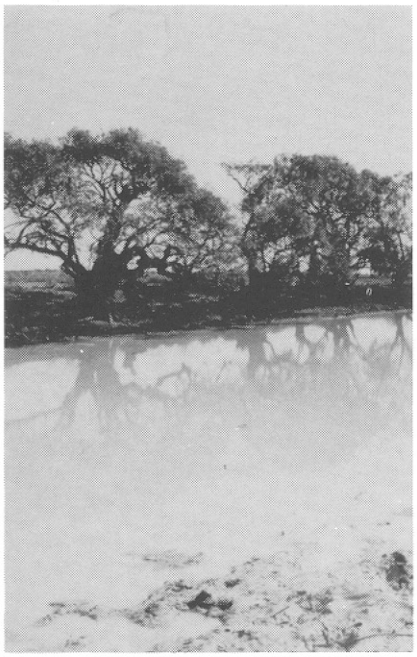
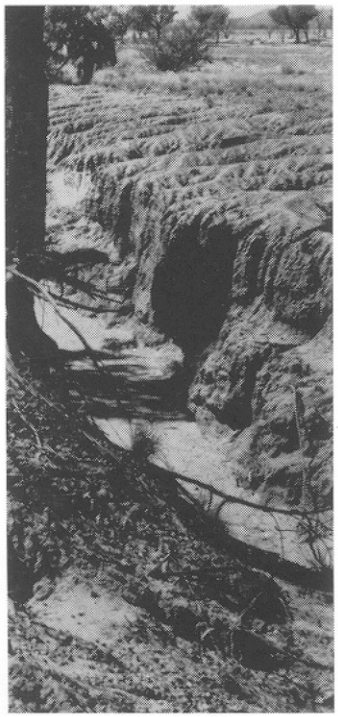
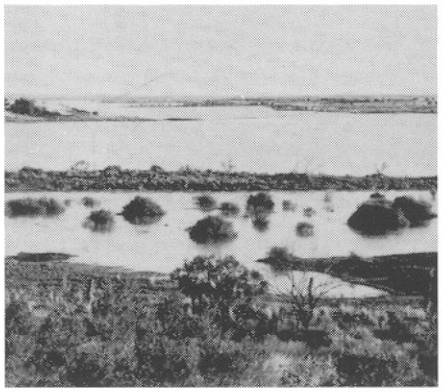
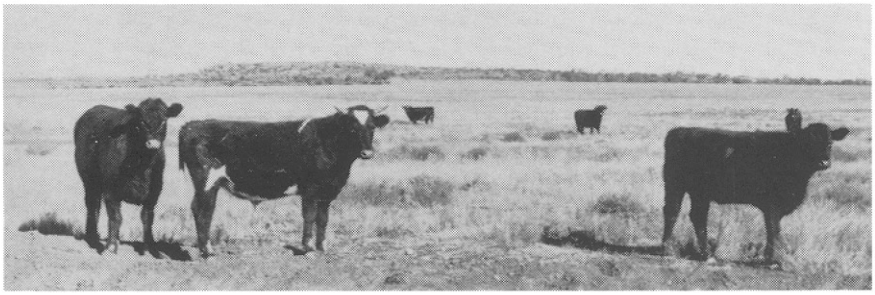
WESTERN ARID REGION

LAND USE STUDY – PART II









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QUEENSLAND
DEPARTMENT OF
PRIMARY INDUSTRIES

TECHNICAL BULLETIN No 22
PUBLISHED BY THE DIVISION OF LAND UTILISATION
1980

Department of Natural Resources, Mines and Energy
Technical Bulletin
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This report is intended to provide information only on the subject under review. There are limitations inherent in land resource studies, such as accuracy in relation to map scale and assumptions regarding socio-economic factors for land evaluation. Before acting on the information conveyed in this report, readers should ensure that they have received adequate professional information and advice specific to their enquiry.

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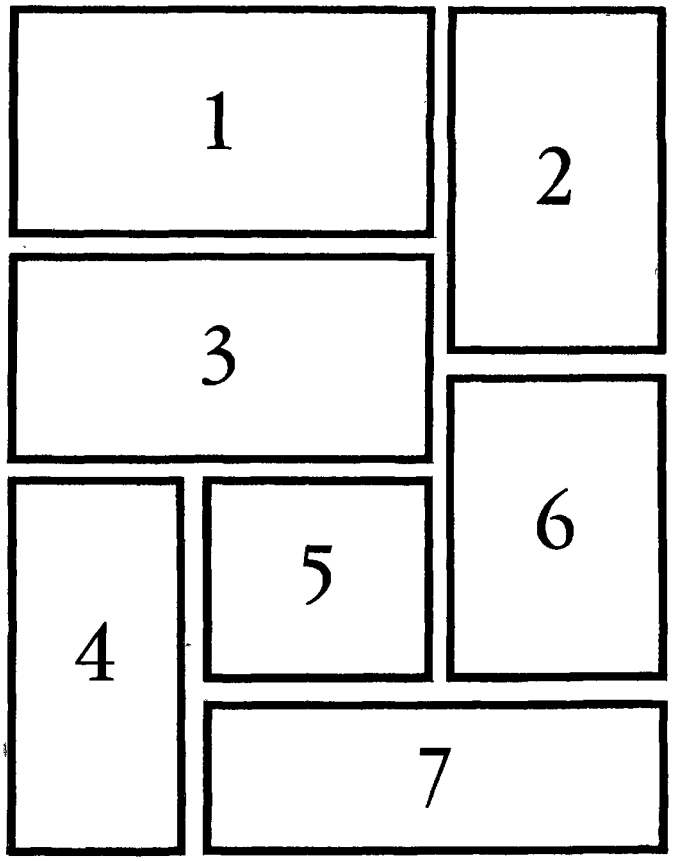

The cover photographs illustrate the following scenes:

1. Main Street of Blackall.
2. Waterhole on the Thomson River.
3. Hard mulga lands in Adavale area.
4. Gully erosion on open alluvial plains.
5. Lake Cuddapan in flood.
6. Flowers of fuchia bush.
7. Cattle on stony downs west of the Thomson River.

WESTERN ARID REGION LAND USE STUDY PART 2

CONTRIBUTING ORGANIZATIONS

State Government

Department of Primary Industries
Department of Lands
Irrigation and Water Supply Commission

TECHNICAL BULLETIN NO. 22

PREPARED BY THE DIVISION OF LAND UTILISATION

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FOREWORD

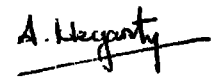
The Division of Land Utilisation has, since 1970, been engaged in the conduct of Land Use Studies in the pastoral lands of western Queensland. The western grazing lands, which are utilised for sheep husbandry and beef cattle production, cover some 60 million hectares of land in an arid and semi-arid environment. These lands support 60% of sheep numbers and 15% of the cattle numbers in the State and as such represent a valuable resource.

This report, which is a companion volume to earlier reports published in 1974 and 1978, describes the physical environment and catalogues the land resource data for about ten million hectares of land which runs west from Blackall and Adavale to the Diamantina River and Haddon Corner.

The information reported in this study is relevant to the 1980's and outlines the land use problems that pastoralists face as they approach the twenty-first century.

The report outlines the pathways for long-term, safe management of these fragile grazing lands, and indicates the safe stocking parameters for the principal Land Systems that have been identified.

I commend this publication to graziers, grazier organisations, Local Authorities and Government Departments who have a commitment to maintain the western pastoral lands in a highly productive state.



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DIVISION OF LAND UTILISATION

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The contributions by the Water Resources Commission and the Department of Lands are acknowledged and their continuing co-operation is sought.

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1	SITE DESCRIPTIONS
2	TABLES - SOILS SECTION by C.R. Ahern and R. Cormack.

SUMMARY

This report presents the findings of a land systems survey of 10 million hectares of pastoral land in central south western Queensland.

The region lies mostly within the 200 - 400 mm rainfall zone. Rainfall is extremely variable and decreases across the area from east to west. Rain is most likely to occur during the summer months of December, January and February. Evaporation rates increase across the area from east to west and are considerably greater than average annual precipitation. Summers are hot and winters mild, although some frosts do occur.

Geologically, the area is part of the Eromanga Basin sequence within the Great Artesian Basin. Cretaceous sediments were laid down and subjected to a considerable period of weathering and chemical alteration. Tertiary deposits and Tertiary laterites were formed covering many areas. Quaternary deposits overlie the original sediments in many areas.

The soils of the area have been classified into 14 major soil groups. These soil groups have been further classified into 37 soil mapping units for comparison. The cracking clay soils of alluvia and the gently undulating plains are the most productive soils of the region. The red earths, earthy sands and siliceous sands are less productive but also cover a significant area. The lithosols are extensive in area but of limited productivity.

Vegetation has been divided into plant associations, based primarily on floristics with structure of secondary importance. The nomenclature of the structural formations follows that of Specht (1970). The vegetation comprises mainly Mitchell grass associations, gidgee associations, mulga associations and spinifex associations. The moisture regime is the major factor influencing vegetation. A total of 706 species are listed for the area.

Much of the country is stable and productive. However, to maintain the productivity of the more readily degraded areas, man must be prepared to manage and stock the country according to the prevailing seasonal conditions.

CONCLUSIONS

Most of the area surveyed is in good condition.

The downs, wooded downs and gidgee lands comprise one third of the area. These lands are stable and productive and not easily degraded. Traditionally these lands have been used for wool production.

Alluvial plains make up 17% of the area. These lands are productive following rain, but are subject to overgrazing. Continued over-use of these lands may lead to degradation. These areas should be monitored to determine whether there is a long term downward trend in condition.

The spinifex sandplains, mulga sandplains and dunefields occupy 14% of the area. These lands are moderately stable and provide useful grazing for cattle at very low stocking rates. The mulga sandplains provide an important topfeed reserve during drought periods.

The mulga lands, comprising the hard and soft mulga land zones, make up about 12% of the area. These lands provide useful grazing at moderate to low stocking rates for both sheep and cattle. These lands are important for their reserves of topfeed which are used during drought periods. The mulga lands are sensitive areas and if adequate ground cover and tree densities are not maintained, are subject to degradation and erosion. Degradation has already occurred over part of this land zone.

The channel country covers about 6% of the area. These are stable lands which provide excellent cattle fattening pasture after floods.

The dissected residual land zone occupies the remaining 18% of the area. These naturally unstable lands are not used extensively for grazing.

