east of the road have died. Disher's Creek evaporation basin has drowned many eucalypts and large areas of river box and river red gums are slowly dying due to raised groundwater levels associated with the basin.

4.2.5 Other

Other effects are the cutting and removal of timber (for firewood), initiation of fires and the unregulated use of trail bikes and cars which degrades the understorey. Destruction of groundcover and the cutting of live timber cause significant management problems near the river.

4.3 CONCLUSION

The vegetation of the Calperum Land Management Area is sufficiently diverse and extensive to permit the conservation of a large number and range of flora and fauna species. The existence of the four hectare patch of Eremophila maculata increases the conservation value of this area. However, the position of the land renders it subject to a wide range of public demands. The type of vegetation adjacent the River Murray increases the public demand for the land.

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CALPERUM

LAND MANAGEMENT STUDY AREA

VEGETATION

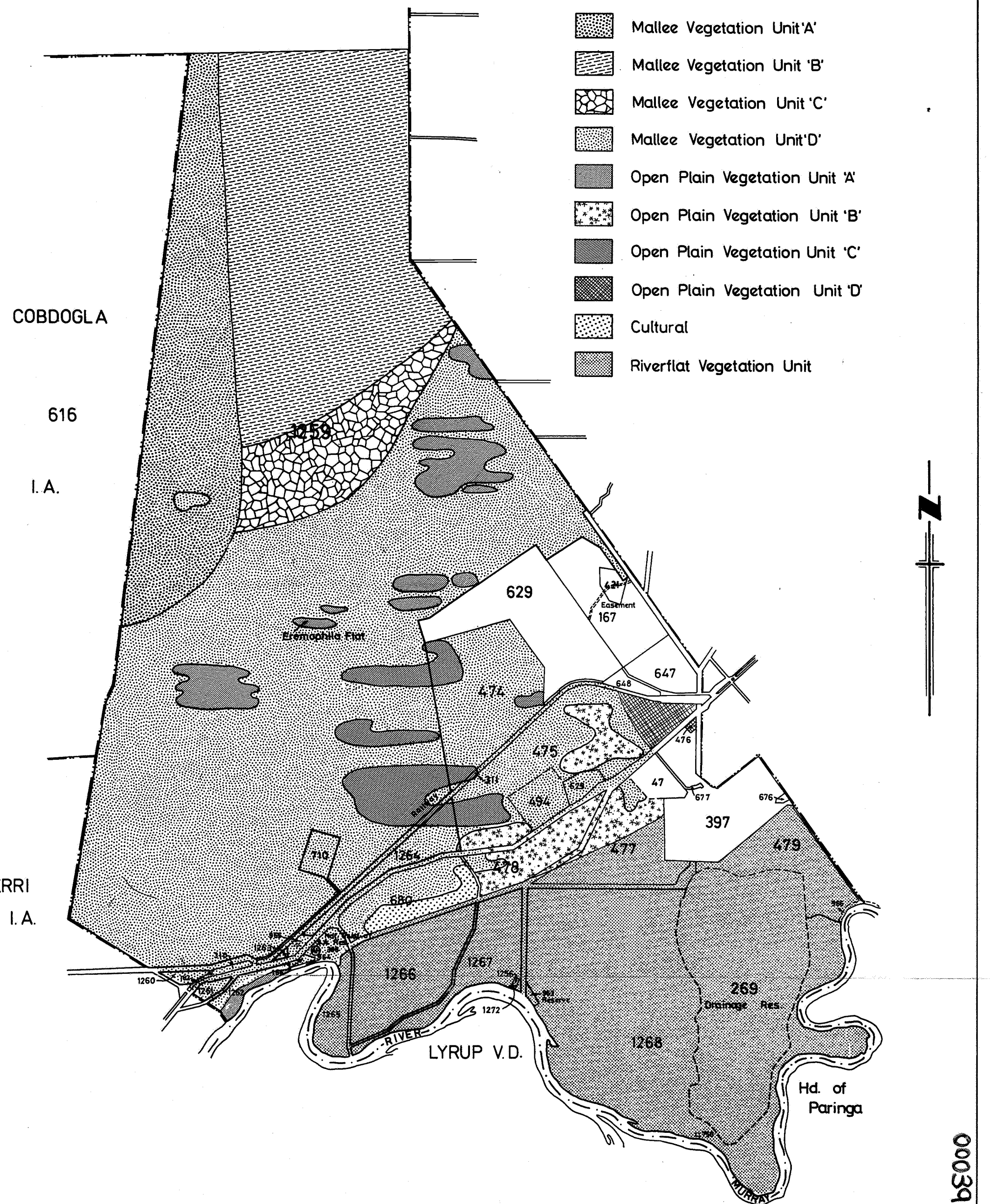

FIG. 4.1

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FIGURE 4.2

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FLORA OF THE CALPERUM AREA

Acacia	acanthoclada	-
	colletiodes	
	hakeoides	-
	ligulata	
	nyssophylla	
	oswaldii	x
	rigens	
	stenophylla	
	wilhelmiana	-
Ajuga	sp	-
Amyema	preissi	x
Angianthus	tomentosus	-
Arthrocnemum	sp	-
Asphodelus	fistulosus	
Atriplex	inflata	
	nummularia	-
	rhagodioides	x
	stipitata	-
	vesicaria	-
Baeckea	crassifolia	-
Bertya	mitchellii	-
Beyeria	leschenaulti	x
	opaca	
Billardiera	sericophora	x
Boronia	coerulescens	-
Brachyscome	ciliaris	
Bromus	sp	-
Callitris	sp	
	verrucosa	x
Calotis	cuneifolia	
	erinacea	
Cassia	artemisioides	
	eremophila	-
	nemophila coriacea	
	nemophila playtpoda	
	sturtii	-
Cassytha	melantha	x
Casuarina	cristata	
Chenopodium	desertorum	x
	nitrariaceum	
	ulicium	x
Codonocarpus	continifolius	x
Crassula	seibierii	x
Cryptandra	amara	
	hispidula	
Cyperus	gymnocaulus	
Dampiera	rosmarinifolia	-
Danthonia	sp	x
Daviesia	nudula	-
Dianella	laevis	
	revoluta	x
Dicrastylis	verticillata	x
Disoocarpus	paradoxa	
Disphyma	australe	
Dodonaea	attenuata	-
	bursariifolia	-
	lobulata	-
	stenozyga	
Duboisia	hopwoodii	-
Enchylaena	tomentosa	
Eremophila	crassifolia	
	divaricata	
	glabra	
	longifolia	-
	maculata	
	oppositifolia	
	scoparia	
	sturtii	-
Eucalyptus	anceps	
	camaldulensis	
	cyanophylla	
	dumosa	
	foecunda	
	gracilis	
	incrassata	
	largiflorens	
	oleosa	
	socialis	
Eucarya	acuminata	-
	perisicaria	-
Eutaxia	microphylla	
Exocarpus	aphyllus	
	sparteus	-
	strictus	
Gasoul	nodiflorum	x
Goodenia	affinis	-
Grevillea	huegelii	
	pterosperma	-
Hakea	leucoptera	
Halgania	cyanea	
Helichrysum	apiculatum	
	semipapposum	-
Heterodendrum	oleifolium	
Hordeum	spp	-
Hybanthus	floribundus	
Leichartia	australis	x
Lepidium	hyssopifolium	
Leptospermum	coriaceum	-

Limoniun	thouinii	
Lomandra	effusa	
	glauca	x
	leucocephala	
Lycium	australe	
	ferocissimum	
Lysiana	exocarpi	x
Maireana	brevifolia	x
	erioclada	-
	pyramidata	
	sedifolia	
Maireana	tomentosa	
	triptera	-
Medicago	sp	-
Melaleuca	lanceolata	
Mesembrianthemum	sp	-
Muehlenbeckia	cunninghamii	-
Myoporum	platycarpum	
Myriocephalus	stuartii	-
Newcastlia	dixonii	-
Nitraria	billardiera	x
Olearia	lepidophylla	x
	magniflora	
	muelleri	
	pimeleoides	-
	teretifolia	x
Oxalis	corniculata	-
Pachycornia	triandra	
Phebalium	bullatum	
Phragmites	australis	
Pimelea	macrantha	x
	microcephala	
Pittosporum	phylliraeoides	x
Podolepis	capillaris	
Prostanthera	aspalathoides	
Ptilotus	sp	x
Rhagodia	gaudichaudiana	x
	nutans	
	spinescens	
	s.var deltaphylla	
Salsola	kali	x
Santalum	acuminatum	x
	murrayanum	x
Scaevola	spinescens	-
Schoenus	aphyllus	-
Sclerolaena	obliquicuspis	
	tricuspis	
	uniflora	x
Senecio	lautus	
Stipa	sp	
Swainsona	microphylla	
Taraxacum	officinale	
Templetonia	sulcata	
Triodia	irritans	
Typha	domingensis	
Vittadinia	triloba	
Waitzia	acuminata	
Westringia	rigida	
Xanthium	californicum	
Zygophyllum	apiculatum	
	auranthecum	x

Source of Information

Unless otherwise denoted,

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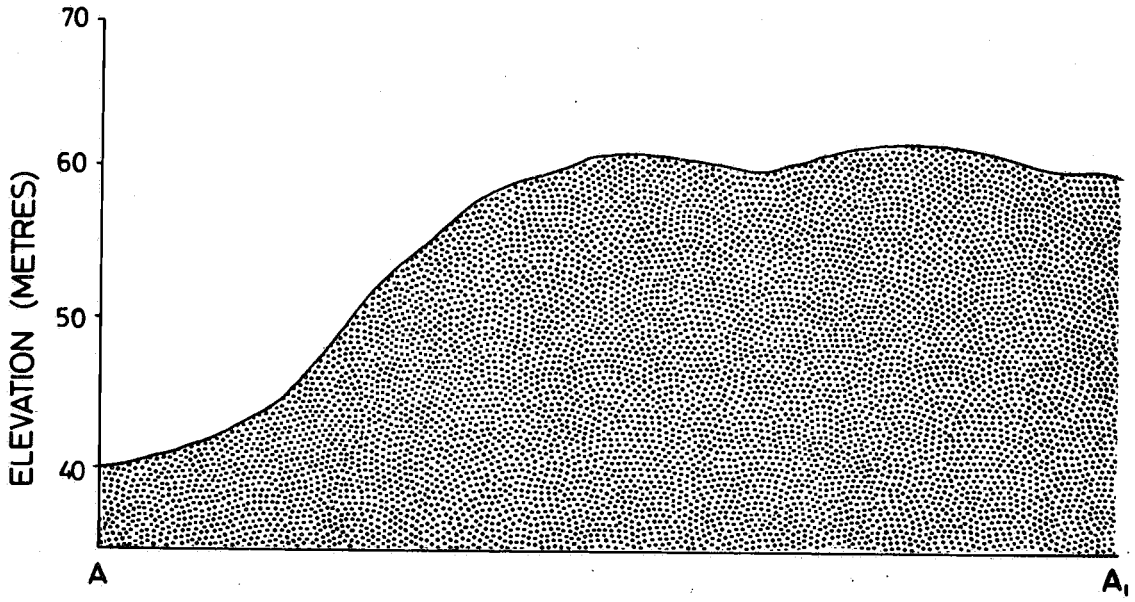
x Botany Club, Field Naturalists Society of South Australia

- D.B. Mack, Department of Lands Docket RO3/79/80

TOPOGRAPHIC CROSS-SECTION



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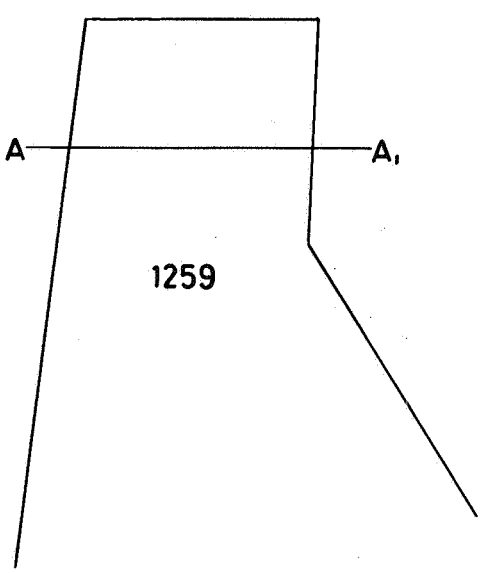

FIG. 4.3

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5. FAUNA

The fauna, fully or partly supported by the environment at Calperum, is diverse and plentiful. In this section the fauna species will be identified, two species being described in detail. Conservation principles in relation to fauna will also be discussed.

The Mallee Fowl is one species described in detail. Submissions from conservation groups placed much emphasis on conservation of this species, as the complex interaction between this species and the environment exemplifies the delicate balances existing in many natural systems.

5.1 MALLEE FOWL (Leipoa ocellata)

The followng information has been extracted from Frith (1962), "The Bird that Builds an Incubator".

5.1.1 Description

The mallee fowl is larger than the Domestic Fowl (Macdonald 1973) and is a greyish mottled colour. Unlike most birds which incubate eggs by sitting on them in a nest, the mallee fowl constructs an incubation mound in which the eggs are buried. The mound is heated by the sun and fermenting organic matter in the ground.

5.1.2 Distribution and Habitat

The distribution of the Mallee Fowl is extensive (Slater, 1970) and is always associated with land which supports mallee vegetation. Their main source of food is the seeds from Cassia and Acacia plants. They also feed on the buds and flowers of various herb species; however, these species do not provide a food source through the summer months, and it is then the seeds of Cassia and Acacia plants are most important.

Frith noted the "detailed distribution of the birds in any one place was found to be related to more subtle characteristics of the scrub associated with the texture of the soil."

The birds prefer soils of lighter texture. The good drainage of light soils enables the mound to dry appreciably after an initial, thorough wetting so the fermentation process, vital to the mallee fowl's survival, can proceed.

5.1.3 Breeding Season and Clutch Size

The breeding season of the Mallee Fowl generally extends from September to April, however, slight variations occur because the female does not lay the first egg until conditions are suitable for incubation. The female generally lays an egg every few days with each egg needing about fifty days to hatch. "In an average season it has been found that mallee fowl will lay between 16 and 33 eggs" (Frith). Consequently, the female lays eggs for approximately four months, the number of eggs laid being dependent upon the number of days between the laying of each egg. Some chicks hatch and leave the mound while eggs are still being laid.

5.1.4 Mound Building

The incubation of the mallee fowl eggs requires a constant temperature if the process is to be successful. It is for this reason that the mallee fowl builds a mound and tirelessly manipulates that mound until no more can be physically done to hold the eggs at this constant temperature.

The incubation mound requires approximately four months of work before it is ready for the eggs. Once egg laying begins, the male, through a number of methods, ensures that the incubation temperature remains constant. At the beginning when the first eggs are laid the male comes to the mound each day and tests the temperature of the egg chamber by placing his beak into the chamber. He then opens up the mound to allow some of the heat generated by the fermentation process to dissipate and thus controls the temperature of incubation. It is at the beginning of incubation that heat released by fermentation is greatest.

As time progresses, the male finds it only necessary to open the mound about every three days. Towards the end of the summer, solar energy becomes the main source of heat and the bird increases the depth of sand covering the egg chamber in order to reduce the amount of heat reaching the eggs. Constant incubation temperature is therefore maintained. Finally, during autumn when the heat of the sun is not as intense, the bird opens up the mound so that the suns rays have only a thin layer of soil to penetrate. The bird then spreads out the sand already removed from the mound allowing it to be warmed by the sun. Once the egg chamber and sand have absorbed enough heat the bird re-builds the mound. The mound is restored to the optimum temperature and the incubation process continues. As autumn progresses the task of maintaining a constant temperature gradually becomes impossible and the mound and remaining eggs are abandoned.

The incubation temperature is maintained around 33`C and only permitted to fluctuate by 1-2`C.

The male and female both are thought to play a part in preparing the mound prior to egg laying but the male does the work of maintaining the mound once egg laying commences. The female then concentrates on gathering food for herself.

5.1.5 Habits

Mallee fowl are solitary birds that live within a restricted area and have only one mate for life. They shelter in trees and bushes and visit the mound when it is thought necessary. The only time the mallee fowl becomes slightly gregarious is the period, about a month, between abandonment of the mound and preparation of the mound for the next clutch.

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5.1.6 Conservation

Sheep and rabbits, apart from the clearing of mallee vegetation, are the biggest dangers to the continued existence of the mallee fowl. They selectively graze herbs and eat the seeds of the Cassia and Acacia plants reducing the available food supply of the mallee fowl.

Foxes and dogs disturb both mallee fowl and incubation mounds.

Although the bird is not, at present, in danger of extinction it is uncommon in South Australia. The mallee fowl is unique to Australia and conservation of the species in South Australia should be encouraged. Land set aside for conservation of mallee fowl would require the exclusion of sheep and rabbits.

5.2 RABBITS (Oryctolagus cuniculus)

Rabbits exist in the study area, especially in sandy areas of the floodplain and constitute a potential hazard to native flora and fauna.

A rabbit invading an area begins feeding on pasture and herbage, preferring small plants, especially seedlings, the grazing of which drastically affects the ability of the plant community to regenerate. In times of adversity, to obtain nutrients and moisture, rabbits effectively ringbark shrubs and trees compounding the problems of vegetation removal and soil erosion.The damaging effect of this wholesale removal of vegetation leaves the soil subject to erosion.

The adaptability of rabbits to most environments and their fecundity, aggravate the problems of vegetation and soil degradation. The rabbit is an opportunistic species surviving the harshest conditions and multiplying rapidly when conditions are suitable.

The breeding capability makes rabbit control difficult and only complete eradication should be considered as a solution. Future exclusion of this pest should be maintained by construction of rabbit-proof fences.

The introduction of the rabbit has jeopardized the continued existence of many native species in this area. The rabbit directly competes for food and contributes to the degradation of both vegetation and soil, thus destroying habitats of native species, reducing their chances for survival. Control and eradication of rabbits in the Calperum area should be of high priority in any plan for the area.

5.3 MAMMALS

Members of the three sub-classes of Mammals can be found on Calperum (See Figure 5.1).

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5.3.1 Placentals

Although none have been captured and identified as part of this study native bats (Order Chiroptera) are common in the study area. Introduced animals such as rabbits (previously mentioned), dogs, cats and foxes are also found. Dogs, cats and foxes prey on smaller native species and introduced herbivores e.g. sheep, compete with native animals for food. Herbivores are also capable of altering vegetation communities and consequently shifting the "balance" of a natural environment.

5.3.2 Marsupials

Grey kangaroos and brush-tailed possums are common in the study area, and red kangaroos have also been seen. The slender-tailed pouched mouse (Sminthopsis murina) has been identified in the mallee area, extending the previously known range of this small "ferociously" carnivorous animal. They are generally present only in low population densities and each individual has a large "home range", necessitating large areas of suitable habitat if the species is to be conserved (Adelaide University Biology Society, 1981).

5.3.3 Monotremes

The spiny anteater (Tachyglossus aculeatus) is a resident in the study area, although they are not commonly seen. Like the related platypus, spiny anteaters are egg laying mammals, and also have a pouch in which the young are carried after hatching (Troughton, 1972).

5.4 BIRDS

(See the bird list, Figure 5.2).

5.4.1 Many birds would benefit from the preservation of breeding habitats and refuge areas at Calperum. Some of the birds amongst these are the:-

(a) Mallee fowl, as already detailed,

(b) Freckled Duck, an endangered species that would benefit from the refuge offered by Disher's Creek (Section 269),

(c) Australasian Shoveler and Hardhead, which are both declining in numbers and would find refuge at Disher's Creek,

(d) Regent Parrot, which uses red gum hollows for breeding and requires "urgent measures" for conservation,

(e) Australian Bustard, whose numbers have declined sharply this century,

(f) Pink Cockatoo, which is seen only rarely along the Upper Murray,

(g) Scarlet Chested Parrot, a rare and endangered species, and

(h) Black and Pied Honeyeaters which are occasional visitors to Eremophila Flat (Adelaide University Biology Society, 1981).

5.4.2 A number of species (e.g. the Striated Grass wren, Gilberts Whistler, Chestnut Quail-Thrush and the Red Throat) can be used as "monitor" species.

These species are sensitive to disturbance, and their presence is indicative of a healthy environment. Similarly, presence of the mallee fowl and crested bellbird, both being ground feeders, is indicative of the state of the natural condition of the environment. (Adelaide University Biology Society, 1981).

5.4.3 There are features regarding the birds in the area which have attracted attention and may be worthy of scientific study. They are:-

(a) Hybridization between the rare Black-eared Miner (Manorina melanotis) and the common Yellow-throated Miner (M. flavigula), and

(b) The interactions between different species of honeyeaters (pollinators) and Eremophila maculata at Eremophila Flat (Adelaide University Biology Society, 1981).

5.5 REPTILES

5.5.1 A diversity of reptiles occurs in the mallee area (See Figure 5.3),and includes four "dragons", four species of gecko, eight types of skinks, three tortoises, and four snakes. One of the geckos, the Beaked Gecko (Rhynchoedura ornata), is considered uncommon.

5.5.2 Tortoises are known to breed on the river flats, and although the short-necked and long-necked tortoises are relatively common, the broad-shelled tortoise is of unknown conservation status. It appears to be more specific in its habitat requirements than the other two species.

5.6 ARTHROPODS

5.6.1 The diversity of vegetation at Calperum provides a diverse range of habitats for arthropods and, although little detailed work has been done, it is expected that there would be a large number and variety of arthropod species present. Limited work on insects has been conducted and some observations on spiders and scorpions have been made in the study area. A list of spiders seen locally is attached (Figure 5.4) and it is believed that there is an undescribed species amongst the scorpions of the area.

5.6.2 One of the spiders of note is the "birdeating spider" (Selenocomia stirlingi). This creature grows up to 40mm in length and is behaviourally adapted to an arid environment as it can dig a long burrow in which it can isolate itself from climatic extremes. It is apparently long lived, and at night feeds at the entrance to its burrow, mainly on insects but occasionally on small reptiles.

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5.6.3 Calperum is one of the areas closest to Adelaide where this spider is known to occur. Of additional significance is the depauperate spiderfauna on nearby land that has been grazed more intensely. (Papps. Personal Communication).

5.7 GENERAL

The presence of the mallee fowl may be sufficient reason to conserve the northern portion of the study area. However, rarely should conservation stem from the projected benefit to one particular species. Other species present may indirectly affect the viability of the species of most concern. Conservation is better approached from a systems basis, ensuring the ecosystem itself is not altered.

If conservation of a system is desired, the area of portions conserved is critical. "The appropriate size of a reserve is closely linked to its structural diversity in relation to the range of habitats required for its component plants and animals. By and large, the lower limit for size of a representative reserve will be determined by the population densities of the rarest species and the range requirements of the more mobile species, including those which move significant distances over contiguous areas of terrain in response to daily or seasonal changes in weather, food supply, or other factors ....." (Slatyer 1975).

5.8 CONCLUSION

The present fauna situation, as described, would evidence the need for conservation of the area. However this need must be balanced with proposed land uses, whether the species requiring protection are suitably protected elsewhere in areas nearby or distant and whether conservation, if implemented, would achieve the aims expected of it. The eventual decision will rest on regional and state requirements and compatibility of proposed land uses.

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FIG. 5.1

MAMMALS OF THE CALPERUM AREA

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Echidna	(Tachyglossus aculeatus)
Slender-tailed Pouched Mouse	(Sminthopsis murina)
Brush-tailed Possum	(Trichosurus vulpecula)
Grey Kangaroo	(Macropus fuliginosus)
Red Kangaroo	(Megaleia rufa)
Bats	(Order Chiroptera)
Rabbit	(Oryctolagus cuniculus)
European Hare	(Lepus capensis)
Common Fox	(Vulpes vulpes)
Domestic Cat	(Felis catus)
Domestic Dog	(Canis familiaris)

Source: M. Tester (Adelaide University Biology Society)

FIG. 5.2

BIRDS OF THE CALPERUM AREA

- / o	x	Emu		x	Laughing Kookaburra
	x	Hoary-headed Grebe	- o		Rainbow Bee-eater
-	x	Australian Pelican	x		White-backed Swallow
	x	Darter	- / ox		Welcome Swallow
	x	Great Cormorant	- / x		Tree Martin
	x	Little Black Cormorant	-	x	Richard's Pipit
	x	Little Pied Cormorant	- / ox		Black-faced Cuckoo-shrike
	x	Pacific Heron	-		Ground Cuckoo-shrike *
	x	White-faced Heron	-		White-winged Triller
	x	Great Egret	-		Southern Scrub-robin
	x	Rufous Night Heron	- / ox		Red-capped Robin
	x	Sacred Ibis	-	x	Hooded Robin
	x	Yellow-billed Spoonbill	/	x	Jacky Winter
	x	Black Swan		x	Gilbert's Whistler
-		Freckled Duck *	/	x	Golden Whistler
-	x	Australian Shelduck	- / ox		Rufous Whistler
-		Pacific Black Duck	- / ox		Grey Shrike-thrush
-	x	Grey Teal	- /	x	Crested Bellbird
-	x	Chestnut Teal	- / ox		Retless Flycatcher
-	x	Australasian Shoveller *	- o	x	Grey Fantail
-		Pink-eared Duck	- / ox		Willie Wagtail
-		Hardhead	- /	x	Chestnut Quail-thrush
-		Maned Duck	- o	x	White-browed Babbler
		Musk Duck	- / ox		Chestnut-crowned Babbler
/	x	Whistling Kite		x	Superb Fairy-wren
-		Wedge-tailed Eagle	-	x	Splendid Fairy-wren
	x	Little Eagle	- / ox		Variegated Fairy-wren
/		Australian Kestrel		x	White-winged Fairy-wren
- / o	x	Mallee Fowl	-	x	Striated Grasswren
-		Little Button-quail	- o	x	Redthroat
		Eurasian Coot	- / ox		Weebill
-		Australian Bustard *	- / ox		Chestnut-rumped Thornbill
	x	Masked Lapwing	- / ox		Yellow-rumped Thornbill
	x	Black-fronted Plover	- / ox		Southern Whiteface
/	x	Silver Gull	- /	x	Varied Sittella
	x	Caspian Tern	-	x	Brown Treecreeper
	x	Feral Pigeon	- / ox		Red Wattlebird
- /		Peaceful Dove	- / ox		Spiny-cheecked Honeyeater
/ o	x	Common Bronzewing	- / ox		Striped Honeyeater *
- / o	x	Crested Pigeon		x	Blue-faced Honeyeater *
- / o	x	Galah	/	x	Noisy Miner
-	x	Little Corella	- / ox		Yellow-throated Miner
-		Pink Cockatoo *	- ox		Black-eared Miner *
- / o	x	Regent Parrot *	- / ox		Singing Honeyeater
- o		Budgerigah	- / ox		White-eared Honeyeater
	x	Crimson Rosella (Yellow variety)	- / ox		Yellow-plumed Honeyeater
			- /	x	Grey-fronted Honeyeater
- o	x	Mallee Ringneck	-		Fuscous Honeyeater *
	x	Red-rumped Parrot	- / ox		White-plumed Honeyeater
-/ o	x	Mulga Parrot	- / ox		Brown-headed Honeyeater
- o	x	Blue Bonnet	- o		White-fronted Honeyeater
-		Elegant Parrot			

-		Scarlet-chested Parrot *
-		Pallid Cuckoo
-	o	Fan-tailed Cuckoo
	x	Black-eared Cuckoo
- /	o x	Australian Owlet-nightjar
	x	Spotted Nightjar
- /	o x	Zebra Finch
- /	o x	White-winged Chough
- /	x	Australian Magpie-lark
-	o	Masked Woodswallow
-	o	White-browed Woodswallow
/	x	Dusky Woodswallow
- /	o x	Grey Butcherbird
	x	Pied Butcherbird *
- /	o x	Australian Magpie
- /	o x	Grey Currawong
- /	o x	Australian Raven
	x	Little Raven
-	o x	Little Crow
-	o	Black Honeyeater *
-	o	Pied Honeyeater *
-		Crimson Chat
	x	White-fronted Chat
- /	o x	Yellow-rumped Pardalote
- /	o x	Striated Pardalote
- /	o x	Mistletoebird
-	o	European Goldfinch
/	x	House Sparrow
	x	Common Starling

Identified by:

- \- D.B. Mack and T.K. Lock (Department of Lands)
- / Field Naturalists Society
- o Banded by C.S.I.R.O.
- x H. Possingham and J. Reid (Adelaide University Biology Society)
- * Species uncommon in South Australia.

FIG. 5.3

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REPTILES OF THE CALPERUM AREA

Tree Dragon	(Amphibolurus nobbi)
Military Dragon	(Amphibolurus fordi)
Bearded Dragon	(Amphibolurus vitticeps)
Painted Dragon	(Amphibolurus pictus)
Sand Goanna	(Varanus gouldii)
Beaded Gecko	(Diplodactylus domaeus)
Jewel Gecko	(Diplodactylus elderi)
Beaked Gecko *	(Rhynchoedura ornata)
Prickly Gecko	(Heteronotia binoei)
Stumpy Tailed Lizard	(Tiliqua rugosa)
Snake Eyed Skink	(Cryptoblepharus plagiocephalus)
Grey's Skink	(Menetia greyii)
Desert Burrowing Skink	(Ergonia inornata)
Striped Skinks	(Ctenotus sp.)
Sand Swimming Skink	(Lerista sp.)
	(Marethia sp.)
Golden Water Skink	(Sphenomorphus quoyii)
Common Brown Snake	(Pseudonaja textilis)
Five Ringed Snake	(Pseudonaja modesta)
Yellow Faced Snake	(Demensia psammophis)
Tiger Snake	(Notechis scutatus)
Long-necked Tortoise	(Chelodina longicollis)
Broad-shelled Tortoise	(Chelodina expansa)
Short-necked Tortoise	(Emydura macquarii)

* uncommon

Source: M.B. Thompson (Adelaide University Biology Society)

FIG. 5.4

SPIDERS OF THE CALPERUM AREA

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This list is incomplete. It is based on incidental observations during field trips to Calperum and a brief survey of the collection held at South Australian Museum.

Mygalomorphae

Family Theraphosidae	Selenocosmia stirlingi	Bird-eating Spider
Family Ctenizidae	Missulena insignis (?)	Mouse Spider
	Blakistonia sp.	
	Aganippe robusta (?)	
Family Dipluridae	Chenistonia maculata (?)	
	Chenistonia tepperi	
Family Barychelidae	Idiommata blackwalli	

Araneomorphae

Family Argiopidae	Araneus transmarinus	Orb-weaving Spider
	Phonognatha graeffi	Leaf-curling Spider
	Nephila edulis (?)	Golden Orb Weaver
	Gasteracantha minax	Six-spined spider
	Leucauge sp.	
	Tetrabnatha sp.	
	Argiope sp.	
Family Zodariidae	Storena sp.	
Family Lycosidae	Lycosa leuckartii	Wolf Spider
	Lycosa godeffroyi	
Family Thomisidae	Sidymella sp.	
Family Salticidae	Breda jovialis	
Family Sparassidae	Delma sp. Huntsman Spider	

Source: D.J. Papps, (University of Adelaide, Information Office)

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6. SUMMARY OF PHYSICAL FEATURES

The physical features of the Calperum study area can be summarised by describing different generalized land units. These units, mapped in Figure 6.1, are described below.