The land resources must be maintained in an acceptable condition if a stable pastoral industry is to continue. To achieve this, competent managers are required. Their strategies must be flexible enough to account for drought periods which occur frequently. Producers who do not operate profitably during the better seasons are unlikely to be able to run an economically viable enterprise when droughts are experienced. Most damage to the land is caused by overstocking during drought.

The floor price scheme for wool administered by the Australian Wool Commission makes an important contribution towards stability in the wool industry. This is necessary to enable property managers and administrators to formulate realistic long term plans. Schemes such as this are an essential part of any integrated programme dealing with future land use in these areas.

There is a need for further biological research to formulate long term management programmes:

Considerable data has been collected by workers investigating various components of the biological system and their reaction to use. Investigation into the manipulation of stocking rates in response to seasonal conditions is required to determine grazing strategies consistent with long term productivity. A continuing examination on a regional basis of costs and returns, property sizes, level of improvements desirable and management strategies is also necessary.

Additional information on burning, labour saving devices and the optimum level of improvements is required. Integrated long term research programmes dealing with financial/animal/land types relationships such as those initiated by officers of the Charleville Pastoral Laboratory are highly desirable. However, research programs should be designed so that their findings are applicable to the land holder. An effective extension campaign to disseminate any practical results should be an intergral part of any project design.

There is a Need to Encourage Diversity of other Industries:

The pastoral industry is the major enterprise in the area and will continue to be for some time to come. However there is a need to encourage other industries to expand and develop to bring a more stable money base to the towns. This would assist when there is a down-turn in rural industry and would help maintain confidence in the towns. Tourism is the industry ready made for expansion. The value of these arid lands for recreation purposes is only becoming apparent.

The decentralization of government services should be continued. Public servants in country towns contribute to the economy of the area. However, it may be more beneficial to establish regional centres at larger towns and contribute more to the economic and social development of these centres rather than have public servants disposed throughout the region.

A Balance Between Topfeed and Herbage Must be Maintained in Mulga Land Zones:

Topfeed provides a valuable drought reserve. However skilful management is required to maintain high livestock production and yet conserve the vegetation essential for long term productivity. Herbage yields can be increased without creating a potential hazard. In western areas mulga densities should not be reduced below 175 shrubs/ha.

Mitchell Grass Pastures Need to be Managed to Optimize Animal Production:

It is desirable to maintain a balance in the composition of the pasture between Mitchell grass, other grasses and forbs. Mitchell grasses are best regarded for maintenance and survival needs. The forbs and some other grasses are the more productive components of the pasture. If a balance between these components is not maintained then animal productivity will not be optimized.

There is a Need for the Gazetting of National Parks and Reserves:

There are no National Parks in the area. It is desirable that all ecosystems be reserved for multi-use within the constraints of the National Parks and Wildlife Act 1975. This will result in the widest range of habitats in which plants and animals may survive. The main needs are for reserves including both mulga and gidgee lands. Other features such as Boss'Gorge which supports species occurring well outside their usual distribution should be considered for future reserves.

The National Trust has classified certain buildings in the area. Serious consideration should be given to the restoration and maintenance of these buildings, other historical buildings and other examples of early architecture.

CHAPTER 1

EARLY SETTLEMENT

by J.R. Mills *

In 1845, Major Mitchell, the New South Wales Surveyor-General, became the first known white man to travel through the area, entering it from the east and travelling along the Barcoo River past the site where the town of Blackall now stands. He concluded that this river flowed north to the gulf and named it the Victoria River, in honour of the reigning Queen. Mitchell commented on the fine quality and abundance of grasses in the area. The native *Astrebla* species which predominate in this country are now known as Mitchell grass.

In the following year, Mitchell's assistant Edmund Kennedy and a party travelled along the Victoria River and learned that the natives called it the Barcoo. In August 1847 they came to the junction of the Barcoo and the Thomson Rivers and immediately noted the change in the country. They recognised the river below the junction as Cooper Creek country which was named and described by Sturt in 1845.

In 1858 A.C. Gregory travelled through the country between the Barcoo and the Thomson Rivers while searching for signs of the lost explorer Leichhardt. It is believed Leichhardt may have passed along the Barcoo in 1848 while attempting to travel to Perth by skirting around the north of the Central Australian desert. Gregory found the country suffering from long and continuing drought and after following the Thomson River north for some distance became disheartened and turned south, travelling down Cooper Creek and then Strzelecki Creek to Lake Torrens in South Australia.

The first settlers moved into the Blackall district in 1861, and by 1864 most of the best country in the area had been taken up as selections. 'Terrick Terrick', 'Ravensbourne', 'Lorne' (originally 'Moorland'), 'Malvern Hills', 'Isis Downs', and 'Listowel Downs' were amongst the first properties taken up in the Blackall Area.

In 1868 Durack and Costello settled in the Thylungra area, and in 1869 Welford travelled up to the Barcoo River where he settled at 'Welford Downs'. Settlers began to spread west of Cooper Creek and in 1874 Costello moved out to the Monkira, Currawilla and Connemara areas. By 1879 a small township had been established at Windorah. 'Tintinchilla' was the first property taken up in the Adavale district by Stephens in 1878. It is recorded that during the shearers' strike of 1891 the town of Adavale supported a considerable population.

Liberal tenure conditions and good seasons during the 1870's were responsible for settlement in the Channel Country. During the late 1880's and 1890's adverse seasons combined with an upsurge in rabbit and dingo numbers and falling prices for cattle caused financial difficulties for many landholders. From that time until 1910 settlers drifted away from the Channel Country, and a number of the original holdings were subsequently amalgamated into larger properties.

* *Development Planning Branch, Queensland Department of Primary Industries.*

Early road communications were established from Longreach through Windorah and Thargomindah to Bourke. Other routes extended from Windorah to Adavale; Jundah to Isisford, and to Betoota. The Central Railway line from Rockhampton reached Longreach and then Winton in 1899. A branch line from Jericho to Blackall was built in 1908 and later extended to Yaraka. At this time a heavy tax was imposed on Queensland goods crossing into New South Wales, with the result that trade to the east through Longreach and Charleville largely replaced trade through Bourke to the south. During the 1890's Cobb and Co. took over most of the mail runs throughout the west of the area.

Artesian bores were sunk at Barcaldine in 1884 and Blackall in 1885, and following on from these many other bores tapped aquifers in the Great Artesian Basin to provide reliable water supplies in previously unwatered areas.

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CHAPTER 2

PHYSIOGRAPHY AND GEOLOGY

by K.K. Hughes *

PHYSIOGRAPHY

One of the most important factors affecting the existing physiography of the area has been the folding of the sediments which has continued until recent times, warping the land surface into broad anticlines and synclines. These have established the pattern for drainage and the development of the present land surface.

The area can be divided into four broad physiographic units:- plateaux, dissected plateaux, rolling downs and plains. These major physiographic features appear on the physiographic map and are briefly discussed:-

Plateaux - Remnants of the Tertiary land surface occur as plateaux. The Tertiary rocks are the most resistant to erosion, and silicified sandstone (or silcrete) is the most common surface rock on the plateaux. The plateaux are stony near the margins, and grade into plains with red earth and sandy red earth soil cover on the tops. Geological erosion is continuing on the plateaux margins.

Dissected Plateaux - The dissected plateaux occur about the margins of the plateaux proper, and also cover large tracts of altered *Winton Formation* sediments which have been partly dissected. The dissected plateaux comprise the more resistant rocks, with the softer fresh *Winton Formation* sediments being exposed in some valley floors, and in central parts of domal structures. Stony red earths and lithosols are the most common soil types. The dissected plateaux are still undergoing active geological erosion.

Rolling Downs - The rolling downs have formed on the weathered Cretaceous *Winton* and *Mackunda Formations*. These comprise labile sandstones, siltstones and mudstones, which weather to cracking clay soils. These beds dip very gently. The *Mackunda Formation* includes some more resistant beds which weather to gentle rises with shallower sandy clay soil cover. The rolling downs are commonly fringed by erosion resisting rocks which form scarps and cuestas. Erosion initially cut down through the resistant rocks into the underlying softer beds, causing scarp retreats. Once stable slopes are developed there is little geological erosion except at the margins against the scarps.

Plains (a) - The plains associated with the plateaux include those which have formed on the Tertiary rocks, the altered *Winton Formation*, and areas of Quaternary cover. Typically these plains are sandy and characterised by red earth soils.

* *Development Planning Branch, Queensland Department of Primary Industries.*

(b) Undulating mantled plains have formed over fresh sediments, and on Quaternary alluvials. The mantled plains are covered with gravels derived from silcrete, sandstone, conglomerates and altered *Winton Formation* material. These materials were part of the overlying resistant rocks which have been eroded and transported onto the fresh *Winton Formation* beds as colluvial and alluvial deposits. The gravels now represent an accumulation of coarse material, with most of the finer fractions being removed by erosion. When sufficiently dense, the gravels form a protective coating over the softer *Winton Formation* beds reducing erosion to a minimum. Consequently mantled plains can persist throughout the downs, though they commonly occur about the margins, adjoining the scarps and cuestas.

(c) Large accumulations of alluvium have built up in down-warped synclinal areas to form broad alluvial plains. These alluvial plains are widespread. These low gradient active flood plains with anastomosing drainage channels form the Channel Country of south west Queensland.

GEOLOGY

The broad distribution of the geological units is shown in the geological map. The base rocks comprise Cretaceous rocks which were deposited as part of the Great Artesian Basin sediments. These sediments comprise the *Mackunda Formation* which was deposited during marine conditions, and the *Winton Formation* which was deposited under fresh water conditions.

Folding of the Mesozoic sediments occurred in the late Cretaceous, with minor folding continuing until recent times. After the close of sedimentation in the Artesian Basin, the Upper Cretaceous land surface was lateritised and subsequently eroded so that only the lower part of the laterite profile, comprising altered *Winton Formation* remained.

During the early Tertiary, river deposits were laid down on this land surface. These were mainly gravels and sands which were consolidated to form conglomerates and sandstones. The upper sandstone beds were silicified in parts to form silcrete. During the late Tertiary this surface was warped by gentle folding with associated faulting. Erosion removed large tracts of resistant rocks, particularly from the anticlinal areas, exposing the underlying softer Cretaceous beds. These have weathered to form large areas of rolling downs. Sands, muds and silts were deposited in the down warped synclinal areas through the late Tertiary.