LAND UNIT

A : The deep Pliocene sands (which underly the whole study area) are overlain directly by regularly spaced, steep, narrow sand-dunes of the Woorinen Formation. This unit forms part of a local topographic depression. Eucalyptus socialis, E. incrassata, and E. foecunda dominate the upper stratum of vegetation, with E. incrassata preferring the sandy rises. Triodia irritans is the predominant ground cover, and various Cassia and Acacia species are common in the area.

B : Dunes are also steep, narrow and regularly spaced although the soils are generally heavier and shallower. The vegetation differs from unit A in that E. foecunda is replaced by E. gracilis which, with E. socialis and E. incrassata, dominate the upper stratum. Triodia irritans is the most prominent ground cover.

C : Sand dunes are steep and regularly spaced but there is more limestone in the inter-dune sub-soils. E. gracilis is replaced by E. cyanophylla, and E. socialis and E. incrassata are still common. T. irritans occurs with Cassia and Acacia species.

D : Sub-surface limestone (Bakara Soil) is intermittent through the area and the dunes, although regularly spaced, have a wide inter-dune swale. E. socialis, E. cyanophylla and E. oleosa dominate the upper stratum, although Exocarpus aphyllus, Heterodendrum oleifolium and Myoporum platycarpum can also be found. T. irritans is restricted to dune crests and Chenopods can be found between the dunes.

E : Irregularly spaced dunes separated by wide inter-dune swales, often with varying degrees and qualities of limestone below the surface. Blanchetown Clay may be present below this limestone. Although more open than unit D, the same plant species occur.

F : The open plains of this unit are, in effect, wide inter-dune swales with varying depths of top soil. The sub-surface layers vary from Blanchetown Clay to limestone to silcrete. Vegetation also varies over these plains, there being few trees (e.g. Myoporum platycarpum) with a range of shrub species (e.g. Maireana pyramidata, Dodonaea attenuata, Eremophila maculata and Acacia colletioides). Open grass plains also occur.

G : Low-lying areas, which may interupt the dune system, characterise this unit. Blanchetown Clay appears to be close to the surface throughout these areas. Maireana pyramidata and M. sedifolia are the dominant shrubs of these tree-less flats.

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H : This unit, the colluvium, consists of deep red sands from the adjacent highlands. Vegetation includes Dodonaea attenuata, Maireana pyramidata and Heterodendrum oleifolium. Cultural plantings (oranges) exist in this unit, on Section 680.

I : A low floodplain, comprising mainly grey clays of the Coonambidgal Formation. Vegetation ranges from red gum forest (Eucalyptus camaldulensis) near the river to lignum and samphire flats (Muehlenbeckia cunninghamii and Pachycornia triandra) in parts of the plain.

J : The soils of this high floodplain unit are marked by a high sand content. River box woodlands (Eucalyptus largiflorens) typify the area, although E. camaldulensis, Melaleuca lanceolata and open salt bush plains are also present.

K : High river terraces, or remnant terraces, were beyond the reach of the 1956 floods. These terraces, especially the southern ones, have red sands overlying the clays of the floodplains. Vegetation ranges from grasses to Maireana pyramidata, Dodonaea attenuata and Hakea leucoptera. Several "dryland" species, such as Acacia oswaldii, Heterodendrum oleifolium and Callitris spp., occur on the southern remnant.

CALPERUM

LAND MANAGEMENT STUDY AREA

GENERALIZED LAND UNITS

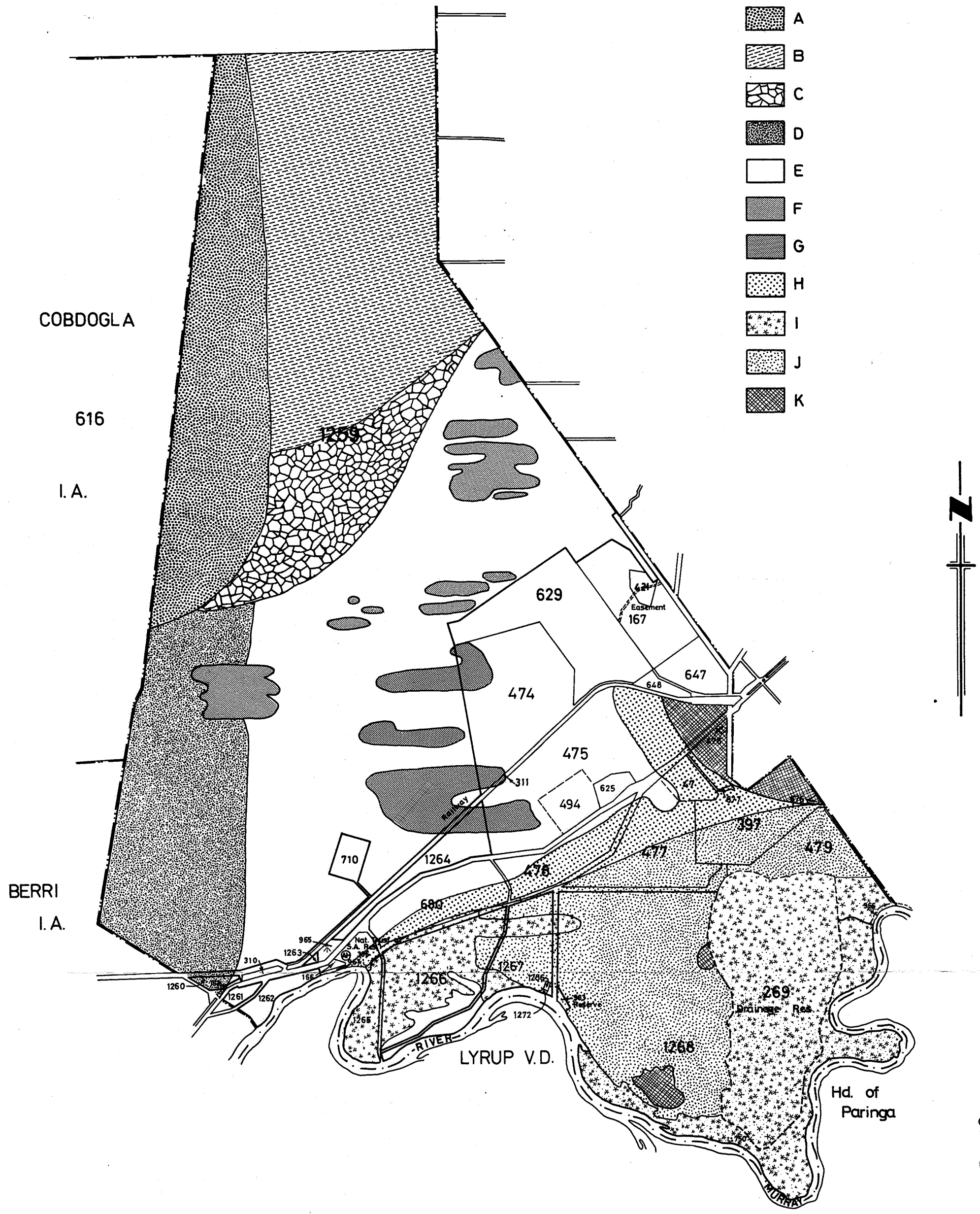

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FIG. 6.1

ASSESSMENT

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7. DEVELOPMENT

7.1 CONSIDERATIONS

7.1.1 Related Submissions

Corporation of the Town of Renmark.
Want 474 and 475 for industrial use, as the land is cheap and near rail, road and air transport. May want to increase the length of the aerodrome.

Berri District Council.
No ribbon development on the Sturt Highway (Industry could situate north of the railway).

Highways Department.
No multi-access or ribbon development on the Sturt Highway. To be consulted regarding access to the Highway.

Dept. of Urban & Regional Affairs.
The Riverland Development Plan opposes urbanisation or road oriented commercial enterprise on the Sturt Highway. Developing rail and water amenities in 474 and 475 would be uneconomic.

DATEL
Want Sections 1261 and 1428 for war veterans' retirement village and a tourist resort.

Christian Revival Crusade
Want 1261 and 1428 for a church, day school, convention centre and retirement village.

Engineering & Water Supply Dept.
Will be erecting a pumping station near Disher's Creek outlet as part of the Noora Scheme. May want part of 1003 above the aerodrome for a proposed industrial effluent disposal scheme.

7.1.2 Demand for Industrial Land in Renmark

(a) Comments from the Director of Industrial Development
Provision of only a minimal amount of vacant industrial land to cater for smaller, light industrial firms should be adequate to meet the future needs of industrial development.

However, "adequate provision should be made to ensure that additional industrial land can be developed, with a short lead time, to cater for any unforeseen large scale establishment or expansion in Renmark."

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(b) Evidence from local sales

There is no demand for heavy industry sites, and virtually nil for light industry.

A limited number of backyard industries or small light industries are the only potential buyers of industrial land. Their needs are likely to be met by blocks of 0.2 hectares in size.

Recent sales of horticultural land in potential industrial areas indicate no premium was paid for location inside a proposed industrial zone.

Recent sales of premises suitable for light industry indicate a value per unit area at a fraction of replacement cost.

(c) Comments from local Land Agents

There is a small but steady enquiry for light industrial land, 0.2 to 0.4 hectares in size. Although suitable land is allocated as industrial it is presently used for horticulture and is not for sale. Estimates of enquiry rate range from 3 to 6 blocks per year.

Light industries (e.g. mechanics, carpenters and crash repairs) want to be located within a couple of kilometres of the town centre, preferably with good road access to the town.

7.1.3 Suitability of 474 and 475 for Development

(a) Planning

Ribbon development along Sturt Highway is undesirable due to additional costs and reduction of the scenic attractiveness of the drive to Renmark.

Industrial development remote from a town results in costs to the public via extensions to public services.

Local service industries are more profitable nearer towns.

Regionally, heavy industry may be more economically located at Berri or Paringa.

A Supplementary Development Plan should be produced if Section 474 or 475 were to be used for industrial purposes, as such use would conflict with the aims and objectives of the Riverland Development Plan, which allocates the area as rural.

(b) Water

The lessees of 475, 494 and 625 currently divert water from the Murray River via the Renmark Golf Club. Similarly, water could be available to industries on 475, but the cost would have to be borne by developers.

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The Renmark Irrigation Trust could possibly supply water to the lower area of 475 (near the S-bend over the railway) but supplies to the highland would incur additonal costs and the quantity may be limited.

Chlorinated water may be required. In that event, a private chlorination plant would have to be installed, or the Renmark Town Water Supply extended to the area. Extension of the main and installation of an internal delivery system would add further to the cost of development.

(c) Costs

Any development of Section 474 or 475 would face the costs of not only supplying water, but also of constructing a complete internal road and drainage network.

Effluent disposal would also have to be provided.

Due to the prevalance of freehold tenure in the Renmark Irrigation Area, private development has been the accustomed means of subdivision. However, the cost of acquisition of 474 and 475 would be reduced if purchased by the Department of Lands, but in both cases the cost of initial aquisition is likely to be only a very small part of the development cost.

(d) Access

Direct access to a main highway may be advantageous to an industry, but light industries are more dependant on easy and convenient access to their customers, so would place more emphasis on being close to the town.

Development should not be allowed to lead to a multiplicity of access points on a highway. If 474 and 475 were developed, their internal road design should have only two access points to the highway.

(e) Land Values

Poorly sited industrial development can have deleterious affects on nearby land values e.g. by lowering nearby residential values.

If 474 and 475 were offered for industrial purposes, the value of other, better sited, potential industrial sites could fall as the market would then be over supplied.

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7.1.4 Suitability of 1261 and 1428 for Development

(a) Access

Direct access from the Sturt Highway is unlikely to be permitted. Instead, access from the old road bordering 1261 and 1428 to the south could be provided. However this arrangement could result in a considerable number of vehicles completing a right-hand turn on the Sturt Highway. Slow moving or stationary vehicles near a major intersection of a main interstate route may present a hazard. Locating a retirement village or day school on the main highway also presents a hazard.

Such development is of less danger to traffic if located in a town where speed restrictions would apply.

(b) Supply of Amenities

Effluent disposal and supply of chlorinated water are two problems requiring solution. These services (and electricity) could probably be developed (e.g. by a diversion licence and a private chlorination plant) but the cost of so doing would be cheaper in a town, where a chlorinated water and common effluent system already exist.

The local District Council may receive additional income via rates, but they may in turn find themselves pressured into supplying additional services, e.g. rubbish disposal. Again, such services could be supplied more economically in a town.

(c) Zoning

An objective of the Riverland Planning Area Development Plan is that, "Towns should be encouraged to develop in an orderly and economic manner by urban development forming compact extensions of existing built up areas, by the discouragement of ribbon development along main roads and the allocation of zones for specific land uses such as living, working and recreation."

The area under review is currently allocated as rural. Clearly, if the proposed developments are considered as urban development, they are in conflict with the objective. However, if development is considered as recreation, the allocation of this area for recreation may be appropriate, providing such use is not seen as encouragement of ribbon development.

(d) Tourism

It is likely, that if successful, both submitted proposals would benefit the tourist industry. However, neither a community club, retirement village, church, day school or convention centre need be located on a main highway. In general, all these developments would probably be better located in a quieter area.

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Alternatively a motel-type tourist resort could be expected to attract one-night stopover guests if located near a main highway.

Most tourists to the Riverland are "mobile", relying on tour coaches or private vehicles. Hence there is little advantage in locating tourist facilities contiguously. The chief concerns of a local tourist resort are the provision of various activities and direct access to water. Cliffs bordering the River Murray in this area restrict direct access, hence some water-based activities, and as they are subject to a mining lease will probably become part of a large quarry.

(e) Public Use

If any Council support is required for the facilities, the Council may prefer development in a town where local residents may be able to make use of it. Vandalism is also then likely to be less of a problem.

Unless a retirement village was fully self contained (e.g. dress and gift shops) the residents would prefer to be close to a town. In this way they could exploit the benefits of the town, and may also retain an active interest in the community.

(f) Environmental Impact

The loss of mallee vegetation from the sections under consideration would not be of regional significance, but if development were to proceed consideration should be given to leaving a buffer of trees along the highway, to retain the area's scenic amenity.

Some consideration should also be given to effluent disposal, to ensure that no seepage entered the River Murray.

7.1.5 Need for Aerodrome Extension

For the type of aircraft now using the Renmark Aerodrome, the length of landing strip is sufficent. However, trees growing outside the Aerodrome have been felled to permit a safe approach to the strip.

If larger aircraft (e.g. Fokker Friendships) were to use the airport, the strip would have to be lengthened, to either the west or east. There are no plans to introduce this type of craft at present.

7.1.6 Engineering & Water Supply Department's Works Programme

The works proposed by the E. and W.S. Department are associated with the Noora Drainage Disposal Scheme or are a consequence of it. As the Drainage Scheme is of State-wide significance and has Cabinet approval, full co-operation should be given to the proposed works, providing they do not seriously interfere with other land uses recommended in this study.

The E. and W.S. Department has been responsible for researching and planning the Noora Drainage Scheme and the proposed industrial effluent scheme. Their investigations have considered the underlying geology of the industrial effluent disposal site (indicating the presence of Blanchetown Clay) and it is suggested, with proper management, seepage problems should be minimal.

7.2 CONCLUSIONS

7.2.1 Sections 474 and 475 are poorly sited for industrial development and probably expensive to develop industrially. Furthermore, it appears there is only minimal demand for small, light, industrial blocks within or near the town of Renmark. Private enterprise can suitably meet this demand from the land currently designated for industry, and any large increase in the supply of sites could decrease the value of other potential sites (rendering their private development uneconomic).

If the need for a large scale development site should arise, part of Section 475 (the lower portion near the railway s-bend) would seem the most appropriate.

7.2.2 There are a number of disadvantages to the development of Sections 1261 and 1428, from both the developer's and the general public's viewpoint. Some of the proposed developments would be better sited in a town, and more appropriate tourist development sites (with good access to the River Murray) would be available through private sales.

7.2.3 Presently there is no need to lengthen the airstrip providing the land at the western end is kept clear of trees. The tenure of this land should be designed to permit easy resumption and inclusion in the aerodrome, if required.

7.2.4 If the proposed, industrial effluent disposal site is to proceed, the Engineering and Water Supply Department will be responsible for negotiating with the Department of Lands and other users of the area (i.e. the holders of extractive mineral leases) for the exact area they wish to have placed under their control. Similarly, it is their responsibility to negotiate with the Department of Lands for the area, tenure and access required for the pumping station.

Consideration must also be given to protecting E. and W.S. sites from public interference.

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8. PRIMARY PRODUCTION

8.1 CONSIDERATIONS

8.1.1 Related Submissions

Calperum Station (Martins)
Want an annual licence over 989 for grazing purposes.

L. Monaghan
Sections 989 and 1003 could be used for restricted grazing by cattle and horses (not sheep as they compete with Mallee Fowl). Wants better tenure over 475.

T. Gallard
Wants 478 for horticulture.

A. Kernich
Wants top part of 1003 for agricultural purposes.

R. Pallant
Wants part of 1003 for cattle grazing.

C. Roesler
No agricultural or clearing should be permitted.

Department of Agriculture
Highland is not well suited to agriculture. River flats have limited grazing potential. There is little land suitable for horticultural expansion.

Renmark Irrigation Trust
Want to log dead trees in Disher's Creek (Section 269).

Woods and Forests Department
Are not interested in gaining control of the area.

Department for the Environment
Dead timber should not be removed from Disher's Creek.

S.A. Apiarists Association
Want the land retained in a natural state. Are interested in leasing the land for beekeeping purposes.

8.1.2 Agricultural Potential of Mallee Areas

(a) Grazing

Most of the mallee area is of poor grazing potential. The northern half of the mallee (Land Units A, B and C of Section 6) has spinifex as the dominant species of understorey, and chenopods of little grazing value are common in the southern half. Some grass plains and a few valuable chenopods (e.g. bluebush) occur in the southern mallee, but these areas are scattered and limited in extent. Any stock water would have to be pumped to the area.

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(b) Cultivation

The presence of spinifex (Triodia irritans) indicates the soils are relatively infertile and most mallee soils are low in phosphorus and nitrogen (Specht, 1972).

Furthermore, clearing and cultivation of the steep sand dunes to the north (generally in Units A, B and C) would be difficult and could initiate soil erosion. The erosion potential could reserve the area from clearing, under the Soil Conservation Act. The gentler sloping dunes of the southern mallee area, if cleared and managed correctly, would not suffer erosion but heavy soils of the interdunal swales, when cultivated, are unlikely to be productive because of the area's marginal rainfall.

The unreliable and generally low rainfall (an annual average of 250mm) reduces the agricultural viability of the whole area, which could expect a growing season of only 2 or 3 months (Potter et al, 1973).

8.1.3 Agricultural Potential of the Floodplain

(a) Grazing

Natural pastures (grasses and bushes - e.g. old man saltbush) give the floodplain some potential for grazing. This potential is increased slightly by the seasonal germination of medics which have established in some parts of the area. However, the grazing potential of the flood plain can only be described as limited, with a carrying capacity of no better than 1 sheep to 3 hectares. Careful "opportunity grazing" following floods, or unseasonal heavy rains, could be considered.

Consideration must be given to the changes which stock can cause to native vegetation communities. Their ability to graze selectively, hence effectively preventing the recruitment of young seedlings to mature tree populations, is well recorded (e.g. Lange and Willcocks, 1980). These changes can be caused by even relatively low grazing intensities, and it is after flooding that many trees and bushes germinate.

Furthermore, people sometimes claim "native bushland needs to be stocked in order to 'keep weeds down'. However, more frequently, it is the grazing which thins out the vegetation palatable to domestic stock and allows inedible weeds to establish themselves, just as happens on run-down pasture." (Victorian Department of Crown Lands and Survey, 1977).

(b) Horticulture

Some areas of land Units J and K (See Section 6) have some potential for horticulture. Part of Unit J is a low river terrace which, although with generally poor soil properties, could be used for irrigated pasture production.

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The soils of the high terrace (Unit K) have better physical properties and could be expected to have a high hydraulic conductivity in underlying soil layers (Cole, 1978). As such, the high terrace has potential to be used for vines.

However, the area of high terrace is limited and development for vines is likely to be uneconomic. Irrigation practised in this area could result in seepage of saline groundwater into the River Murray.

8.1.4 Agricultural Potential of the Colluvium

(a) The deep sandy soils of the colluvium are likely to be free draining and suitable for citrus production - as already occurs on Section 680. Natural run-off from the highland may cause erosion problems unless the land is managed properly, and the possible affects of seepage on the floodplain and the River Murray also need consideration.

Without detailed information on soils and methods of water application, it is difficult to predict the impact of irrigation. However, in the long term there would be a direct sub-surface drainage flow to the river, with consequent adverse effects on water quality and native flora. Difficult and expensive measures, to intercept and dispose of seepage water, may be required.

(b) A direct vegetation link between the mallee and the floodplain may be of advantage to some fauna species (See Section 11) but may also result in an additional traffic hazard through animals crossing the Sturt Highway. Other vegetation links occur (e.g. Spring Cart Gully) and the value of Section 474 as a "fauna corridor" is reduced by the lack of trees.

8.1.5 Timber Removal

Using Disher's Creek as an evaporation basin has resulted in the death of many of the trees in that area, due to raised groundwater levels. Although the live timber on the Calperum floodplain is not of importance to a forestry enterprise, interest has been shown in removing the dead timber. Whether removal would be a commercial enterprise is not known but officers of the Department for the Environment have expressed concern over the affect of such activites. Their concern is over potential damage by the vehicles used to remove the timber, and that birds (e.g. parrots and water fowl), possums and bats would be left without a valuable habitat.

Much of the Calperum Study Area has had mallee timber cut from it, and the whipstick mallee now present is regrowth. Under strict control, some regrowth could also be cut. If the tuberous base of the tree is not damaged, the tree should shoot again. Such activites would of course be unacceptable in any conservation area, and irrespective of location trees such as native pine, bullock bush, false sandalwood or black oak should not be cut in any way.

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8.1.6 Beekeeping

Due to vegetation clearance, the South Australian Apiarists' Association faces the problem of securing access to suitable areas of native scrubland. Although beekeepers have a basic interest in conserving the native flora, their activities can cause problems in Conservation Parks.

The main problems relate to access. In some cases access to delicate environmental areas may be increased by tracks made by beekeepers, and in others the public may not be able to use popular areas because of the presence of bee hives. The condition of public access tracks may also suffer from beekeeping activites, depending upon the frequency of use and the type of vehicle used by the beekeepers.

8.2 CONCLUSIONS

8.2.1 The local topography, soils, vegetation and climate indicate the mallee area is not well suited to agricultural pursuits.

8.2.2 Although the floodplain does have limited grazing potential, any such use would clearly be in conflict with conservation objectives. There is also some potential for irrigation, but the sites involved are likely to result in direct saline seepage to the River Murray.

8.2.3 The colluvium could support irrigated citrus production but such a land use has the potential to cause long term seepage problems with deleterious affects on floodplain vegetation and River Murray water quality.

8.2.4 Conservation of the floodplain would preclude the removal of dead timber from Disher's Creek. Limited mallee could be taken from highland areas for firewood without unduly damaging the appearance of the area. Such activities would not be consistent with preserving the ecology of the area.

8.2.5 Theoretically, beekeepers could operate in a conservation area if strict management conditions were imposed and obeyed. However, if the land is used for conservation, the managing body should have the authority to permit operation and stipulate conditions of operation.

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9. MINING

9.1 INTRODUCTION

Mining control in South Australia can be a complex matter, involving (among others) the Mining Act, the Mines and Works Inspection Act, the Planning and Development Act, and the Crown Lands Act. Before discussing mining at Calperum it is necessary to understand the interaction between these Acts and determine the role of the Department of Lands in mining control.

This brief discussion cannot cover all aspects of mining or all the interested parties and their Acts (e.g. E. & W.S. and the Water Resources Act or the Highways Department and the Highways Act), but aims at describing the current legislative framework of mining control, with emphasis on the role of the Department of Lands and specific problems at Calperum. It is hoped the need for brevity does not render this section so simplistic as to be inaccurate, and it should be noted that the situation may change due to new legislation in the near future.

9.1.1 Definition

Extractive minerals are defined in the Mining Act to include sand, gravel, stone, shell, shale, clay, and any minerals to be used in cement or lime manufacture or for agricultural uses. Soil is not an extractive mineral and quarrying loam is exempt from controls of the Mining Act, but not the Mines and Works Inspection Act.

9.1.2 Authority, Restrictions and Requirements

The process to obtain mining authority is (in theory) as follows:-

(a) a miner's right is obtained

(b) a claim is pegged and, unless labour conditions are suspended, the claim must be worked for 100 manhours per month but the minerals cannot be commercially disposed. The Department of Mines and Energy (after circulating the claim to other Departments) assesses which conditions should be included in the lease (e.g. a development and rehabilitation plan, via regulations of the Mines and Works Inspection Act, may be needed).

(c) an extractive mineral lease is granted - the lease must be worked, in accordance with lease conditions, and royalties paid. Money may then be available through the Extractive Areas Rehabilitation Fund to aid quarry rehabilitation.

On freehold land the owner of the land is the only person who can register a claim, and he may later transfer his extractive mineral lease.

On perpetual leasehold land 21 days written notice must be given to the lessee before entry is made to peg a claim. The lessee may object and take his case to the Wardens Court.

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On Crown Lands no notice is needed.

On reserves under Council control, the written authority of the Minister of Mines and Energy is needed before a claim can be registered.

Mining is not permitted within 400 metres of any dwelling house, on any parklands or recreation grounds under Council control, or in any cultivated field, orchard, airfield or institution grounds.

No mining tenement under the Mining Act is needed by people recovering extractive minerals for their own personal use.

Mining is considered to be a change of land use, and thus, under the Planning and Development Act, a separate consent to mine is needed from the planning authority. To aid the assessment of applications, the State Planning Authority has established the Extractive Industries Committee.

9.1.3 Mining Authorised by other than Mining Act

Under the Local Government Act, Councils have the authority to acquire stone within their districts, and this authority is recognised by the Mining Act, so Councils do not require mining tenements. However an area worked by Council may be pegged under miner's right and Council would forfeit their quarrying right.

The Crown Lands Act can be used to place Crown Land under Council's control as a Stone Reserve, in which case no royalties are payable, no other mining authority is needed, and, because the Minister's permission would be needed before any other mining tenements were issued, the minerals are reasonably secured.

The Crown Lands Act also permits the issue of licences over Crown Lands for the removal of gravel, stone, clay or earth and establishes penalties for so doing without a licence or "other authority". Obviously an extractive minerals lease provides other authority but where the Mining Act does not apply, licences under the Crown Lands Act are still required. Examples are areas excluded from the Mining Act and personal use where a lease is not required.

9.1.4 Overlap of Legislation

Although the Mining Act is concerned mainly with minerals, and the Crown Lands Act with tenure of the land surface, there is an overlap and conflicts do arise.

An example is the miscellaneous lease over Section 625 County Hamley issued under the Crown Lands Act, for quarry purposes. The area is now used only for processing quarried rubble, but if rubble is removed from that Section for commercial use (as it originally was) that action would be contrary to the Mining Act, as no mining tenement exists.

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Alternatively, W. Santos has a cement works and processing equipment apparently partly on the unallotted Crown Lands adjacent his extractive minerals leases on Section 1262 County Hamley. Under the Mining Act, a Miscellaneous Purposes Licence would legalise the situation. However, under the Crown Lands Act occupation of Crown Lands would remain unauthorised until appropriate tenure (either an annual licence or a miscellaneous lease) was issued. In such cases it may be necessary to apply both Mining and Crown Lands legislation.

9.1.5 Role of the Department of Lands

Considering the above, the role of the Department of Lands in mining control at Calperum is to:-

(a) Ensure mining activities meet the requirements of the Crown Lands Act,

(b) Ensure Local Government and local private enterprise are not denied necessary minerals,

(c) Aid other Departments in their regulation of mining activities, and

(d) Establish a realistic balance between mining activities and other land uses.

9.2 CONSIDERATIONS

9.2.1 Related Submissions

Corporation of the Town of Renmark
Want to secure limestone rubble supplies.

District Council of Berri
Rely heavily on limestone rubble and use red sand.

Scherer Contractors
Need red sand and limestone rubble. Will buy 500 ha.

W. Santos
Wants long term tenure over area already occupied.

Department of Mines and Energy
Formalise all extraction through the Department of Mines.

9.2.2 Mineral Deposits

(a) Limestone

The sub-surface limestone (Bakara Soil) present throughout much of Land Units D and E (see Section 6) is of value as a mineral resource. This deposit is of restricted occurrence in the Riverland, and being located near the settled areas of Berri and Renmark, is of high value.

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Local Councils are reliant on the rock for road surfacing, and material suitable as concrete aggregate can be obtained by selective mining (Martins, 1981). The latter is done by private enterprise.

(b) Silicified Sandstone

In some locations (e.g. parts of Land Unit F north of the airport) a silicified cap has formed on the Pliocene sands. This cap rock is considered unsuitable for concrete aggregate, but has been used minimally for building and fencing stone (Martins, 1981). The rock may also be tried in the future as a road surfacing material.

(c) Red Sand

Fine, red sands of the Woorinen Formation are widespread throughout the Riverland. These sands are used for filling at building sites etc. and for top dressing gardens. Although widespread, it is not always easy to obtain red sand near settled areas due to competing land uses such as orchards or cultivation.

Some aeolian and alluvial sand deposits also occur in the river valley.

(d) Pliocene Sands

Coarse Pliocene sands, which underly the whole study area, are exposed in the cliff-face at Spring Cart Gully, where they are mined for making concrete. Limited use is also made of these sands for topdressing local roads and carparks.

Objections on environmental grounds, have been raised against mining at Spring Cart Gully. The operation is now subject to a water quality order (via the E. & W.S. Department) and the conditions of the mining tenements covering the area. The exact location of the buildings associated with the concrete plant on site cannot be related to the boundaries of the mining tenement without a survey.

Martins (1981) has indicated the potential of extracting Pliocene sands from beneath old limestone quarries, which have had the over-burden removed. This would have less environmental impact than opening new mines at cliff-faces or in regional depressions (e.g. lower parts of Land Unit A) where the sands may be near the surface.

(e) Clay

Large reserves of Blanchetown Clay occur in the study area (e.g. Land Unit G) but Martins (1981) reports previous investigations have shown the clay to be "unsuitable for bricks, tiles or pipe manufacture unless blended with other clays".

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9.2.3 Access to Mineral Deposits

(a) Mining Tenements

There were four extractive mineral leases registered in the study area at 1st May, 1981. Two of these are in Section 1262 for sand, and are due to expire in 1983 and 1986. The other two (for calcrete) are in Section 474, and are due to expire in 1983 and 1985 (See Figure 9.1).

During the course of this study, claims have been pegged north of the airport, in the area marked 1 on Figure 9.1. It is understood that further claims may be pegged in that area and in Section 474.

9.2.4 Unauthorised Operations

Prior to the commencement of this study, adjoining Local Government bodies and private operators were working unauthorised borrow pits in the study area (See Figure 9.1). If quarrying is to continue legally, mining tenements must be issued or the area brought under Local Government jurisdiction.