During the Quaternary, alluvial and colluvial materials were deposited over large areas of the older formations (altered *Winton Formation*, fresh *Winton Formation*, Tertiary sandstones and Tertiary sediments) to form plains and mantled plains.

Sands derived from the weathering of the Tertiary rocks formed sandplains and dune fields. Large alluvial plains formed by flood plain deposition have built up about present river drainages.

The relationship between physiography, geology, land zones and land systems, is listed in Table 2.1. A block diagram showing the physiographic units and associated geology for the central portion of the area is shown in Figure 2.1.

TABLE 2.1 Relationship between Physiography, Geology, the Land Zones and the Land Systems.

PHYSIOGRAPHY		GENERAL DESCRIPTION	GEOLOGY	LAND ZONE	DOMINANT LAND SYSTEMS
Plateaux	1.	Stony plateaux, with stone cover and silcrete common.	Tertiary sandstone (Tg,) silicified sandstone (silcrete).	Dissected Residuals.	R1, R5, R6, H2.
	2.	Soil-covered plateaux, with red earths and sandy red earths.	Quaternary sands (Qs) overlying Tertiary sediments and altered *Winton Formation.*	Soft Mulga Lands.	M2, M4
Dissected Plateaux	3	Mesas, buttes, low hills and rises with associated valleys and minor undulating plains.	Silicified Tertiary sandstones Tertiary sandstones, altered *Winton Formation* with some fresh *Winton Formation,* in valley floors.	Dissected Residuals.	R2 to R8.
Rolling Downs	4.	Undulating plains.	Unaltered, fresh *Winton Formation.* Unaltered, fresh *Mackunda Formation.*	Downs. Wooded Downs. Wooded Downs.	F3, F5, F6, F7, T1 to T3. T4.
Plains	5.	Undulating plains with shallow red earths.	Shallow Quaternary cover on Tertiary sandstone and altered *Winton Formation.*	Hard Mulga Lands	H1, H3, H4, H5 on Tertiary sandstones, H3, H5 on altered *Winton Formation.*

6.	Flat to undulating plains with moderate to deep, red earths.	Deeper Quaternary cover on Tertiary sandstones, altered *Winton Formation*.	Soft Mulga Lands	M1 to M4.
7.	Flat to gently undulating sandplains including dunefields.	Quaternary sands.	Sandplains. Dunefields.	S1 to S6. D1 to D4.
8.	Undulating mantled plains.	A. Quaternary gravels on fresh Cretaceous sedimentary rocks.	Gidgee Lands.	G1 to G4.
		B. Quaternary gravels on fresh Cretaceous sedimentary rocks.	Downs.	F4.
		Gravels formed on Quaternary colluvia over altered *Winton Formation* and Tertiary sandstone.	Downs.	F1, F2.
9.	Flat plains formed on fine Tertiary sediments and on fine Quaternary sediments.	Tertiary siltstones. Quaternary lake sediments.	Downs.	F8.
10.	Alluvial plains.	Quaternary alluvium deposited on flood plains.	Alluvia. Channel Country. Miscellaneous. Alluvial plains.	A1 to A6 C1 to C3 L1. W1 to W7.

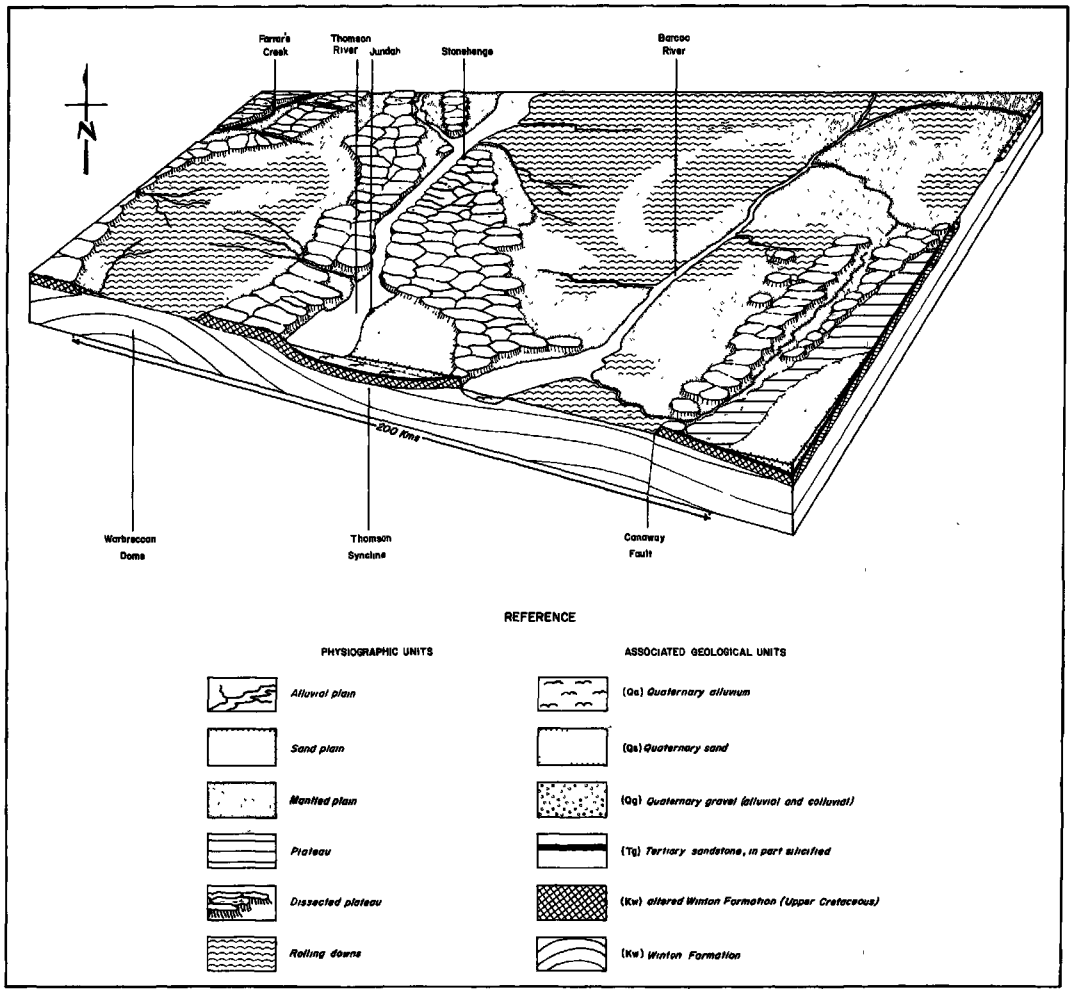

Figure 2 1 Physiographic Units

The Jurassic sandstones, Cretaceous sediments, Tertiary sandstones and Quaternary sediments contain the underground water resources, although the better aquifers in the Jurassic beds are generally too deep for economic exploitation. Most of the bores tap aquifers in the *Winton Formation*, encountering water supplies of variable quality and yield.

The Quaternary sediments and the Tertiary sandstones, in synclinal locations, offer the best potential for further shallow water supplies for livestock purposes. Those areas where Quaternary sand dunes have encroached into the alluvia to form sandy alluvial plains and possibly buried sand dunes, are of particular interest for shallow underground water supplies.

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SOILS

by J.R. Mills and C.R. Ahern+*

Previously collected information on soils in the area is to be found in the Atlas of Australian Soils, Sheets 4 and 10, (Isbell *et al.* 1967, Northcote *et al.* 1968). Other studies covering specific parts of the area were undertaken by Blake (1938), Skerman (1947), Hubble and Beckman (1956), and Hubble and Reeve (1970).

In this section it is aimed to delineate the principal soils over 10 million hectares of pastoral land in western Queensland. Information contained in the above maps and reports has been used where necessary to supplement data collected during this survey. The relationship of soils to geology, vegetation and climate has been one of the main considerations in classifying the soils of the area into the various profile classes. Special reference is made to the effect of land use of this relationship where relevant.

Brief summaries of the important soils present, and their principal characteristics are included in the land unit and land system descriptions (Appendices IV, V respectively). Analytical data for analysed profiles is published in Microfiche 1. A map at a scale of 1:1 000 000 shows the distribution of the major soil groups.

SOIL DEVELOPMENT

1. Geology and Climate

Development of soils is governed by climate and associated geomorphic processes acting on the geology of the area.

The main events in the development of the present land surface have been

- formation of an old land surface in upper Cretaceous times, with chemical alteration of the Cretaceous sedimentary rocks associated with lateritisation.
- stripping of upper parts of the laterite by erosion.
- deposition of sandy sediments during the Tertiary over parts of the eroded surface to form the *Glendower Formation*.
- formation of an old Tertiary land surface, with silicification and alteration of the upper beds of *Glendower Formation*.
- erosion of the Tertiary land surface to expose areas of fresh Cretaceous rocks with deposition of gravels, sands and alluvia continuing through the Quaternary to the present.

The lithology, depositional environment and the extent of chemical alteration of the particular sediments from which sedentary soils are derived determine many of the characteristics of that soil. The texture and nutrient status of different soil types are

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of particular significance to their land use, and throughout this survey have been found to be characteristic of the various parent materials or sediments from which they are derived. Most of the fresh sediments originally deposited in the Cretaceous period *(Winton, Mackunda Formations)*, weathered to form clay or sandy clay soils with adequate plant nutrient status for the growth of desirable native plant species. Where significant chemical alteration of these sediments has occurred, the nutrient status has been severely affected by leaching. Tertiary sediments throughout the area weather to form sandy or loamy soils with relatively poor nutritional status. Quaternary deposits reflect the characteristics of the parent materials from which they are derived. Many are composed of a mixture of products derived from different parent materials encountered as the erosion gradient cuts down through the landscape.

2. Other Factors

Other factors such as vegetation, soil fauna, animals and man have had a significant influence on the properties of some soils. One of the major influences on soil organic matter and nutrient levels in the surface of the red earth soils is the type and density of vegetative cover present. Analytical data from this survey indicate that brigalow, gidgee and mulga communities are capable of significantly increasing phosphorus, nitrogen and soil organic matter levels in the surface soil by recycling and leaf drop. Similar effects have been referred to by Ebersohn and Lucas (1965) and Dawson and Ahern (1974).