If brought into an area of Local Government, relevant parts could be proclaimed Stone Reserves under the care and control of the Local Government authority. Provision should be made to permit private operations in nominated areas of the Stone Reserve (via Ministerial and Council approval). Otherwise, there should remain areas of Crown land on which claims may be pegged. If it is intended certain areas not be mined, these areas should be exempt from provisions of the Mining Act.

(a) Management

Efficent present and future exploitation of the mineral resources necessitates "systematic development" and an "effective programme for the rehabilitation of the workings" (Martins, 1981).

The following development and rehabilitation guidelines have been suggested for the area:-

: "Work the deposit in strips and practise progressive rehabilitation while earthmoving equipment is on site"

: "Remove topsoil from the first strip and stockpile"

: "Batter terminal face of first strip and spread some topsoil"

: "Extract stone from first strip and rip floor"

: "Remove topsoil from the next strip and place directly onto the floor of the worked out section. Lightly rip"

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: "Progressively work and rehabilitate deposit to its limit using the topsoil stockpiled from the first strip on the floor of the final strip" (Martins, 1981).

When siting and operating quarries, care should also be taken to protect the scenic amenity of the area, particularly from the Sturt Highway and the River Murray.

Development and rehabilitation plans, as in the Mines and Works Inspection Act, would probably be the most appropriate way to ensure the effective working of both Coucnil and privately operated pits.

9.3 CONCLUSIONS

9.3.1 Reserves of hard rock (limestone and silicified sandstone) need to be made avilable for community use. Red, aeolian sands should also be available in the same general areas. It may be possible to economically obtain Pliocene sands from beneath old rubble pits. The sections marked 1, 2 and 474 on Figure 9.1 should provide adequate mineral reserves for the future.

9.3.2 Due to the scenic and environmental impact, and the availability of similar minerals elsewhere, no new mining operations should be permitted on the floodplain, river cliff-faces or the valley-slope (colluvium).

9.3.3 The areas mentioned in CONCLUSION 9.3.1 should be brought inside Local Government boundaries. Some Sections should be proclaimed as Stone Reserves and some should be left as unallotted Crown Lands.

9.3.4 All mining operations should be subject to a development and rehabilitation plan via the Mines and Works Inspection Act.

9.3.5 Any areas to be set aside for conservation, should be exempt from the operations of the Mining Act.

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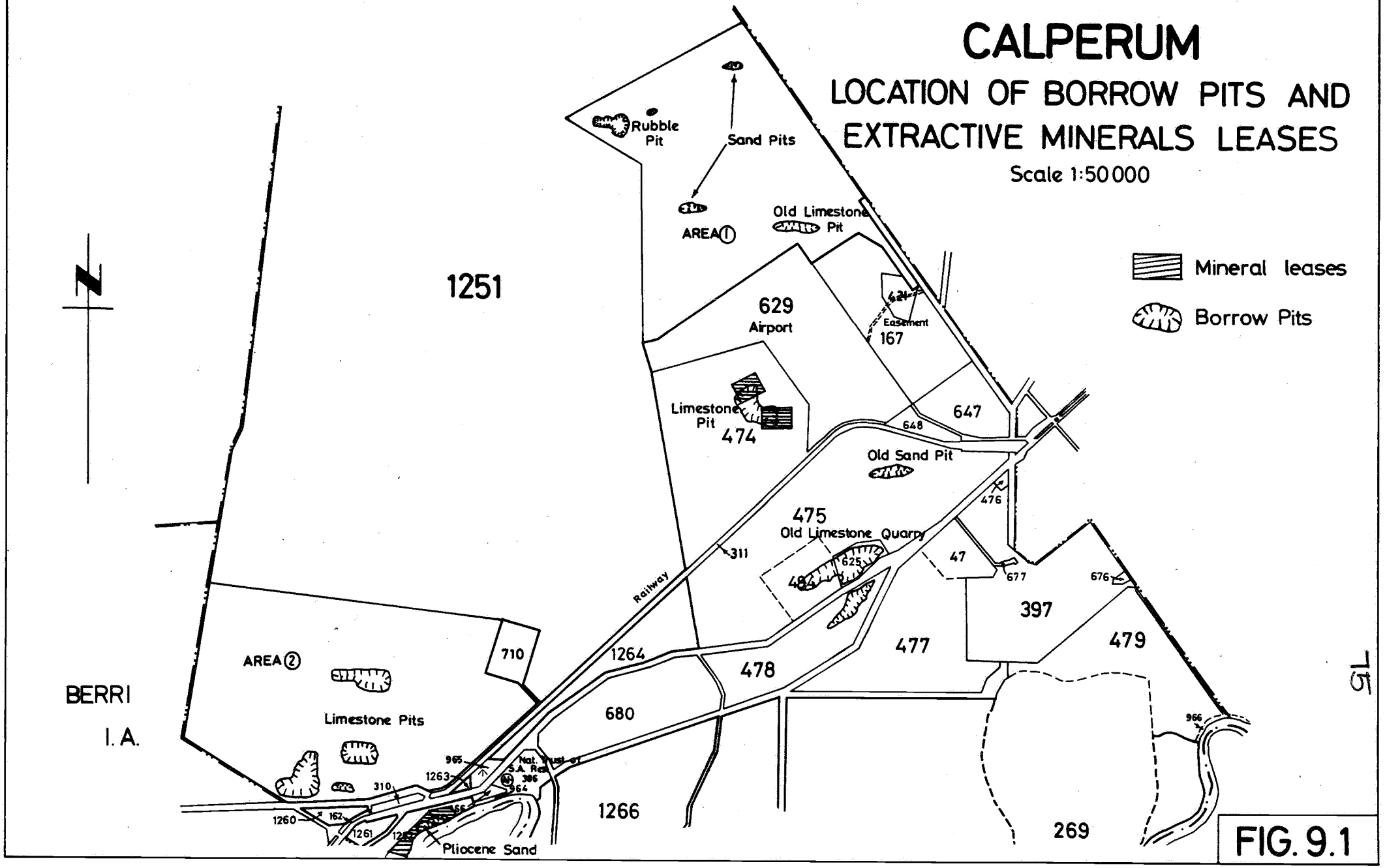
The informal advice offered by officers of the Dept. of Mines and Energy and what is now the Dept. for Environment and Planning is also thankfully acknowledged.


CALPERUM
LOCATION OF BORROW PITS AND EXTRACTIVE MINERALS LEASES
Scale 1:50000
Mineral leases
Borrow Pits
N
Rubble Pit
Sand Pits
AREA (1)
Old Limestone Pit
1251
629
Airport
421
Easement
167
Limestone Pit
474
647
648
Old Sand Pit
475
Old Limestone Quarry
476
311
625
47
677
676
397
479
Railway
AREA (2)
710
1264
478
477
680
Limestone Pits
965
1263
310
1260
162
1261
1266
966
269
Pliocene Sand
BERRI
I. A.
FIG. 9.1

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10. RECREATION

10.1 CONSIDERATIONS

10.1.1 Related Submissions

Berri Pistol Club
Would like to stay where they are.

Renmark-Berri Field and Game Club
Would like a better form of tenure.

Riverland Raceway Assoc. Inc.
Want better tenure and part of 475 for off-road vehicles.

District Council of Berri
Block 989 should be reserved for parklands and recreation.

10.1.2 Un-regulated Uses

(a) Camping

The Calperum floodplain is one of the Riverland's popular camping areas, During the Easter weekend, 1981, there were a total of 37 caravans and 63 tents in the area. The distribution of these campers is shown in Figure 10.1, and is similar to that observed at other "peak use" periods (e.g. school holidays and long weekends).

The high number of caravans in some areas indicates the ease of access to specific sites. In general, the areas not used have difficult access, or the waterfront is not suitable for use, due to water-logging, dense reeds or steep banks.

Camping causes a number of problems which could be largely overcome with increased user education and more intensive and planned management. These solutions unfortunately require capital.

The problems common to most popular camping spots along the River are as follows:-

: Litter (especially broken bottles) is often left at camp sites, spoiling the appearance of the area and creating a hazard. Maintainance of a litter collection service to individual campsites is costly.

: Ground cover plants (the grasses and low bushes which bind the soil) are damaged by vehicular and human traffic, leaving the soil liable to erosion. On the open floodplain it is difficult to confine traffic to one track, and consequently, a maze of roads develops, giving unlimited access to the area.

: Firewood supplies become exhausted and then, to obtain wood, saplings are felled or branches broken from living trees. Large trees are felled or burnt, apparently to ensure ample dead wood for future visits. Supplying firewood is costly and may encourage greater wood consumption.

: Overcrowding, noise (from generators, music, cars or trailbikes) and disturbance by cars travelling through or past campsites, can detract from the appeal of areas, as well as scaring wildlife. Controlling access, and the number of cars that will fit into a carpark, could alleviate some of these problems.

A limited number of visitors, mainly those interested in nature study or biological research, camp in the mallee area of Calperum. As such people generally are conscious of litter etc., the only management problem likely to arise is an increase in the number of access tracks, especially around features of interest.

(b) Daytrips (fishing, picnics, swimming or skiing)

Visitors to the riverfront on daytrips, generally, less intensively use the area, but are more consistent i.e. they come more often, but in lower numbers than the peak period users. They can, however, cause the same problems and face the same difficulties as campers. On long weekends or during school holidays in the warmer months, they compete for the best spots, often already occupied by campers.

The "Lyrup sandbar" (B on Figure 10.1) is a popular swimming and skiing area, though reed growth is reducing its appeal. Also used, is a site near Spring Cart Gully, for picnicking and launching boats.

(c) Houseboats

People on houseboats often like to moor near sandbars, and hence sites A, B, C and D (Figure 10.1) are attractive to them. Sites C and D have the added advantage of poor land access, and hence are relatively isolated, providing an impression of remoteness.

(d) Nature Study

As mentioned above, some people camp in the mallee area purely for nature study reasons. A few people also make day trips to both the mallee and floodplain to watch birds or look at wild-flowers. Furthermore, as established in submissions to Section 11, local schools use the area for biological studies. Many students may argue that such an activity is not recreation, but for others these lessons may initiate new hobbies.

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(e) Shooting

Although shooting is prohibited in the Disher's Creek Evaporation Basin, the remainder of the floodplain is Crown Land, over which shooting is legal, provided the necessary gun licences and shooting permits are obtained. However, the Crown Land areas are not major duck shooting sites.

Some illegal spot-lighting has occurred in the mallee area. In the past year three dead kangaroos have been found, but shooting may have been more prevalent than indicated by this number of victims.

(f) Trail Bikes, off-road vehicles etc.

In the study area, there is a small but significant number of people who use the land for trail bike riding, driving off-road vehicles, or just "hanging wheelies" in their own cars. Although the number of people involved in such activities at any given time is small, the impact of associated noise and physical, environmental disturbance, can be significant.

Dune buggies and people doing "wheelies", cause most environmental abuse, as their activities are generally off existing roads and tracks. However, even in areas of thick mallee, which restricts trail bikes etc. to existing tracks, they create noise which may frighten wildlife away from nesting sites and disturb the soil on sandy tracks.

A further hazard associated with unrestricted use of the northern areas is that of a head-on collision involving speeding vehicles coming over the steep dunes on narrow tracks.

10.1.3 Organised Activities

(a) Renmark-Berri Field and Game Club

The Field and Game Club have had an annual licence over what is now Section 1264 since 1975, the year in which they also erected solid-construction clubrooms. Members use the area for shotgun practice, and the firearms range is also available to groups such as the S.A. Police Force, for training programmes.

Being unfenced at one end, the club has suffered episodic vandalism and theft. Tenure, different to that presently held, has been sought to provide future security.

(b) Berri Pistol Club

As with the Field and Game Club, the Pistol Club provides an established area where people can learn and practise the safe use of firearms, while also enjoying themselves. The existence of the club has been recently authorised with provision of an annual licence.

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Both the Field and Game Club and the Pistol Club require a degree of isolation for safety reasons. The Field and Game Club is well isolated, the Pistol Club faces a sand dune and is also protected by earth banks at the side of the shooting galleries. Provided sensible firing procedures are followed the club should ensure there is no public danger.

If public use of the area near the Pistol Club was to increase, vandalism of the site could become a problem. Furthermore, if nearby land was to be used for conservation purposes, some people may consider the present siting of the club to be inconsistent with that use.

(c) Riverland Raceway Association Inc.

The Raceway occupies Section 494 under an annual licence, and runs a speedway, moto-cross track, and a mini-bike track. The Association appears to manage the area well. The speedway area has been in use since 1964, although tenure was not issued until 1975. Access to the Raceway is directly from the Sturt Highway, an arrangement which should be treated with caution.

To gain security for more improvements to their site, the Raceway Association has applied for better tenure.

Interest has also been expressed in developing areas for off-road and recreational vehicles. It is envisaged that areas for sand buggies, four-wheel-drive and motor cycles could be developed, possibly with camping facilities also. To achieve the establishment of a regional, family-oriented, recreational facility, application has been made for the western portion of Section 475.

10.2 CONCLUSIONS

10.2.1 There is considerable merit in keeping much of the study area (in particular the floodplain west of the old Calperum Homestead) open for free, recreational activities such as camping, picnics, skiing and nature study. Visitors to these areas need to be "educated" so that they are aware of problems they may cause, and that they can assist by:-

: not damaging any vegetation

: keeping vehicles to existing tracks

: taking litter home, burning it or using disposal facilities

: not being excessively noisy

More intensive management is needed to foster such "education" and to control access, litter and damage to trees. The following proposals should help achieve this end.

: Select specific tracks to be upgraded possibly on a cul-de-sac design, to give more privacy to campers. Others to be rendered impassable. Where feasible, carparks of specific sizes could be developed to prevent overcrowding.

: Provide a basic litter-collection service. Install a limited number of large bins (2 to 4) at prime access points.

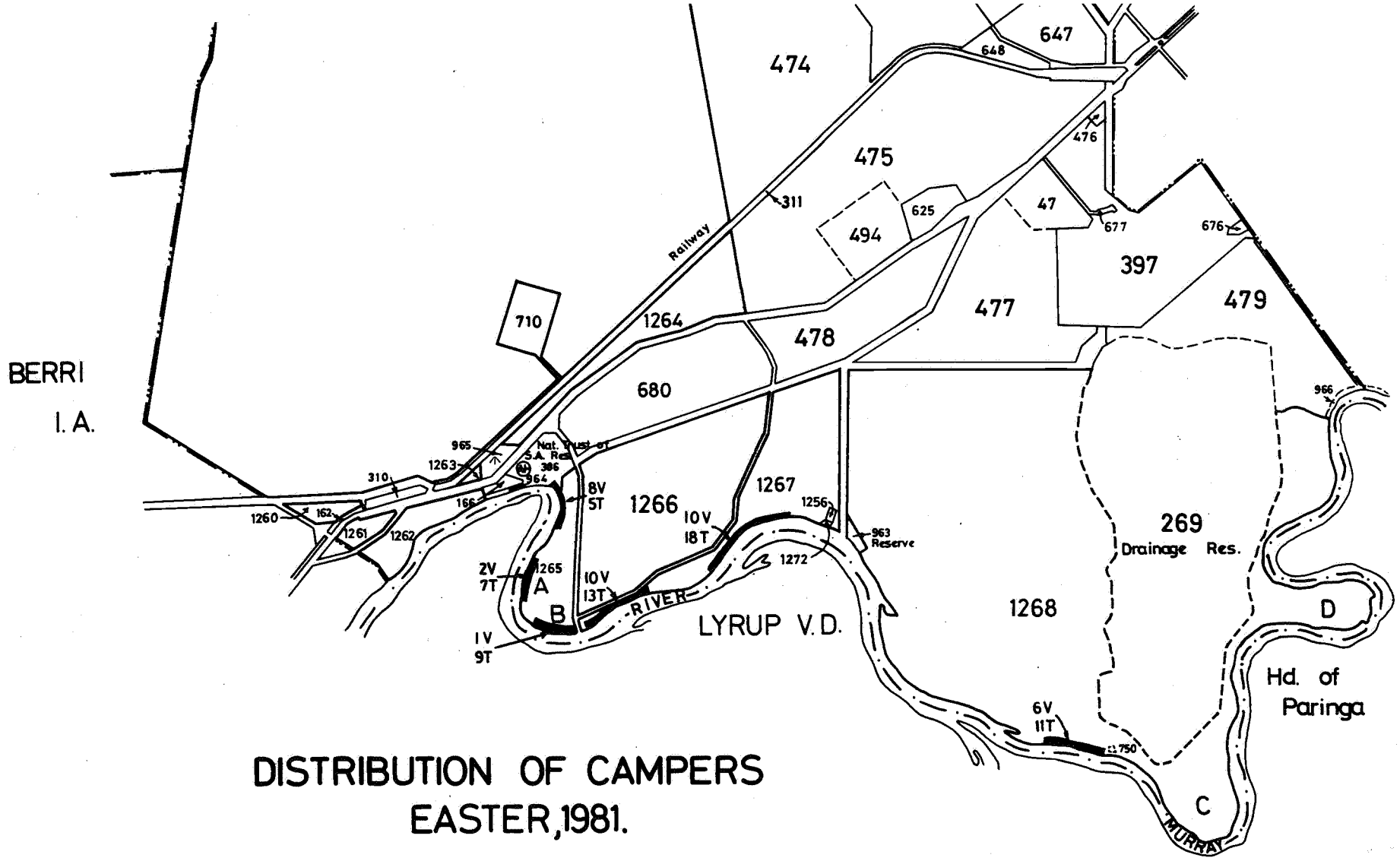
: Visitors could be attracted to specific areas by the presence of fire-pits and the supply of firewood.

: Regulations could be produced and policed as a support to education and more subtle management techniques.

10.2.2 Activities likely to cause undue noise or environmental damage (e.g. trail bikes and shooting) should be prohibited from delicate environmental areas or popular camping spots, and be directed to areas set aside for such purposes.

10.2.3 Access by land to the river east of Disher's Creek Evaporation Basin (Section 269) should be limited, so the area's remote character is maintained.

10.2.4 Consistent with CONCLUSION 2, the Field and Game Club, the Pistol Club and the Riverland Raceway should be promoted.



DISTRIBUTION OF CAMPERS EASTER, 1981.

V.....Caravans
T.....Tents

SCALE 1:50000

M. 1000 500 0 1 2 3 4 5 KM.

FIG.10.1

18000

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11. CONSERVATION

11.1 CONSIDERATIONS

11.1.1 Related Submissions

District Council of Berri
Block 989 should be reserved for parklands and recreation.

Corp. of the Town of Renmark
In the long term, there is potential for a flora and fauna reserve.

Mr. Jeffree
People are burning live trees along the River. Please control.

C. Roesler
1003 and 989 should be a National Park.

Mr. Munchenberg
1003 should be a flora and fauna reserve.

10 concerned Barmera residents
Preserve Eremophila Flat.

J. Brodie (Renmark High School) and C. Lill (Glossop High School)
Preserve the area as a Conservation Park. The S.G.A.P., Field Naturalists and National Trust could help with management. Finding uncleared land, without stock, for field trips is getting harder in the Riverland.

Society for Growing Aust. Plants
Conserve all of Sec. 1003.

Field Naturalists Soc. of S.A.
Sec. 1003 should be a Conservation Park.

National Trust of S.A.
In support of Field Nats., 1003 should be a Conservation Park.

National Trust of S.A.(Berri Branch)
1003 and 989 should be a Conservation Park. They could help with management.

R. Seymour (Adelaide University)
Calperum has been used for work on spiders, goannas and mallee fowl. Work on the mallee fowl will continue and conservation of 1003 is advocated.

Adelaide Uni. Biology Society
The diverse range of habitats leads to a diverse range of fauna. As much land as possible should be reserved for conservation and scientific study purposes.

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Dept. of Urban & Regional Affairs
Part of 989 should be for recreation, and part for conservation.

Dept. of Agriculture
1003 has conservation merit, but little agricultural potential. The vandalism to trees in 989 should be stopped.

Dept. for Environment & Planning
1003 and 989 should ultimately be managed by the National Parks and Wildlife Service.

National Parks & Wildlife Service
Dead timber should not be removed from Section 269. 1003 is of conservation merit but beyond current management resources. Making 989 a Conservation Park or Game Reserve is not unrealistic.

11.1.2 Conservation Value

The Calperum land under investigation is a large representative sample of local land form, vegetation and fauna; as indicated in Chapter 6 where a range of typical mallee and floodplain units is described. This contiguous range of structural diversity (through mallee and floodplain) awards the Calperum study area considerable conservation merit.

Due to it's limited agricultural use, much of this area has suffered relatively little interference from man.

(a) Mallee Areas

The land north of the Sturt Highway (formerly part of block 1003) is the only expanse of mallee vegetation in the Riverland not under perpetual or pastoral lease. Elsewhere, large tracts of mallee vegetation have been cleared for cultivation especially in more reliable rainfall areas south of the river, or to increase the short term grazing potential of the land.

The large size, combined with the variety of land units contained, make the mallee area a viable conservation unit. The importance of size and variety has been stressed in Chapter 5. By altering the boundaries, to exclude awkward corners, the area would have a shape cheaper to manage in regard to fencing and firebreaks.

A number of specific features also warrant protection (see Chapter 5). The mallee fowl (Leipoa ocellata), which breeds in the area, is officially recognised as uncommon in South Australia. Mallee fowl are relatively numerous at Calperum because of the presently suitable vegetation and lack of competition from sheep and rabbits (both generally are absent). Continual clearing of similar vegetation elsewhere, reduces the habitat of this species and increases the importance of habitat conservation.

Unique local features of vegetation are Eremophila Flat and the large river box (Eucalyptus largiflorens) growing in a nearby flat to the southwest.

The regional location adds to the conservation value as the area functions as a wildlife corridor. Birds, such as the white-fronted honeyeater which seasonally moves between Danggali Conservation Park, the River Murray and Billiat and Scorpion Springs Conservation Parks, would pass through Calperum. This corridor or stop-over would assume increased importance if intervening mallee was cleared for pastoral use.

A natural vegetation link between mallee and floodplain would allow movement of animals e.g. emus and black-winged currawongs, when searching for water during dry periods.

(b) Floodplain Areas

The floodplain (formerly block 989) also has varying vegetation types, among them are samphire, low shrublands, open woodlands and open forest formation. Stands of coobah and tea tree occur among the usual river box and redgum, and old native pines can be seen on a river terrace.

The range of vegetation types creates a diversity of fauna habitats and possesses some special features e.g. the native pines, and stands of regenerating river box. Maturation of these stands will increase the number and extent of fauna habitats and so add to scenic attractiveness and conservation value.

The floodplains provide breeding sites for tortoises, possums, bats, dryland parrots and possibly water fowl (under the right seasonal conditions). It is possible they also supply spawning sites for native fish at times of flood.

As shooting in Disher's Creek evaporation basin is prohibited by management, waterfowl possess a suitable refuge. With adjacent land the area could be managed as a Game Reserve. This benefit, however, must be balanced with the drowning of many river redgums in the basin and the gradual decline of others due to seepage.

The aboriginal chert mine on Section 386 is thought to be the major source of chert on the River Murray. The chert was fashioned into cutting and scraping tools and relics have been found throughout the Murray Valley and inland areas. The mine area, now known as Spring Cart Gully and apparently as Memdelbuick to the aborigines, is still in good condition but for some poorly sited tracks.

Old surveys of the area record Section 478 as Miwangburk Hill, the land near the Lyrup ferry as Coolaltit, and the flood plain north of the old Calperum homestead (Section 1256) as Bercallung. These are presumably Aboriginal names.

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11.1.3 Uses

(a) Mallee Areas

The mallee area is used by those interested in natural history. Field Naturalist Clubs and Schools use the area for field trips.

A number of scientific bodies conduct research programmes. Bird-banding has been done for the C.S.I.R.O., and post graduate students from the University of Adelaide have examined spiders and goannas, particularly Varanus gouldii Further research on the mallee fowl (thermoregulation and ecology of the incubation mound, the development of chicks without imprinting and the energetics and water balance in adult birds) is either underway or proposed and the site is also used for undergraduate field experience.

The land copes with the limited camping occurring in specific areas but the type, location and number of access tracks requires control to protect the safety of users, prevent undue environmental damage and exclude noisy activities from sensitive areas e.g. mallee fowl mounds.

Uses, contrary to conservation, are varied and include mining, organised sport and recreation (shooting and racing clubs) and unauthorised shooting and off-road vehicle use. See paras. 9.2.2, 10.1.3 and 10.1.2(f) respectively, in this report, for greater detail. Suggested contrary uses include grazing, by cattle or horses, under licence and clearing for cultivation.

Beekeepers, represented by the S.A. Apiarists Association, wish to use the area. Their concerns are conservation of the area and provision of suitable tenure permitting their use.

The limited use of the mallee area and subsurface existence of Blanchetown Clay, combined with the area being Crown Land possibly prompted the E. & W.S. Department to propose the area north of the Renmark aerodrome as an industrial effluent site.

The mallee area could easily be managed for conservation purposes if activities incompatible with conservation (particularly mining and industrial waste disposal) were restricted to specific areas. Modifications to boundaries of the conservation zone, producing a more easily managed expanse, should be based on the necessary availability of land for activities important to the economy of the Riverland.

(b) Floodplain Areas

Apart from Disher's Creek evaporation basin, recreation is the major use of the floodplain and is generally based in the western portion of the floodplain. Visitors chiefly enjoy the unrestricted access to water and the natural environment.

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Swimming, skiing, fishing, picnics and camping are the main recreational activities, although there is also a small amount of duck shooting and off-road vehicle activity. The main management problems caused by these activities are control of vehicular access, prevention of the felling of live timber for fire-wood and litter control.

The only private occupation of the floodplain is the former Calperum homestead and a shack near Disher's Creek. The homestead is occupied under miscellaneous lease, issued for rural living purposes and of 20 years duration. The shack is occupied under annual licence and is subject to the Shack Site Policy of the Department of Lands. The site is classed as unacceptable and consequently a freehold title cannot be obtained.

In the future, the drainage waters from Disher's Creek evaporation basin will be pumped across the river to Noora. The E. & W.S. Department will be erecting a pumping station for this purpose, and they also intend to upgrade the road to the site. When the Noora scheme is operational only the existing Disher's Creek channel will be permanently inundated.

11.2 CONCLUSION

11.2.1 The Calperum area possesses biological, cultural and historic features worthy of conservation. The diverse vegetation types are generally healthy, possess some unique features and provide breeding areas and refuge for various fauna including several uncommon species. The area, comprising expanses of mallee and floodplain, is also well-sited as a regional conservation zone.

11.2.2 Conservation of the area is supported by local and State organisations and also by amateur and professional groups.

11.2.3 Several community groups and individuals currently use parts of the area and Local Government and private enterprise bodies use materials quarried in the area. Resources required by the community must be kept available whether the resource be recreational or material. The conservation of the area, without prohibition of community use of locally valuable resources will be the crux of any land use proposals.

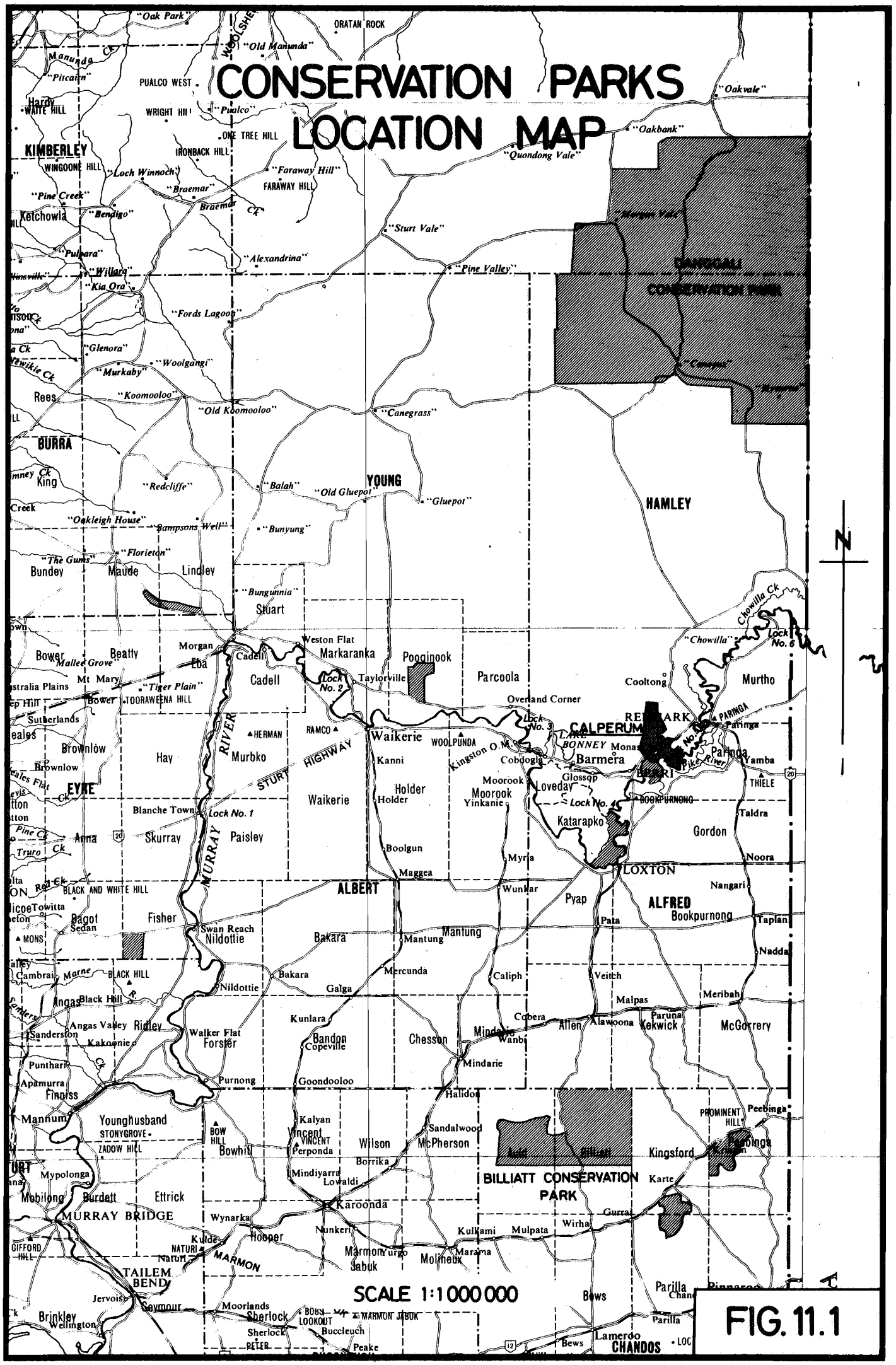
CONSERVATION PARKS
LOCATION MAP
SCALE 1:1000000
N
BILLIATT CONSERVATION PARK
BANRGALE CONSERVATION PARK
KIMBERLEY
BURRA
YOUNG
HAMLEY
EYRE
ALBERT
ALFRED
CHANDOS
MURRAY BRIDGE
TAILEM BEND
LOXTON
CALPERUM
RENMARK
MURRAY RIVER
STURT HIGHWAY
"Oak Park"
ORATAN ROCK
"Old Manunda"
"Pitcairn"
PUALCO WEST
"Pualco"
WRIGHT HILL
WAITE HILL
ONE TREE HILL
IRONBACK HILL
WINGOONE HILL
"Loch Winnoch"
"Faraway Hill"
FARAWAY HILL
"Braemar"
"Pine Creek"
"Bendigo"
Ketchowla
"Pulpara"
"Willara"
"Kia Ora"
"Alexandrina"
"Sturt Vale"
"Pine Valley"
"Oakvale"
"Oakbank"
"Quondong Vale"
"Fords Lagoon"
"Glenora"
"Woolgangi"
"Murkaby"
"Koomooloo"
"Old Koomooloo"
"Canegrass"
"Redcliffe"
"Balah"
"Old Gluepot"
"Gluepot"
"Oakleigh House"
"Sampsons Well"
"Bunyung"
"The Gums"
"Florieton"
"Bungunnia"
Bundey
Maude
Lindley
Stuart
Morgan
Eba
Cadell
Weston Flat
Markaranka
Pooginook
Taylorville
Parcoola
Overland Corner
Cooltong
Murtho
"Chowilla"
Chowilla Ck
Lock No. 6
Lock No. 2
Lock No. 3
Lock No. 4
Lock No. 1
Bower
Beatty
Mallee Grove
Mt Mary
"Tiger Plain"
TOORAWEENA HILL
Sutherlands
Brownlow
Hay
Murbko
HERMAN
RAMCO
Waikerie
WOOLPUNDA
Kingston O.M.
Kanni
Cobdogla
Barmera
Monash
LAKE BONNEY
Paringa
Pike River
Yamba
THIELE
Holder
Moorook
Yinkanie
Loveday
Glossop
BOOKPURNONG
Taldra
Gordon
Noora
Blanche Town
Skurray
Paisley
Anna
Katarapko
Boolgun
Myrtle
Maggea
Wunkar
Pyap
Nangari
Bookpurnong
Pata
Taplan
Nadda
Towitta
Pagot
Sedan
Fisher
Swan Reach
Nildottie
Bakara
Mantung
Mercunda
Caliph
Veitch
Malpas
Meribah
Cambrai
Marne
BLACK HILL
Black Hill
Angas
Angas Valley
Ridley
Sanderson
Kakoonie
Walker Flat
Forster
Kunlara
Bandon
Copeville
Chesson
Mindarie
Wanbi
Cobera
Allen
Alawoona
Paruna
Kekwick
McGorrery
Punthari
Apamurra
Finniss
Purnong
Goondooloo
Halidon
Younghusband
STONYGROVE
ZADOW HILL
Mannum
Kalyan
Vincent
Perponda
Wilson
McPherson
Sandalwood
Borrika
Mindiyarra
Lowaldi
Kingsford
Peebinga
PROMINENT HILL
Mypolonga
Mobilong
Burdett
Ettrick
Karoonda
Karte
Gurra
Wirha
Wynarka
Nunkeri
Kulkami
Mulpata
Hooper
Kulde
Marmon urgo
Molineux
Marama
Jabuk
MARMON
GIFFORD HILL
Jervois
Seymour
Brinkley
Wellington
Moorlands
Sherlock
BOBS LOOKOUT
MARMON JABUK
Buccleuch
Peake
Parilla
Bews
Lamerdo