In the mulga lands, adverse changes in soil physical properties leading to erosion problems can occur when vegetative cover and soil organic matter drop below adequate levels. Erosion results in further loss of nutrients as surface soil is removed and worsens the existing physical problems such as scalding, increased runoff and lowered infiltration rates.

Throughout the distribution of a particular soil type, productivity is related to the quantity, duration, intensity and seasonal timing of rainfall. In grove mulga areas the "run on, run-off" situation between grove and intergrove areas represents naturally occurring redistribution of water on a small scale. Run-off water is normally distributed to areas lower down the landscape influencing the productivity and erosion susceptability of soils in these areas. The position of a soil in the landscape, slope, surface cover in the form of vegetation or stone and surface microrelief all influence the erosion potential of a particular soil. The most productive soils of the survey area comprise sedentary cracking clay soils. These appear relatively stable, in the short term at least, to the changes imposed by man in the normal use of these grazing lands.

The combination of different soil types (and hence land units) occurring on a particular grazing property or management unit is of considerable significance to land use. The total stocking capacity of the property is the sum of the stocking capacity of each of the different soil types in the property. Lighter textured soils (e.g. sandy loams) respond to small falls of rain and can produce winter growth. Heavier textured soils (e.g. cracking clays) are capable of a longer growing season following substantial rains (usually summer) and generally support stable perennial pastures.

SOIL DISTRIBUTION AND MORPHOLIGICAL CHARACTERISTICS

Cracking clay soils cover approximately half of the survey area. They occur in two situations, as sedentary soils on the gently undulating plains of the "rolling downs", and on flat

plains of Quaternary alluvium. The downs, wooded downs and gidgee areas are the main areas of sedentary cracking clays, these being formed on the Cretaceous *Winton* and *Mackunda Formations*. Heavy textured grey and brown clays predominate, with minor areas of red clays, which occur mainly in scarp retreat zones. Minor variations in the morphology of these soils are due to the exposure of different beds in the underlying sediments with subsequent differential weathering of these beds. Most soils in this group are greater than 75 cm deep and have strongly structured subsoils. Surfaces are cracking and display varying degrees of self-mulching structure. A weak crust 1-2 mm thick is present over the self-mulching layer which ranges from 2-5 cm in thickness.

Incipient gilgai microrelief occurs over much of the downs and wooded downs land zones. Linear gilgai development occurs on the *Mackunda Formation*. In the gidgee lands gilgais range from incipient to well developed. Scattered surface gravel occurs on small areas of the downs and wooded downs. This cover becomes denser in the sedentary gidgee lands, forming gravel pavements in the more undulating areas. In the west, significant areas of downs with gravel and stone pavements and weak gilgai development occur.

Lime is present throughout most profiles. Gypsum is usually present at depth, particularly in the soils of the gidgee lands where large quantities of gypsum below 60 cm are characteristic. Infiltration rates on these soils are not well documented. They are generally high when the soils are dry and cracked and decrease rapidly as the surface soil swells on wetting and the cracks close. Under these conditions a high proportion of rainfall is converted to run-off. Observations show that the low slopes (<1%) and uneven surfaces of the sedentary clay soils result in relatively low runoff velocities.

Extensive areas of grey and brown cracking clays occur on the alluvial plains of the Barcoo and Thomson Rivers and Cooper Creek. Grey clays predominate on the Thomson River and Cooper Creek, and in the more frequently inundated areas of the Barcoo River. Brown clays and minor areas of red clays are associated with the less frequently flooded parts of the alluvial plains and scalded areas.

Local alluvial plains formed on soils derived by weathering and erosion of the Cretaceous sediments are comprised of a complex of cracking clays and texture contrast soils. Local alluvial plains formed of soils derived by weathering of the Tertiary *Glendower Formation* and altered *Winton Formation* are mainly texture contrast soils in the upper reaches. As the alluvial plain increases in size the proportion of grey and brown clays increases, and these soils predominate on the larger alluvial plains.

The alluvial clays are medium to heavy textured clays, with varying amounts of silt and sand throughout the profile. Surfaces are cracking, particularly in swampy areas where very wide cracks may occur. Strong platy surface crusts of sand and silt are common in frequently flooded areas. Hexagonal cracking patterns are common. Profiles are well structured to massive throughout, with massive grey clays predominating in swampy situations. Minor occurrences of lime and occasionally gypsum were recorded but are not common. Infiltration rates are high when the soil is dry and widely cracked but decrease rapidly as the surface is wet up, resulting in water being ponded in depressions. This is particularly so on the massive structured grey clay soils.

Desert loams occur in the arid western areas, usually on gently sloping fan plains between remnants of the Tertiary land surface and flat plains of Quaternary alluvium. On the lower slopes these soils grade into red clays which have similar subsoils to the desert loams but lack the surface cover of gravel (mostly ironstone shot) and hardsetting loamy material which forms the A horizon on the desert loams. Slight gilgai development is common on these soils.

Subsoils are well structured, light to medium textured clays. Depth varies from shallow on the upper slopes of the fan plains to deep at the bottom of these plains.

Loamy red earths occur throughout the southern part of the area, on altered *Winton Formation* and Tertiary *Glendower Formation*. Grove mulga communities predominate. Two broad subdivisions, the shallow and deep red earths have been recognised. The deep red earths typically increase in texture from loams at the surface to sandy clay loams and light to medium clays at depth. They are greater than 50 cm in depth. Surfaces are hardsetting. Sink holes may occur in grove areas. Subsoils are massive with earthy fabric; occasionally ferruginous gravel or inclusions may be present. Infiltration rates are variable and depend on surface characteristics, and the amount of vegetative cover present. High rates of run-off can occur where surface cover is inadequate resulting in sheet or gully erosion.

Shallow red earths have hardsetting clay loam surfaces with uniform textured profiles less than 50 cm in depth. Scattered silcrete gravel is frequently present on the surface, with ferruginous gravel throughout the profile. Infiltration and run-off characteristics are similar to the deep red earths. The incidence of excess runoff and subsequent erosion is higher because these soils are shallower and support less vegetative cover during dry periods.

Sandy red earths have formed on flat to gently sloping sandplains over the Tertiary land surface. These consist of redistributed material derived from the erosion of this land surface. Surfaces are hardsetting sandy loams with textures increasing down the profile to sandy clay loams and light clays at depth. Profiles range from moderately deep to very deep and are massive throughout. Infiltration rates are relatively high and excessive runoff is not common.

The earthy sands and siliceous sands form sandplains, which were formed by aeolian resorting of sands derived from erosion of the Tertiary *Glendower Formation*. Red siliceous sands occur mainly on the crests of dunes. Red earthy sands predominate on the spinifex sandplains, and on the interdune areas and lower duneflanks. Soils are deep to very deep throughout. Textures range from loose sands on the dunes to loamy sands and occasional sandy loams in the interdune and sandplain areas. The loamy sands appear massive structured *in situ*, but break down readily into single grain structure when disturbed. Infiltration rates are high and excessive run-off is not common on these soils.

The lithosols occur where weathered remnants of the Tertiary land surface are covered with a thin veneer of detritus. Reddish, gravelly, sandy loam to sandy clay loam textures predominate. Little profile development is evident and soils are usually less than 25 cm deep. Surfaces are hardsetting and have stone and gravel pavements. Exposed weathered rock is common. Organic matter may accumulate on the surface in areas where Acacia shrublands occur.

SOIL GROUPS AND PROFILE CLASSES

Soils recognized in the area have been arranged into 14 major Soil Groups and 37 Soil Profile Classes. The major Soil Groups follow those used by Dawson and Ahern (1974). They are based on the Great Soil Groups described by Stace *et al.* (1968), with alterations where necessary to obtain a more meaningful classification of the soils in this arid area. Thirty-seven soil profile classes have been delineated using the morphological, physical, and chemical properties, and geological and vegetation characteristics considered most relevant to land use. The relationship between soil profile classes and vegetation associations is shown in Table 3.1.