FIG. 11.1

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MANAGEMENT PLAN

000089

12. PROPOSED USE

12.1 OBJECTIVES

The following objectives are offered as guidelines for the future management of the Calperum Study Area.

(a) The basic resources (with regard to conservation, mining, and recreation) are available for public use.

(b) The resources be used in a manner which will permit continued use and minimise the conflict between different uses.

(c) Management of those resources does not impose an unjust financial burden on the community or harm aspects of the area's scenic, environmental, educational, recreational, or scientific features.

12.2 LAND USE PROPOSALS

The following proposals are consistent with the CONSIDERATIONS and CONCLUSIONS of previous sections, and also reflect the OBJECTIVES. These proposals outline the basic land allocation policies to be used in the study area.

12.2.1 Conservation

(a) Mallee Area

After modifying the boundary of the mallee area (see Figure 12.1) to accommodate quarrying and waste disposal, and produce a more manageable shape, the area should be reserved as a park for conservation purposes. Such a reservation should hopefully be only an interim measure, with control of the land resting ultimately with a body such as the National Parks and Wildlife Service. Management of the land would include boundary fencing, closing superfluous internal tracks, delineating camping areas (e.g. at Eremophila Flat and Cooltong Dam) and policing park regulations (e.g. no shooting).

(b) Spring Cart Gully Aboriginal Reserve

The old Aboriginal chert mine at Spring Cart Gully, Section 386 should be retained as a reserve to protect this feature of aboriginal heritage. There appears no reason to remove the National Trust as the controlling body and the current proclamation should not be altered. With increased finance and management, the reserve has the potential to become a tourist attraction, but vehicular and pedestrian access will have to be controlled.

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(c) Roadside Vegetation and Scenic Aspects

Sections of land adjacent the Sturt Highway should be retained as vegetation reserves. The attendant values of roadside vegetation (scenic qualities, breaks in monotony of long trips) combined with unfavourable aspects of ribbon development (potential traffic hazards, uneconomic sprawl of development) provide strong support for this retention. Sections 965, 1260, 1261, 1262, 1263 and 1264 are well vegetated and should be retained as unallotted Crown land or reserved under the care, control and management of Local Government.

part 1262 ... 625

Other sections along the Highway should be managed with emphasis on maintaining roadside vegetation and scenic views (e.g. across the floodplain from adjacent R & F Quarries - Section 625). The presence of the Santos quarry on Section 1262 makes inappropriate the development of scenic lookouts in that area even though views over the river floodplain are impressive.

(d) Floodplain

Management emphasis in this area, particularly the portion east of the old Calperum homestead, should be toward conservation, with minimal access to permit limited recreation in a "remote" area. The main physical management need is control of the number and location of access tracks. The area could be left as unallotted Crown Land, reserved for conservation purposes, or placed under the control of a District Council or the National Parks and Wildlife Service (N.P. & W.S.).

The Management of Disher's Creek should be conservation oriented as the waterfowl present play a significant role in maintaining local waterfowl populations. Unfortunately there is insufficient knowledge of the future water regime (and its interaction with flora and fauna) to propose definite management conditions, but the following factors should be considered by future managers,

- Waterfowl breeding is stimulated by rising water levels; especially if these rises approximate those of a natural system i.e. pre-lock conditions.

- Water depths of 0-1 metres can provide suitable feeding conditions for a variety of waterfowl.

- Permanently raised groundwater levels have a deleterious effect on native vegetation.

Control of Disher's Creek evaporation basin should remain with Renmark Irrigation Trust or transfer to E. & W.S. Department. Another option is management as a game reserve with E. & W.S. and N.P. & W.S. in joint control.

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12.2.2 Recreation

(a) Floodplain Area

The area from Spring Cart Gully (Section 386) to the old Calperum Homestead (Section 1256) should be managed to cater for recreation in a natural environment. By implementing the suggestions made in para. 10.2.1 of this report, visitors should be able to continue camping and picnicking in the area indefinitely. However, as a management and administrative framework is required to maintain the resource, control should be delegated to N.P. & W.S. or Local Government body. In the latter case, officers of State Government Departments (e.g. Dept. for Environment & Planning, Dept. of Lands) may be able to assist with management suggestions and local service groups may help implementation of any formulated, detailed plans.

The remainder of the floodplain, especially the river bends east of Disher's Creek, should retain its restricted access so a remoteness of the area is maintained. This isolated area could be used for the mooring of houseboats or by campers or fishermen travelling by boat or over the rough track to the area.

(b) Organised Activities

The Pistol Club, Field and Game Club and Riverland Raceway should remain in their current locations. No objections to the locations or operations of the organisations were raised. The Clubs and Raceway provide specialised forms of recreation which should be located in open, vacant areas because of associated noise and safety factors. More secure tenure should be issued to the Raceway and Field & Game Club and the Raceway should gain control of part of Section 475 to permit greater development and use of their site. Until the effect, on the Pistol Club, of opening the conservation area (and vice versa) is clear, the Club should remain on annual licence.

(c) Accommodation

The development of sites for holiday accommodation would not be consistent with the intended future use of the area. Present Shack Site Policy of the Department of Lands would also preclude any shack development on the floodplain. The shack on Section 750 has been in existence for some time and it would not be proper to alter the situation.

Similarly,the Department of Lands is committed to permitting continued residential occupation of the old Calperum Homestead. The relatively recent issue of a 20 year lease and approvals permitting renovations and additions to the historic building make any alterations to the present arrangement inappropriate at this time.

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12.2.3 Mining

(a) The mineral resources on parts of Section 1259 (areas 1 and 2 on Figure 12.1) and part of Section 474 should be kept available. These parts should be surveyed, section numbers allocated and some portions should be proclaimed as Stone Reserves under Local Government control and others left as Crown Land.

(b) All mining operations in the area should be subject to development and rehabilitation plans.

(c) The mallee conservation area and the flood-plain should be excluded from the Mining Act.

(d) The improvements associated with the concrete plant on Section 1262 should be surveyed and given security by improving tenure.

(e) No [illegible]

12.2.4 Primary Production

(a) Mallee Area

As the mallee area is not suited to agriculture and any grazing, clearing or cultivation would be in conflict with the proposed use of the area (i.e. a reserve for conservation purposes) no such activities should be permitted. It should, however, remain the prerogative of the manager of the mallee area to determine whether apiarists are permitted in the area and if so, under what conditions.

Timber cutting licences could be issued in the areas set aside for mining activities, depending on the amount of timber to be removed, and the condition of the mallee; and providing that such activities did not interfere with mining operations.

(b) Floodplain Area

The proposed use of the floodplain (i.e. conservation and recreation) is not consistent with light grazing and therefore no such activities should be permitted. No land on the floodplain should be allocated for irrigation, due to potential ground water seepage to the River Murray.

(c) Colluvium

Use of the colluvium (or face-slope) for citrus production, should not be permitted as in the long term, seepage problems would eventuate and have detrimental effects on native vegetation and River Murray water quality. The land should be retained as a scenic backdrop to the floodplain and could possibly serve as a wildlife corridor.

(d) Section 475

Light grazing, for which this section is presently used, should be allowed to continue. By itself there is little conservation value and the area may be developed as a rural living site, provided no other suitable uses are determined.

12.2.5 Development

(a) Sections 474 and 475

Neither Section 474 or 475 is well suited to light industrial development, and in view of the small current demand for such land, neither section should be used for such purposes. Section 474 would be of greater use to the community if its mineral reserves were available The eastern portion of Section 475 (in particular the lower land) could be kept available as a potential site for rapid development, if the need for a large scale development site should arise.

(b) Commercial

Commercial enterprises along the Sturt Highway should not be encouraged, particularly near major intersections due to the detriment to sites along the highway and the disadvantages of ribbon development. Therefore, in line with OBJECTIVE C [See para. 12.1(c)], no development should be permitted on Sections 1261 or 1428 and the Sturt Highway through the Calperum area should be kept free of commercial development.

(c) Ship Building

No definite decision concerning this enterprise can be made as yet, but various options can be proposed.

The enterprise began, during research and compilation of this report, on Crown Land (Section 1262) over which Santos has a mineral lease. The enterprise is not authorised by any State Government Department concerned with the River Murray and also lacks any form of tenure. The suitability of location and satisfactory operation of the enterprise are concerns of various State Government Departments, as is prosecution for breaches of Acts administered by each Department.

If the determinations of other Departments are consistent with the objectives guiding land use at Calperum, the Department of Lands should support their decisions with tenure control. Tenure should be refused if the shipbuilding is determined to be an unsatisfactory operation in an unsuitable location. Alternatively, if approved by other Departments, tenure should be issued, reflecting the intended permanency of the operation and with conditions supporting the requirements of other Departments.

CALPERUM

LAND MANAGEMENT STUDY AREA

BASIC LAND USE PROPOSALS

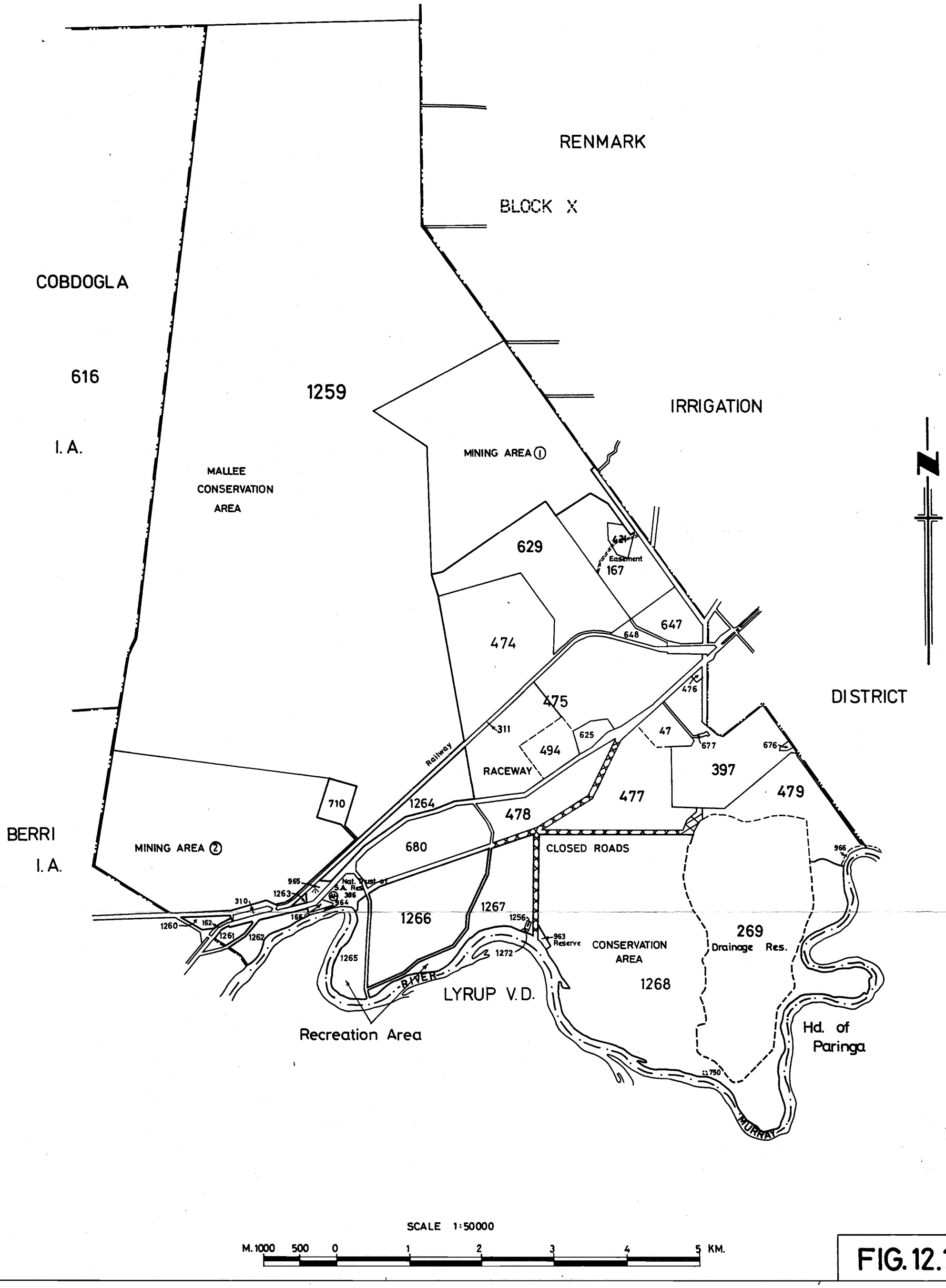

FIG. 12.1

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13. PROPOSED TENURE AND MANAGEMENT CONDITIONS

13.1 FRAMEWORK

To accommodate the land use changes proposed for the Calperum Study Area, two basic types of tenure-detail changes are required. These changes will provide a framework for other tenure/management conditions.