TABLE 3.1 CHARACTERISTICS OF THE SOIL PROFILE CLASSES

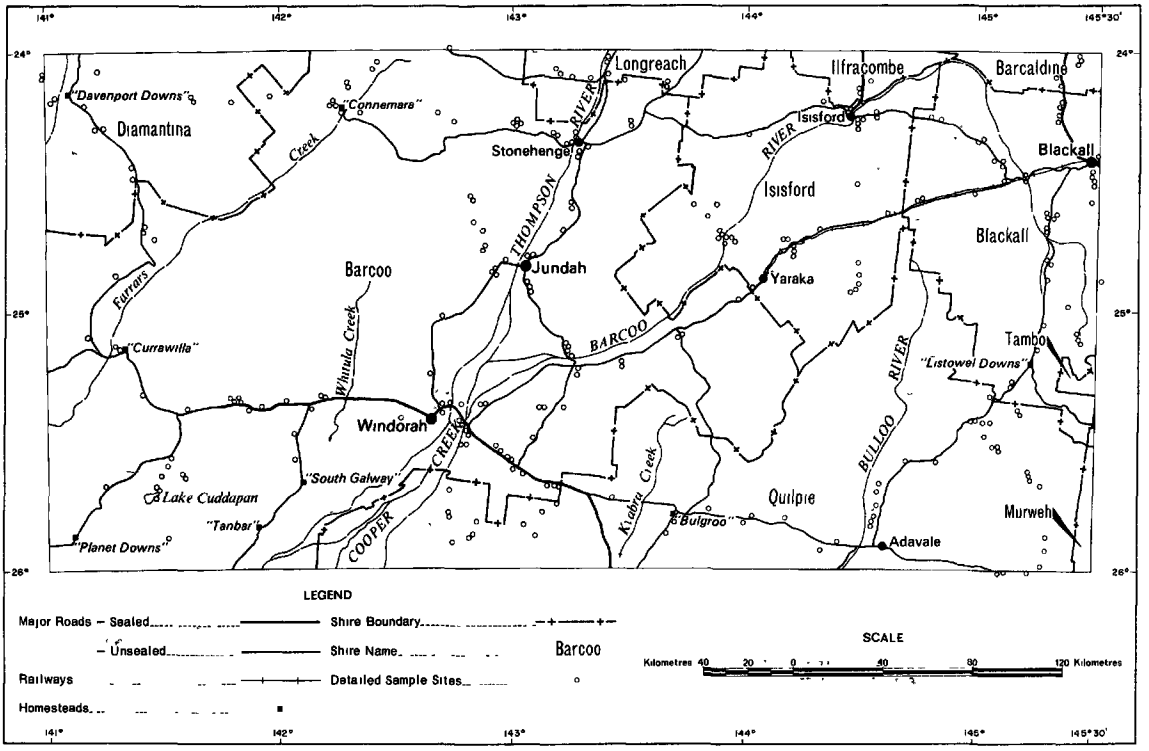
SOIL	DISTINGUISHING CHARACTERISTICS	GREAT SOIL GROUP	PPF	VEGETATION	GEOLOGY	SITES
(A) BROWN AND GREY CRACKING CLAYS ON GENTLY UNDULATING ("ROLLING") PLAINS						
Thornleigh	Shallow to moderately deep, brown and grey cracking clays, strongly self-mulching surfaces, incipient gilgai microrelief in some areas, reaction is alkaline; lime occurs throughout the profile with accumulations of gypsum at depth	Brown and grey clays	UG5 21, UG5 22 UG5.24, UG5.25 UG5.31, UG5 32 UG5.24	Mitchell grass open tussock grasslands	Cretaceous Winton Formation	29, 41, 43, 44, 46, 47, 57, 58, 64, 121, 133, 134, 135, 141, 145, (147), (151), (152), 162, 179, 192, 194, 201, (202), (260), (262)
Lynbrydon	Deep, brown and grey cracking clays similar to Thornleigh, a thin veneer of surface gravel is characteristic, incipient gilgai microrelief is common.	Brown and grey clays	UG5 31, UG5.32 UG5 34	Mitchell grass open tussock grasslands	Cretaceous Winton Formation	14, (15), 59, 130, 131, 155, 190 (261), (269)
Cootabynia	Deep, brown cracking clays, moderately self-mulching surfaces with fragile crusts, reaction is alkaline, lime occurs throughout the profile with accumulations of gypsum below 60cm	Brown clays	UG5 24, UG5 31 UG5 32, UG5 34	Boree / wooded downs / Mitchell grass open tussock grassland	Cretaceous Winton and Mackunda Formations	34, (35), 40, 49, 123, (143), 144, 149, 153, 157, 158, (159)
Sylvester	Deep, grey, brown and reddish brown cracking clays, surfaces are self-mulching with well developed gilgai microrelief, surface gravel cover is characteristic, reaction is alkaline, lime occurs throughout the profile with accumulations of gypsum below 60cm	Brown and grey clays	UG5.21, UG5 24 UG5 28, UG5 31 UG5 34, UG5 37 UG5 38	Gidgee shrublands	Cretaceous Winton Formation	11, (142), 146, 247, 248, 251, 253, (264)
Caflow	Deep cracking clays soils similar to Sylvester, however only slight gilgai development occurs and gravel cover is sparse	Brown clays	UG5 31, UG5 32 UG5 34, UG5.36	Gidgee shrublands	Cretaceous Winton Formation	11, (142), 146, 247, 248, 251, 253, (264)
(B) RED CLAYS ON FLAT TO GENTLY UNDULATING PLAINS						
Hayfields	Deep, red clays, often with gilgai development, crusting surfaces, reaction is generally neutral at the surface becoming alkaline at depth	Red clays	UG5 38, UF4 43	Mulga woodland / shrublands	Undifferentiated Quaternary deposits	89, 119, (168)
Boolooroo	Moderately deep, red cracking clays, surfaces are often pitted with small sink holes, sparse gravel cover and incipient gilgai microrelief occur in some areas, reaction is neutral at the surface becoming alkaline at depth	Red clays	UG5.31, UG5.37 UG5.38	Open tussock grasslands	Clay beds in Tertiary Glendower Formation	195, (203), 211, (266)
Mellew	Predominantly very shallow red clays and sandy clay loams Sand is present throughout the profile Surfaces are crusting, with frequent outcrops of sandstone Scattered lumps of sandstone occur on the surface Reaction is neutral	Red clays	UG5.37, UM6 24	Mitchell grass / short grass grasslands / Wooded downs	Cretaceous Mackunda Formation	39, 42, 250
Sharpham	Moderately deep to deep, red clays Surface stone and gravel pavements are characteristic Gilgai microrelief is usually well developed, reaction is alkaline Lime occurs in all profiles	Red clays	UG5 34, UG5 37 UG5.39	Gidgee open shrublands	Cretaceous Winton Formation	9, 122, 165, 249
Bonnie	Deep, reddish-brown, clays Surfaces are strongly self-mulching and have scattered gravel cover Reaction is alkaline Lime occurs in all profiles	Red clays	UF6 31, UG5 34 UG5 38	Brigalow open woodlands	Cretaceous Winton Formation	218, 252, 254, 255
(C) RED AND BROWN CLAYS ON ALLUVIAL PLAINS						
Blackwater	Very deep brown, and reddish-brown cracking clays Surfaces are weakly self-mulching with fragile crusts Reaction is alkaline Lime is present in all profiles	Brown clays	UG5 24, UG5.25 UG5 34, UG5 38 UG5 37	Mitchell grass open tussock grasslands herbfields	Quaternary alluvia	13, 27, 36, 45, 74, 85, 118, (174), 188, 215, (223)
Powell	Very deep, red and brown clays crusting, cracking surfaces Seasonally scalded Thick platy or vesicular crusts are characteristic Lime and gypsum occur at depth in some profiles	Red and brown clays	UG5 24, UG5 32 UG5.34 UG5.38	Open herbfield / tussock grassland	Quaternary alluvia	12, 28, 37, (38), (54), 55, 90, 109, 125, (126), 127, 166, (167), (182) 183, (194), (204), (234), 244, (267), (268)
Conniston	Very deep, brown and minor grey-brown cracking clays Surfaces are crusting Weakly gilgaied microrelief is common Reaction is neutral Lime and gypsum occur at depth in most profiles	Brown clays	UG5 24, UG5 25 UG5 34, UG5 39	Gidgee shrublands, occasionally brigalow woodlands in the west	Quaternary alluvia	3, 8, 75, 94, (148), (191), 210, (224), (235)
(D) GREY CLAYS ON ALLUVIAL PLAINS						
Pelican	Very deep, strongly structured to massive grey clays with surfaces widely cracking, when dry	Grey clays	UG5.24, UG5 28	Bluebush / lignum swamps	Quaternary alluvia	(23), 56, 61, 80, (222).
Morunda	Very deep, grey and grey-brown cracking clays Surfaces are weakly self-mulching or crusting Reaction is neutral at the surface becoming alkaline at depth Lime and gypsum occur in most profiles below 60cm	Grey clays	UG5.24, UG5 25 UG5 28, UG5 29	Coolibah open woodlands	Quaternary alluvia	(53), 62, 79, (93), 97, 136, (137), (154), (163), (164), (172), 173, (187), 246

(E) SCALDS AND CLAYPANS						
Moonbang	Very deep, scalded, grey and brown clays. Surfaces have strong platy or vesicular crusts up to 2cm thick, often displaying hexagonal cracking patterns. Reaction is neutral becoming alkaline at depth.	Grey and brown clays.	UG5.24, UG5.28 UG5.34.	Sparse herbfields / no vegetation	Quaternary alluvia	84, 106, 124, (240), 242.
Oakham	Very deep, greyish-brown cracking clays Surfaces are widely cracking when dry Soil is strongly structured to massive and mottled at depth Reaction is neutral	Grey and brown clays.	UG5.24, UG5.28, DY3 12	Swamp canegrass open tussock grasslands	Quaternary alluvia	(108), 175, (233).
(F) DESERT LOAMS						
Stewart	Shallow reddish-brown texture contrast soils with surface gravel pavements. Reaction is neutral	Desert loams	DR2.12, DR2.3 DR2.43, DR2.52	Sparse short grasses / herbfields / gidgee shrublands.	Undifferentiated Quaternary deposits.	63, (65), 102, (103), 216, (217)
Geiger	Moderately deep to deep, red texture contrast soils similar to Stewart. Surfaces have ironstone shot pavements with slight gilgai development in some areas Reaction is neutral at the surface becoming alkaline at depth Lime and / or gypsum are present at depth	Desert loams	DR2 12, DR3.13 DR1.13	Open tussock grassland / sparse herbfield / gidgee shrublands.	Undifferentiated Quaternary deposits	178, 181, 185, (208), (263).
(G) TEXTURE CONTRAST SOILS ON ALLUVIAL PLAINS						
Cumberoo	Deep to very deep, red texture contrast soils Surfaces are crusting silty loams or sandy loams overlying red sandy or silty clays of medium to heavy texture Reaction is neutral at the surface becoming alkaline at depth	Solodic / alluvial soil	DR1.12, DR2.13 DR2.43	Herbfields / low shrublands	Quaternary alluvia	111, (180), 197
Mons	Very deep, red and brown texture contrast soils with sandy loam to loamy sand surfaces which may be hardsetting or loose Subsoils are red and brown sandy clays A bleached A2 horizon may be present. Reaction is neutral to slightly acid at the surface becoming alkaline at depth Lime is commonly present below 60cm Soils may be mottled at depth.	Solodic / alluvial soil.	DR2.13, DR3.13 DY5.43, DB3.12 DB4.13.	Eastern dead finish open woodland	Quaternary alluvia.	51, 52, 132, 214, (219), (239), 245, (271).
Retreat	Very deep, red and brown texture contrast soils with hardsetting sandy loam to loamy sand surfaces overlying sandy grey and brown clays. Reaction is neutral. Subsoils are occasionally mottled and a bleached A2 horizon may be present.	Solodic / alluvial soil.	DG2.43, DR4.12 DY3.42, DY5.53	Variable, herbfield to beefwood open woodland.	Quaternary alluvia.	76, 95, (107), 128.
(H) TEXTURE CONTRAST SOILS ON GENTLY UNDULATING PLAINS						
Essex	Deep to very deep, red and brown texture contrast soils Surfaces are hardsetting sandy loams to clay loams over massive, medium to heavy textured red and brown clays A thin sporadically bleached A2 is often present Reaction is slightly acid to neutral at the surface becoming alkaline at depth Lime is often present in the subsoil	Red-brown earth / solodic intergrades	DR2.13, DR2.42 DR2.43, DR2.83 DR3 43, DY2 13 GN4.12	Mulga / box / gidgee open woodlands.	Undifferentiated Quaternary deposits.	1, 2, 16, 19, 110, 115, (205)
Holmes	Shallow to moderately deep texture contrast soils Surfaces are hardsetting clay loams overlying red, strongly structured, heavy clays. Reaction is neutral at the surface becoming alkaline at depth Lime is present in the subsoil	Red-brown earths	DR2 13	Mulga shrublands / bloodwood open woodlands.	Quaternary limestone and minor chalcedony.	87, 120, 129, (270)
Greers	Moderately deep to deep, red texture contrast soils Surfaces are hardsetting sandy loams to clay loams overlying strongly structured heavy clay subsoils. Reaction is slightly acid at the surface becoming neutral at depth	Red-brown earths	DR2 12	Mulga / horse mulga open shrublands	Undifferentiated Quaternary deposits.	88, (206)
(I) DEEP RED EARTHS						
Bulgroo	Moderately deep to deep, red earths in grove areas Surfaces often have organic matter accumulations and sink-holes Textures are loams to sandy clay loams grading into sandy clay loams and light clays at depth Reaction is slightly acid to neutral Traces of ironstone shot may occur on the surface and in the profile	Red earths	GN2 11, GN2.12 UF4.41, UF4.43 UM1 43	Mulga open shrublands (groves)	Undifferentiated Quaternary deposits	69, 177, (220), (230), 236, (241), (256), (257)
Lynwood	Similar red earth soils to Bulgroo, but in intergrove areas, with hardsetting, usually slightly deflated surfaces Ironstone shot and gravel occur on the surface and throughout the profile Reaction is acid at the surface becoming neutral or alkaline at depth	Red earths	GN2.11, GN2.12	Mulga open shrublands (intergroves)	Undifferentiated Quaternary deposits	22, 117, (169), 196, (237), (258).

(J) SHALLOW RED EARTHS						
Wichilo	Shallow red earths in grove areas. Surfaces are hardsetting clay loams, commonly with slump-holes, and sometimes with scattered gravel Subsoils are weakly structured clay loams to light clays. Reaction is slightly acid to neutral throughout	Red earths	GN2.12, GN2 84 UM1:43, UM5.21	Mulga open shrublands (groves)	Undifferentiated Quaternary deposits	4, 24, 71, 116, (265)
Newhaven	Shallow to very shallow red earths with gravel and stone pavements. Ironstone shot and gravel occur throughout the profile Surfaces are hardsetting loams to clay loams with sandy clay loam to light clay subsoils Reaction is slightly acid to neutral	Red earths.	GN2.12, GN2 81 UM1 43, UM5.51 UM5.31	Mulga open shrublands	Thin Quaternary deposits over the Tertiary land surface	10, 73, (86), 92, (198), (225), 243.
(K) SANDY RED EARTHS						
Woomelang	Deep sandy red earths with hard-setting sandy loams grading into sandy clay loams at depth. Reaction is highly acid to neutral	Red earths	GN2.11, GN2.12	Mulga open shrublands.	Undifferentiated Quaternary deposits. (mainly sand)	17, (18), 20, (21), 70, 91, (98), 112, 213
Bindaree	Shallow to moderately deep sandy red earths similar to Woomelang	Red earths	GN2 11, GN2.12	Mulga open shrublands	Undifferentiated Quaternary deposits (mainly sand)	96, 105, (212), (228), (229).
(L) EARTHY SANDS						
Mitchells	Deep, to very deep, red earthy sands Surfaces are usually loose but coherent loamy sands grade into sandy loams at depth Reaction is slightly acid to neutral	Earthy sands	UC1 23, UC1 43 UC5 11, GN2.11	Spinifex open hummock grasslands	Quaternary sands	77, 78, (104), 113, (232), (259).
Ingella	Moderately deep, red hardpan soils with hardsetting scalded surfaces and a soft ferruginous hardpan at depth. Textures are loamy sand throughout Reaction is neutral	Earthy sand	UC1 23	Sparse vegetation	Quaternary sands	(171)
(M) SILICEOUS SANDS						
Ullenbury	Very deep, red, siliceous sands Surfaces are loose and non-coherent Reaction is neutral	Siliceous sands	UC1.23, UC5 21	Spinifex / mulga / beefwood hummock grassland to open shrubland	Quaternary sands	81, 82, (83), 170, (176), (186)
(N) LITHOSOLS						
Stonehenge	Bare outcropping weathered rock with occasional pockets of soil in cracks and depressions	Lithosols		Lancewood / mulga open shrublands	Tertiary Glendower or altered Winton Formations	(25), (60), (101).
Moses	Very shallow gravelly sandy clay loams with frequent outcrops of weathered rock Reaction is alkaline	Lithosols	UM1.11	Variable low open shrublands	Tertiary Moses Sandstone Formation	(184), (189)
Woolga	Shallow to very shallow red gravelly lithosols Surfaces have stone and gravel pavements Textures are loams to sandy clay loams with grit and gravel throughout Reaction is usually acid	Lithosols	UC1 23, UC1 43 UM1 23, UM1 43 UF5 12	Bastard mulga / mulga / bendee open shrublands	Tertiary Glendower or altered Winton Formations	5, (6), (7), (66), (67), (68), 72, 99, (100), 114, (138), (139), (140), (193), (199), (207), (209), (231), (238).

The distribution of the major soils groups is shown on the accompanying 1:1 000 000 soils map. This map was compiled from the existing land systems mapping boundaries, which necessitated the amalgamation of some of the major soil groups.

Profile descriptions were obtained at 271 detailed sample sites. Figure 3.1 shows the distribution of these sites. A further 900 observation sites provided additional information on the distribution of soil types.



Aerial photographs and ground information were used to select sample sites on the various land units. The number of sample sites recorded for each land unit was increased on the more productive types, with more intensive sampling on the cracking clays, and less intensive sampling on the dissected residuals and the more arid land units in the west.

DESCRIPTIONS OF MAJOR SOIL GROUPS

(A) Brown and Grey Clays on Gently Undulating Plains

These soils occur on fresh sediments of the Cretaceous *Winton Formation* forming large, relatively homogeneous areas of Downs, Wooded Downs, and Gidgee lands. They have high clay contents throughout. Surfaces are seasonally cracking and self-mulching to varying degrees. Soil reaction is alkaline throughout. Varying forms and degrees of gilgai microrelief occur. Lime and gypsum are usually present in the profile. Grey and brown clays occur intermixed, and hence are described together.

Laboratory pH is neutral to strongly alkaline in the surface, increasing slightly down the profile to 30 cm and then decreasing gradually. This is thought to be due to the presence of gypsum in increasing quantities below 30 cm in most profiles (Fig.3.2).

Electrical conductivity (E.C.) values increase down the profile from very low to low in the surface to low to very high at 120 cm or the base of the profile. All surface soils are non-saline+ but approx. one third of this group had saline subsoils at the base of the profile. Most profiles are non-sodic at the surface but become sodic by 30 cm and strongly sodic by 120 cm.

Mean surface clay percentage is 46%, increasing to 52% by 60 cm, and decreasing slightly below that. Cation exchange capacity (C.E.C.) has a mean surface value of 38 m. equiv/100 g. Mean profile C.E.C./clay ratio of 77 indicates a predominantly montmorillonite type clay. Soils are base saturated with (Ca) calcium the dominant cation throughout.

Exchangeable potassium (Ex. K) values are high. Most acid extractable phosphorus (A.P.) values range from fair to very high, (mean surface = 82 ppm, actual range 1 - 600 ppm). Bicarbonate extractable phosphorus (B.P.) values are generally low to very low, (mean surface value = 16 ppm). Organic carbon (C), Total Nitrogen (N) nitrogen) values are low to very low in the surface.

Available soil water capacity (A.W.C.) ranges from medium to high in the surface, increasing slightly with depth.

(B) Red Clays on Flat to Gently Undulating Plains

These soils comprise red and reddish-brown clays occurring on flat to gently undulating plains. The group has been subdivided into five soil profile classes on the basis of the geology of the parent material, physiography and vegetation (Table 3.1). The five soil profile classes in this group vary considerably in morphological and chemical properties.

Lab. pH ranges from very strongly acid for profiles in the Hayfields SPC (soil profile class) to mildly alkaline and strongly alkaline for profiles in Bonnie SPC.

E.C. values are low to very low in the surface increasing sharply down most profiles to high and very high values at the base. See Fig 3.6 and microfiche 2, Table 3.2. Gypsum is common in lower horizons. All profiles had non-saline surfaces but some subsoils in Boolooroo and Bonnie SPC's were saline. Surfaces were non-sodic in all profiles except two in Sharpman SPC. Subsoils were sodic to strongly sodic except Hayfields SPC.

Ex. K is adequate in all SPC's except Sharpham where some very low values were recorded. Acid P is variable, but generally low to very low in all except Mellew and Bonnie SPC's where some fair to very high values were recorded. Bicarb. P values follow a similar pattern. C and N values are very low to low with one fair value recorded in a dense brigalow open woodland.

A.W.C. ranges from low for Hayfields SPC to high and very high for Bonnie SPC.

+ *Definition Northcote and Skene (1972), see Appendix II*

(C) Red and Brown Clays on Alluvial Plains

This group represents a large proportion of the seasonally flooded clay soils found on alluvial plains. Red and brown clays with sand and silt intermixed predominate. These soils have been formed from Quaternary alluvia. Surface crusts are present in most cases. Reaction is neutral to alkaline. Traces of lime were recorded in some profiles. Three SPC's have been delineated in this group on the basis of surface characteristics, susceptibility to scalding and vegetation.

Lab. pH values are generally within the range slightly acid to strongly alkaline. E.C. values are commonly low to very low with occasional medium to very high values at 120 cm. Surfaces are non-saline, subsoils are only rarely saline. Most surfaces are non-sodic, generally with sodic subsoils (occasional strongly sodic subsoils occur).

Clay contents are greater than 30% and show little change down the profile. The well-grassed alluvial soils of Blackwater SPC had a mean clay content of 50% in the surface, while the frequently scalded soils of Powell SPC has a surface mean value of 42%. C.E.C. values are correspondingly lower (mean values down the profile of approximately 20 m. equiv./100 gm. for Powell SPC compared with mean values of approximately 30 m. equiv./100 gm. for Blackwater SPC). Soils are base saturated with Ca the dominant cation.