13.1.1 Survey

The first changes are survey alterations and they are as follows:

(a) In accordance with Land Use Proposal 1. (a) (para 12.2.1) survey the conservation area (A on Figure 13.1) and the road allowing access. There is already an unsurveyed road in existence at that location.

Three new Sections, B, C and D, will also be created and they all have access.

(b) As the roads marked on surveys between Sections 477, 478, 1267 and 1268 are not in existence, they should be closed (indicated on Figure 12.1). A new road to Section 1256 should be surveyed along the existing track (as shown on Figure 13.1). A new Section E is created, to which Section 1272 should be added.

(c) The Drainage Reserve (Section 269) should also be resurveyed. By extending the new section (F on Figure 13.1) south to the River Murray, the new pumping station would be included in the reserve. The existing track to the west of Section 269 should be included in Section F, which should also adjoin Section 750.

By surveying the existing road from the Sturt Highway to Section F, that section would be given access. The Engineering and Water Supply Department should lodge this survey. It would then be necessary for the Engineering and Water Supply Department to either register an easement to provide Section 750 with legal access, or enter into an informal, written agreement undertaking to maintain access.

Such a resurvey would create Sections G and H (See Figure 13.1). Section 963 should be amalgamated into Section G and Section 479 into Section H.

(d) Section 474 requires access, and this may be most easily achieved by securing an easement over Section 629.

(e) Section 1264 is to be resurveyed as shown in Figure 13.1 to create Section I and J.

(f) Consistent with Land Use Proposals 2(b) and 5(a), Section 475 needs to be subdivided into Sections K and L (see Figure 13.1).

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(g) The area of Santos' improvements (Section M) should be surveyed, thus creating Section N as well (see Figure 13.1).

13.1.2 Local Government

The second basic change is that the whole of the study area should be brought under the control of Local Government authorities. This change is necessary to implement some of the Land Use Proposals and also seems appropriate as the few land holders in the study area would use facilities in nearby Local Government districts. Furthermore, with the proposed changes to planning legislation in this State, Local Government control may become increasingly important.

Both the Corporation of the Town of Renmark and the District Council of Berri have viewed the boundary, proposed in Figure 13.2, and have accepted it as a mutually appropriate dividing line. Its adoption should be recommended to the Local Government Boundaries Commission and (together with re-survey) proceed forthwith.

13.2 DETAIL

All section numbers used relate to Figure 13.1. Therefore, it will not be possible to implement many proposals before the basic resurvey and inclusion into Local Government areas is completed.

13.2.1 Section A

To be reserved for Conservation Park purposes. If the National Parks and Wildlife Service is not able to manage the area at present, the land should initially be placed under the care, control and management of the Minister of Lands, pending an improvement in N.P. & W.S. management resources.

13.2.2 Section B

(a) To be proclaimed a Stone Reserve and placed under the care, control and management of the District Council of Berri. An agreement should first be obtained from the Council that all mining operations in the area will accord with a development and rehabilitation plan, and that they will not object to the Minister of Mines and Energy issuing mining leases which will not jeopardize Council's future mineral supplies.

The development and rehabilitation plans should be produced as specified in the Mines and Works Inspection Act, and cover, at least, features such as stockpiling and re-spreading top-soil, progressive development, maintaining scenic vistas and non-visibility from nearby roads.

(b) Part of Section B (marked Section 0) is to remain under an annual licence to the Berri Pistol Club Inc. The Club is to be responsible for all safety aspects.

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13.2.3 Section C

To be retained as Crown Land. Mineral leases may be registered in the area without the administrative complications of doing so in a Stone Reserve. Development and rehabilitation plans should be produced for all mining operations.

A limited number of timber licences may be issued in the area, depending upon the condition and amount of existing mallee, and providing it does not interfere with mining operations or reduce scenic qualities of the area.

13.2.4 Section 474

To be proclaimed a Stone Reserve under the care, control and management of the Corporation of the Town of Renmark. An easement, giving access to the area, will have to be negotiated across Section 629 (which is already held by the Corporation).

The same undertakings as sought from the Berri Council, regarding the issue of mining leases and rehabilitation plans (as detailed in 13.2.2(a) above) should be procured from the Corporation of the Town of Renmark, before the Stone Reserve is proclaimed.

13.2.5 Section D

To be retained as Crown Land. Mineral leases may thus be registered in the area (although they should be accompanied by development and rehabilitation plans) and future options regarding industrial effluent disposal may be kept open.

13.2.6 Sections 1265, 1266 and E

To be reserved for Recreation and Conservation purposes, under the care, control and management of the District Council of Berri, unless the National Parks and Wildlife Service acquire sufficient resources to manage the area. Management should be directed toward recreation in a natural environment, and be concerned with the problems of access, timber cutting and litter.

13.2.7 Sections G and H

To be reserved for Conservation and Recreation purposes, under the care, control and management of the Minister of Lands or, if they have sufficient resources to manage the area, the National Parks and Wildlife Service. Public access to the area should be possible, but limited, especially near Disher's Creek.

13.2.8 Section F

To be dedicated for Drainage Basin and Pumping Station purposes. As the Engineering and Water Supply Department will be operating the pumping station, which will control water levels in the drainage basin, it would seem appropriate that the E. & W.S. Department

assume control of the whole area. The reserve should thus be placed under the care, control and management of the Minister of Water Resources. The approval of the Renmark Irrigation Trust would have to be obtained, before Section 269 could be resumed and rededicated as part of Section F.

It may be necessary to limit or prohibit public access to the area if the maintenance or operation of the facility are jeopardized. Either an easement, or a written undertaking ensuring access, will have to be issued to the Licensee of Section 750.

13.2.9 Section 750

To remain under annual licence and administered through the Shack Site Policy. Access to the area needs to be guaranteed by the E. & W.S. Department.

13.2.10 Section 1256

To remain under miscellanoues lease. It may be appropriate to review this situation in ten years.

13.2.11 Sections 1260, 1261, 1263, 965 and I

To be reserved as Roadside Vegetation reserves, under the care, control and management of the District Council of Berri. No development or clearing should be permitted on these sections, and Section 1428, Berri Irrigation Area (next to Section 1261) should also be included in the reservation.

Sections 1263, 965 and I could be amalgamated into one section.

13.2.12 Section J

To be placed under miscellaneous lease to the Renmark-Berri Branch of the South Australian Field and Game Association Inc. The Field and Game Club is to be responsible for all safety aspects and approval should be given to erect a fence along the western boundary.

13.2.13 Section K

To be placed under miscellaneous lease to the Riverland Raceway Assocation Inc. as an off-road vehicles area. The destruction of native vegetation should be kept to a minimum and all physical access should be through Section 494 to maintain control of vehicles entering and leaving the Sturt Highway.

13.2.14 Section 494

To be granted freehold title to the Riverland Raceway Association Inc.

13.2.15 Section 625

To remain under miscellaneous lease for quarry purposes. This situation should be re-assessed if the use of Section 625 is proposed to be altered.

13.2.16 Section L

To be placed under miscellaneous lease to the Corporation of the Town of Renmark for rural occupation purposes. The Corporation may then sublet the land to the current lessee. No further permanent improvements should be erected on the land without the permission of the Minister of Lands. If the land is required for large industrial development, then the lease could be cancelled.

13.2.17 Section M

To be placed under miscellanoues lease to W. Santos for mineral processing purposes. The conditions of the lease should support the conditions of mining tenures held by the lessee and also the water quality order imposed by the E. & W.S. Department. Furthermore, the lease should not be transferable and should expire at the same time as the longest serving mining tenement in the area.

13.2.18 Section N

To be retained as Crown Land, to minimise local conflicts in land use, and to permit full assessment of any future variations to the complex problems in the area.
CML 3374 & 4685 need to be recognised and given necessary protections.

LAND MANAGEMENT STUDY AREA

PROPOSED SURVEY DETAIL

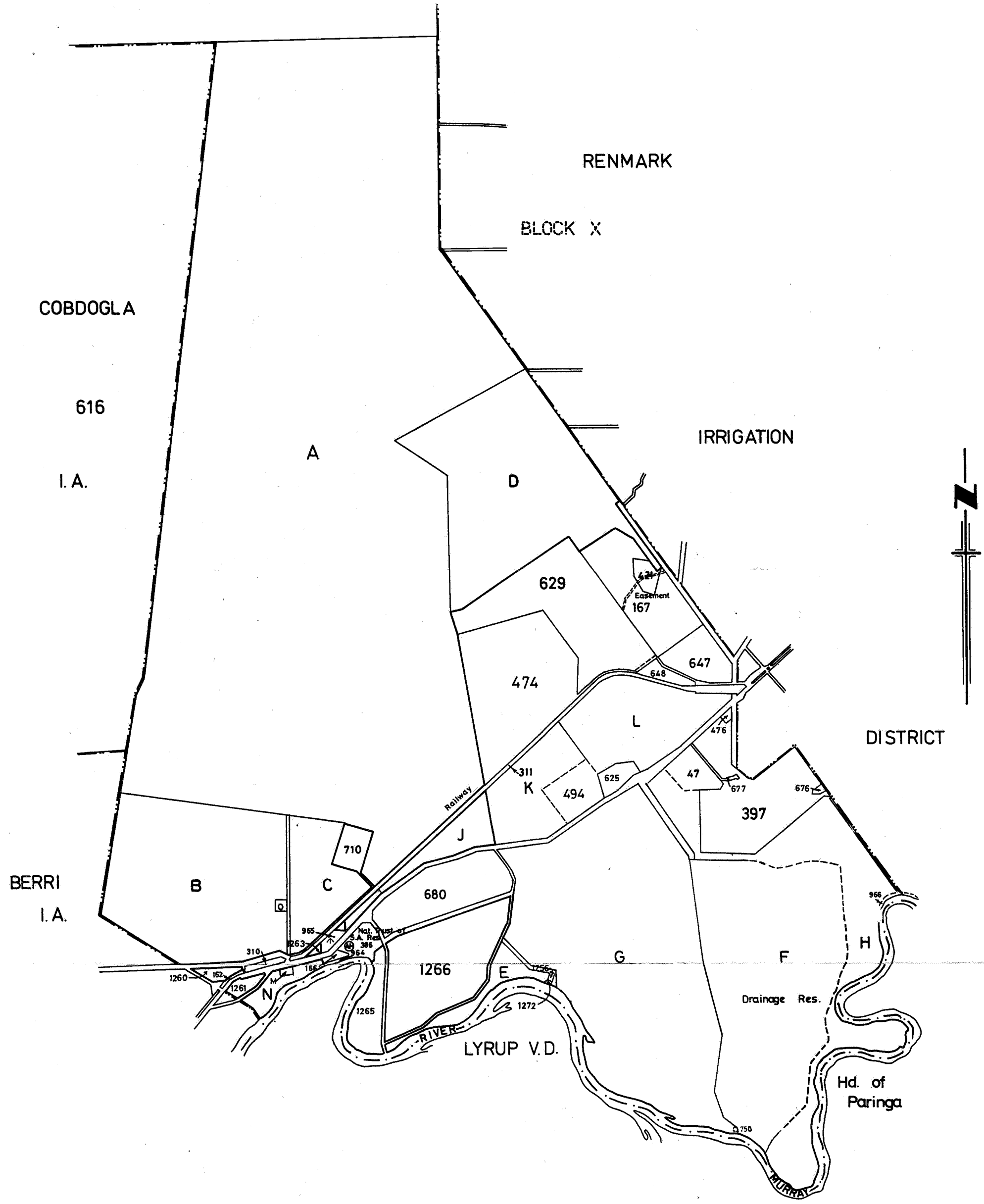
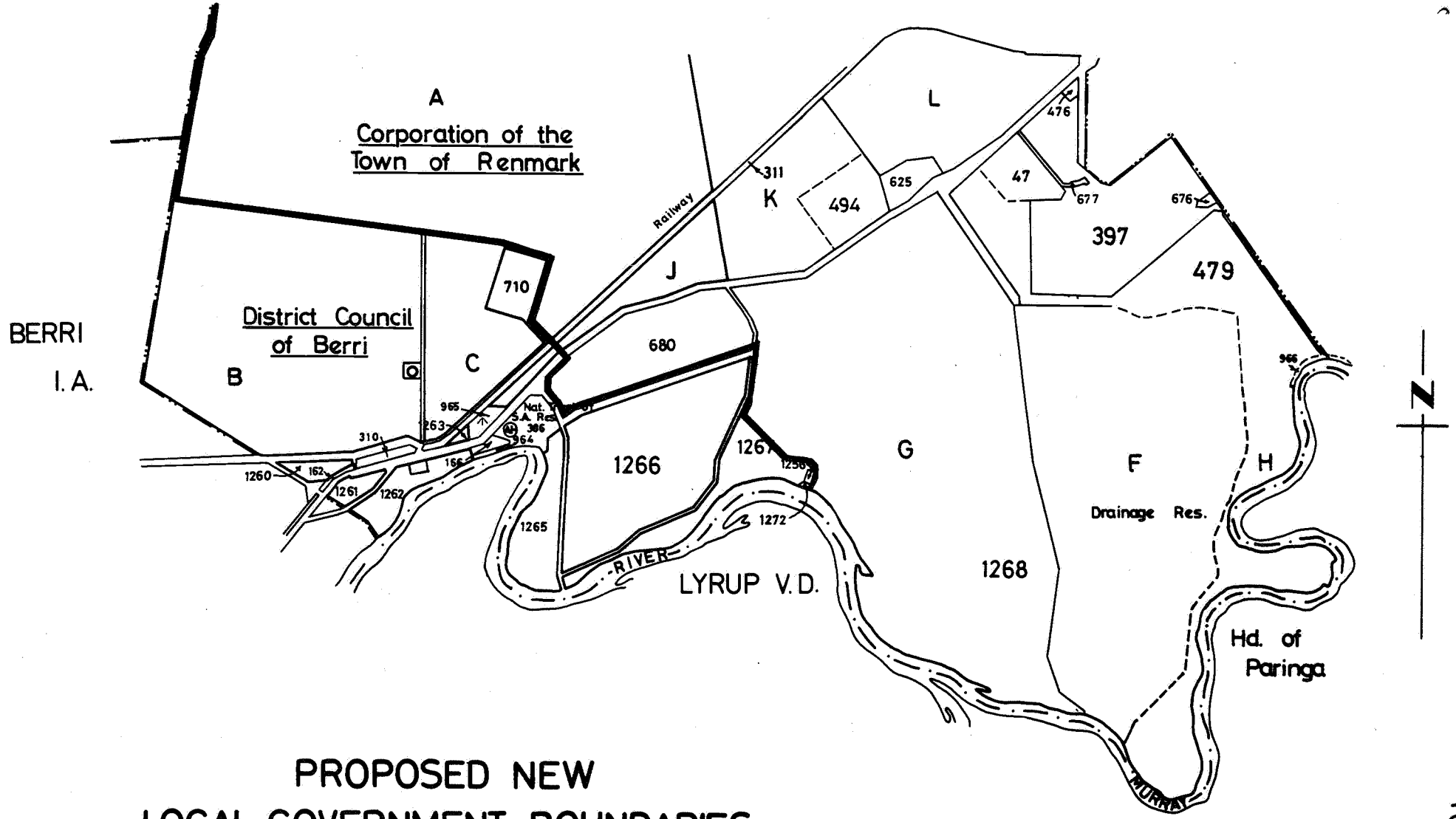


FIG. 13.1



PROPOSED NEW
LOCAL GOVERNMENT BOUNDARIES

SCALE 1:50000

M. 1000 500 0 1 2 3 4 5 KM.

FIG. 13.2