Ex. K values are fair to high for profiles in Blackwater SPC. Powell SPC has high values in the surface which decline rapidly to very low to fair values below 30 cm. Acid P values are extremely variable and range from very low to high. Highest values occur for profiles in the Blackwater SPC (mean surface value = 30 ppm). Bicarb P values are also extremely variable, generally ranging from very low to fair. C and N values range from very low to low, again being slightly higher for Blackwater SPC.

A.W.C. ranges from medium to high with occasional very high values.

(D) Grey Clays on Alluvial Plains and Channel Country

This group comprises very deep, grey and grey-brown clays which have been laid down on plains of Quaternary alluvia. Considerable variation occurs in these soils which have been separated into two SPC's mainly on the basis of soil structure and position in relation to flooding.

Lab. pH ranges from neutral to strongly alkaline. E.C. values are variable ranging from very low to occasional very high values at 120 cm . Surfaces are non-saline and non-sodic, but saline subsoils are fairly common in Morunda SPC. Sodic to strongly sodic subsoils are common.

Clay contents are greater than 40% with occasional sand bands being encountered. C.E.C.'s are variable ranging from 20 to 50 m. equiv./100 gm. Soils are base saturated with Ca being the dominant cation.

Ex. K ranges from very fair to high for most profiles. Acid P values are generally fair to very high. Bicarb. P values are extremely variable but adequate at most sites. C and N levels are very low. A.W.C. ranges from medium to very high.

(E) Scalds and Claypans

This group comprises deep clay soils on alluvia with strongly crusting surfaces in scalded areas and massive structured clays in the claypans.

Lab. pH generally ranges from medium acid to mildly alkaline. Scalded sites had very high E.C. values and were saline throughout the profile. Most surfaces were sodic. Acid and bicarb. values are very low to low. C and N values are very low.

(F) Desert Loams

Texture contrast soils formed mainly in the drier western parts of the area make up the desert loam group. These soils are formed where erosion has produced long fan slopes of redistributed material between remnants of the previous land surface and drainage lines. Pavements of ironstone shot and gravel are characteristic. Thin sandy loam to silty clay loam surfaces up to 5 cm thick overlie red, strongly structured, blocky clays. Reaction is neutral, sometimes becoming alkaline at depth. The group has been subdivided by depth into two SPC's.

E.C. values are variable, but most profiles increase to very high values by 120 cm. Subsoils are generally saline and sodic to strongly sodic.

(G) Texture Contrast Soils on Alluvial Plains

Three SPC's have been recognized in this group which consist of soils formed where coarser textured material has been deposited over alluvial clay plains.

Most profiles have very low to low E.C. values and are non-saline throughout. Surfaces are non-sodic, but a number of profiles (particularly in Mons SPC) become sodic or strongly sodic by 120 cm.

Acid P and Bicarb. P values are generally low to very low with some fair values recorded for the surface in Mons and Retreat SPC's. C and N values are low to very low. A.W.C. values range from low to medium for Cumberoo SPC to very low for Retreat SPC.

(H) Texture Contrast Soils on Gently Undulating Plains

This group comprises soils formed in run-on areas of the hard and soft mulga land zones. Three SPC's have been recognized in this group, distinguished by differences in geology and physiography. All have hardsetting, sandy loam to clay loam surfaces.

Lab. pH increases from very strongly acid to medium acid at the surface to mildly to strongly alkaline at depth for the Essex and Holmes SPC's. E.C. values are generally very low to medium and soils are non-saline. Subsoils of Essex SPC were strongly sodic.

Ex. K values are generally greater than 0.2 m. equiv./100 g. Acid P values are very low. Bicarb. P values are very low to low. C and N values are low to very low. A.W.C. values range from low to medium.

The red earths in the area are the characteristic massive, earthy soils with gradual or diffuse horizon boundaries, and often a gradual increase in texture with depth, as described by Stace *et al.* (1968).

These soils have been derived by the weathering and erosion of sediments of the Tertiary *Glendower Formation*. Redistribution of the erosion products from this process over the land surface has produced soils of variable depth and texture.

The red earths group has been divided into loamy red earths which have hardsetting loamy surfaces, and sandy red earths, which have more friable, sandy loam or coarser surface textures. Depths are variable throughout these groups, and a further subdivision of the loamy red earths into shallow red earths (less than 50 cm deep) and deep, red earths (greater than 50 cm deep) has been made.

(I) Deep Red Earths

These soils predominate in the soft mulga land zone and have hardsetting loam to sandy clay loam surface textures which grade into sandy clay loams or light clays at depth. The group has been divided into two SPC's, one representing the grove or run-on areas and the other the intergrove or run-off areas.

Predominant Lab. pH is in the range very strongly acid to slightly acid. E.C. values are very low. Soils are non-sodic and non-saline.

Ex. K values are usually greater than 0.2 m. equiv./100 g. Acid and bicarb. P values are very low, though some build up was noted in the surfaces of the groves (Bulgroo SPC). Most C and N values are very low to low. A.W.C. values are low.

(J) Shallow Red Earths

This soil group occurs mainly in the hard mulga land zone. Scattered surface gravel is common. Again two SPC's representing the run-on (grove) areas and run-off (intergrove) areas have been recognised. Surface textures range from loam to clay loam and overlie clay loam to light clay subsoils.

Lab. pH ranges from very strongly acid to medium acid. E.C. values are very low. Soils are generally non-saline and non-sodic.

Ex. K values are mostly greater than 0.2 m. equiv./100 gm. Acid and bicarb. P values are very low to low. C and N values typically range from very low to low. A.W.C. values are low.

(K) Sandy Red Earths

This group of soils has been formed where Quaternary sand sheets have covered the Tertiary land surface. Profiles are gradational with sandy loams grading into sandy clay loams at depth. Surfaces may be hardsetting or loose.

Lab. pH ranges from extremely acid to slightly acid. E.C. values are very low to low. Soils are non-saline and non-sodic.

Ex. K values recorded range from low to very fair. Acid and bicarb. P, C and N, and A.W.C. values are very low to low.

(L) Earthy Sands

These soils are former aeolian sands which have formed extensive sandplains over the Tertiary land surface. They are now stabilized in most areas by vegetation. Textures are uniform loamy sands to sandy loams. Occasional gradational profiles occur where clay content increases with depth. Soils of this group exhibit an earthy appearance, said by Stace *et al.* (1968) to be due to coating and bridging of the sandgrains by clayey material and iron oxides. Soils are loose and only weakly coherent in most cases but surfaces may be hardsetting under some conditions.

Lab. pH ranges from medium acid to very strongly acid. Clay contents generally range from 11 to 15%.

Ex. K values range from low to very fair. Acid and bicarb. P, C and N and A.W.C. values are very low.

(M) Siliceous Sands

These soils are again formed where aeolian Quaternary sands have covered the Tertiary land surface. The siliceous sands usually occur on the crests and upper flanks of sand dunes. Whitehouse (1947) and Dawson (1974) have referred to an increase in clay content in the centre of these sand dunes forming a "clay core" or "clay layer" (see Ingella SPC).

Lab. pH ranges from medium acid to neutral. E.C. values are very low and soils are non-sodic and non-saline. Clay contents are less than 10%.

Ex. K values range from low to very fair. Acid P values are predominantly very low to low with occasional fair values being recorded at the surface. Bicarb. P values are very low to low. C, N, and A.W.C. values are very low.

(N) Lithosols

These are characteristically very shallow gravelly soils with horizon development limited to organic matter accumulations in the surface. Decomposition of this organic matter forms an important part of the nutrient recycling process in these soils, where Acacia shrublands are present. The group has been divided into three SPC's on differences in depth of soil and geology of the underlying rock.

Lab. pH ranges from extremely acid to medium acid. Most Ex. K values are greater than 0.2 m. equiv./100 g. Acid P, Bicarb. P, C, and N values range from very low to low. A.W.C. values are generally low to medium.

SOIL CHEMICAL AND PHYSICAL PROPERTIES

Methods of analysis used are given in Appendix VI. The range of values on which the ratings (e.g. high, low, medium etc.) for various soil attributes are based, are given in Appendix II.

A total of 160 profiles were analysed for pH, chloride (Cl), electrical conductivity (E.C.) and acid extractable phosphorus. Organic carbon (C), total nitrogen (N) and bicarbonate extractable phosphorus were also determined on all 0-10 cm samples.

From these, 110 profiles were selected for further detailed analysis. Particle size distribution, exchangeable cations, cation exchange capacity (C.E.C.), total phosphorus, potassium, sulphur, and $^1/_3$ and 15 bar moisture determinations were carried out on 0-10, 20-30, 50-60 and 110-120 cm samples from these profiles. The 10-20 cm depth of these profiles was analysed for C, N, and bicarb. P. Analytical data for each analysed profile are presented in microfiche 1 together with other site description data.

Brief summaries of the chemical and physical properties of the fourteen major soils groups described earlier in this chapter follow. Distribution tables showing the range of values of the various soil chemical and physical properties are presented in microfiche 2 for the 14 major soil groups and the 37 soil profile classes (SPC). A summary of important analytical data for the major soil profile classes and land units is presented in microfiche 2, Tables 3.27 and 3.28.

Correlation coefficients were calculated for the soil chemical properties, using the 0-10 cm values. The more important correlations have been presented in Table 3.2. Data are presented for three broad soil types, the sedentary clays (group A), the alluvial clays (group C and D), the red earths (groups I, J, K), and for all soils.

SOIL pH

The distribution of laboratory pH values for the soil groups and profile classes is shown in microfiche 2, Tables 3.1 and 3.1A.

Field pH was recorded for all sites where samples were taken. Field pH and lab. pH in the surface were strongly correlated $r_{158} = 0.86^{***}$ for all analysed sites. Laboratory pH is correlated with clay % ($r_{107} = 0.63^{***}$), exchangeable Ca (0.82^{***}), C.E.C. (0.79^{***}) and C.E.C./clay (0.80^{***}) for all soils. This shows that generally the lower pH values occur on coarser textured, leached soils, with low exchangeable Ca and C.E.C.

If pH 8 or greater is taken to represent alkalinity in the surface soil, then the brown and grey clays (A) are the soils where plant growth may be affected by alkalinity. (Mean surface pH = 8.3, C.V. = 6%). High levels of alkalinity or acidity can lead to toxicity or deficiency of some trace elements.

The earthy sands (L) and siliceous sands (M) are strongly acid to neutral in the surface. Most of the red earths (I, J, K) and lithosols (N) are acid throughout, with the majority of sites in groups I to N having a surface pH <5.6. O'Hagan (1966) found that optimum plant calcium levels were reached in mulga seedlings on red earths in western N.S.W. at a soil pH range of 5.8 to 6.1. In this range efficient symbiosis resulted in gains of organic carbon and nitrogen in both the surface and subsurface horizons. This resulted in increased biological

Table 3.2 Correlation Co-efficients between soil factors (0-10 cm)

GROUP A Brown and grey clays on gently undulating plains.

	No.	% Clay (35)≠	C.E.C. (35)	Org. C (47)	Tot. P (35)	Acid P (47)	Bicarb. P (47)
Org. C	(47)≠			-			
Total P	(35)	-0.42*	-0.35*		-		
Acid P	(47)	-0.34*			0.80***	-	
Bicarb. P	(47)		-0.44**		0.75***	0.36*	-
Total N	(47)			0.93***	0.34*		
1/3 Bar	(35)	0.66***	0.86***				-0.39*
15 bar	(35)	0.56***	0.80***				
Av. Water Cap.	(35)						
A.D. Moist.	(35)	0.46**	0.75***		-0.37*	-0.39*	

Field pH and lab. pH $r_{45} = 0.49^{***}$, Total K and acid P $r_{33} = 0.74^{***}$

Total K and bicarb. P $r_{35} = 0.53^{***}$, Total K and exch. K $r_{35} = 0.62^{***}$

GROUPS C AND D Red, brown and grey clays on alluvia

	No.	% Clay (23)	C.E.C. (23)	Org. C (34)	Tot. P (23)	Acid P (34)	Bicarb. P (34)
Org. C	(34)			-			
Total P	(23)				-		
Acid P	(34)	0.54**	0.61**		0.53**	-	
Bicarb. P	(34)	0.45*	0.45*		0.61**	0.87**	-
Total N	(34)			0.91***			
1/3 Bar	(23)	0.77***	0.82***			0.69***	0.52*
15 Bar	(23)	0.85***	0.90***			0.45*	
Av. Water Cap.	(23)	0.47*	0.53*		0.42*	0.78***	0.66***
A.D. Moist.	(23)	0.55**	0.71***				

Field pH and lab. pH $r_{32} = 0.57^{***}$, clay % and CEC $r_{21} = 0.87^{***}$

≠ no. of determinations

Table 3.2 cont...

GROUPS I, J, AND K The red earth soils

	No.	% Clay (13)	C.E.C. (13)	Org. C (23)	Tot. P (13)	Acid P (23)	Bicarb. P (23)
Org. C	(23)	0.75**	0.58*	-			
Total P	(13)		0.69**		-		
Acid P	(23)					-	
Bicarb. P	(24)				0.60*	0.88***	-
Total N	(23)	0.56*		0.94***			
1/3 Bar	(13)	0.70**	0.85***		0.88***		
15 Bar	(13)	0.94***	0.84***	0.81***	0.70***		
Av. Water Cap.	(13)		0.63*		0.83***		
A.D. Moist.	(13)	0.67*	0.89***				

Field pH and lab. pH $r_{21} = 0.64^{***}$, C.E.C. and clay $r_{11} = 0.77^{**}$

Total K and avail. soil water capacity $r_{11} = 0.74^{**}$

ALL SOILS

	No.	% Clay (109)	C.E.C. (109)	Org. C (160)	Tot. P (109)	Acid P (160)	Bicarb. P (160)
Org. C	(160)	0.24*	0.23*	-			
Total P	(109)			0.38***	-		
Acid P	(160)	0.26**	0.43***		0.64***	-	
Bicarb. P	(160)				0.46***	0.47***	-
Total N	(160)	0.28**	0.31**	0.92***	0.41***	0.22*	0.25**
1/3 Bar	(102)	0.92***	0.84***	0.32***	0.22*	0.38***	
15 Bar	(102)	0.91***	0.72***	0.35***		0.37***	
Av. Water Cap.	(102)	0.78***	0.68***	0.21*	0.25*	0.33***	0.22*
A.D. Moist.	(102)	0.85***	0.88**	0.27**		0.31**	

Field pH and lab. pH $r_{158} = 0.86^{***}$; C.E.C. and clay $r_{107} = 0.79^{***}$

Lab. pH and C.E.C. $r_{107} = 0.79^{***}$; Lab. pH and clay $r_{107} = 0.63^{***}$

*** 0.1% significance level; ** 1% significance level;

* 5% significance.

activity in the soil. On this basis, the predominance of surface soil pH values <5.6 in the coarser textured soils, suggests less than optimum conditions for buildup and maintenance of organic carbon and nitrogen levels under mulga. Adequate levels of C and N are essential to maintain stability on the red earth soils.

Fig. 3.2 Mean pH Values at Sample Depths of Soil Groups.

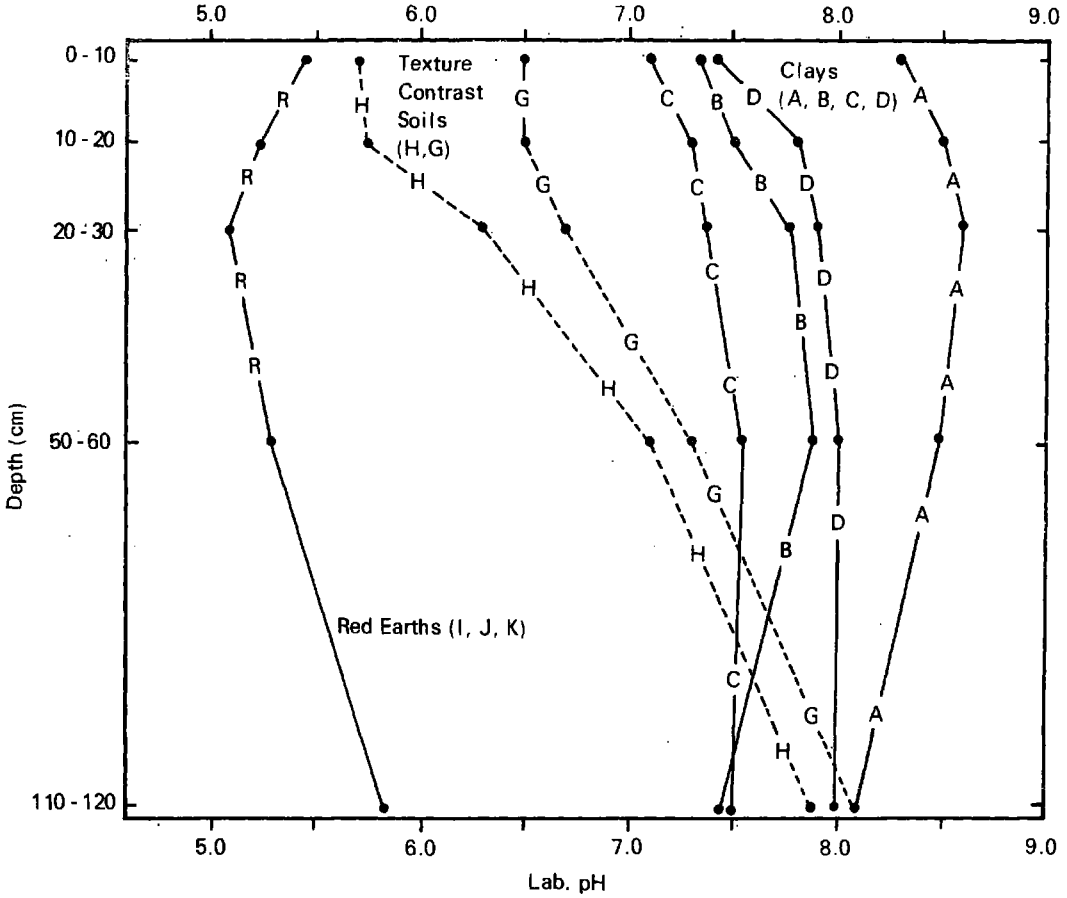


Fig. 3.2 shows the mean pH values of soil groups down the profile. A similar profile trend is evident for the clays (A, B, C, D). Mean pH increases down the profile to the 30 or 60 cm depth. Among the clay soil groups, there is a general increase in mean pH from the red and brown alluvial clays (C) to the red clays (B), then grey alluvial clays (D) and finally the brown and grey clays of the plains (A).

The texture contrast soils of the plains (H) have lower mean pH values than the texture contrast soils on alluvia (G), particularly in the surface. Both groups show similar mean profile trends with pH increasing sharply beyond 20 cm depth.

CARBONATE

Carbonate is present in the soil as calcium and/or magnesium carbonate. The concretionary and soft forms have been referred to as lime in the field survey. Distributions showing the amount of lime (calculated equivalent to calcium carbonate) present in the soil groups and profile classes are included in microfiche 2, Tables 3.5 and 3.5A. Only those samples which effervesced with 1N HCl, were analysed for carbonate.

No carbonate was recorded in the shallow red earths (J), sandy red earths (K), earthy sands (L) or siliceous sands (M) and only occasional traces were recorded at the base of the deep red earth (I) profiles. High carbonate values occurred at the base of profiles in the Mons SPC of the alluvial texture contrast soils (G). Carbonate occurred in varying amounts in the remaining soil groups with highest values being recorded in the brown and grey clays (A) and red clays (B). For group A, 58% of carbonate values in the surface were >3%, and 66% of values at 120 cm were >3%. In the red clays an increase in carbonate values at depth was recorded in Sharpham and Bonnie SPC's (predominantly gidgee and brigalow shrublands) and Mellew SPC (shallow soils over Cretaceous *Mackunda Formation*).

GYPSUM

Gypsum crystals are present in the lower parts of the profile of many of the clay soils. Lime generally occurs in association with gypsum in the brown and grey clays (A).

Gypsum in a soil profile is relatively insoluble, and over a period of time is leached down to the depth of regular wetting where large crystals form. High gypsum levels at depth have resulted in a slight decrease in pH at the base of some profiles in the brown and grey clays (A) and red clays (B).

Comparison of electrical conductivity and chloride figures gives an approximate guide to the quantity of gypsum present, but large crystals of gypsum are difficult to dissolve in the 1:5 soil/water extract used in E.C. measurements. A 1:50 soil/water extract was used on most samples where gypsum was suspected and E.C. >1.0 mS/cm.

ORGANIC CARBON AND TOTAL NITROGEN

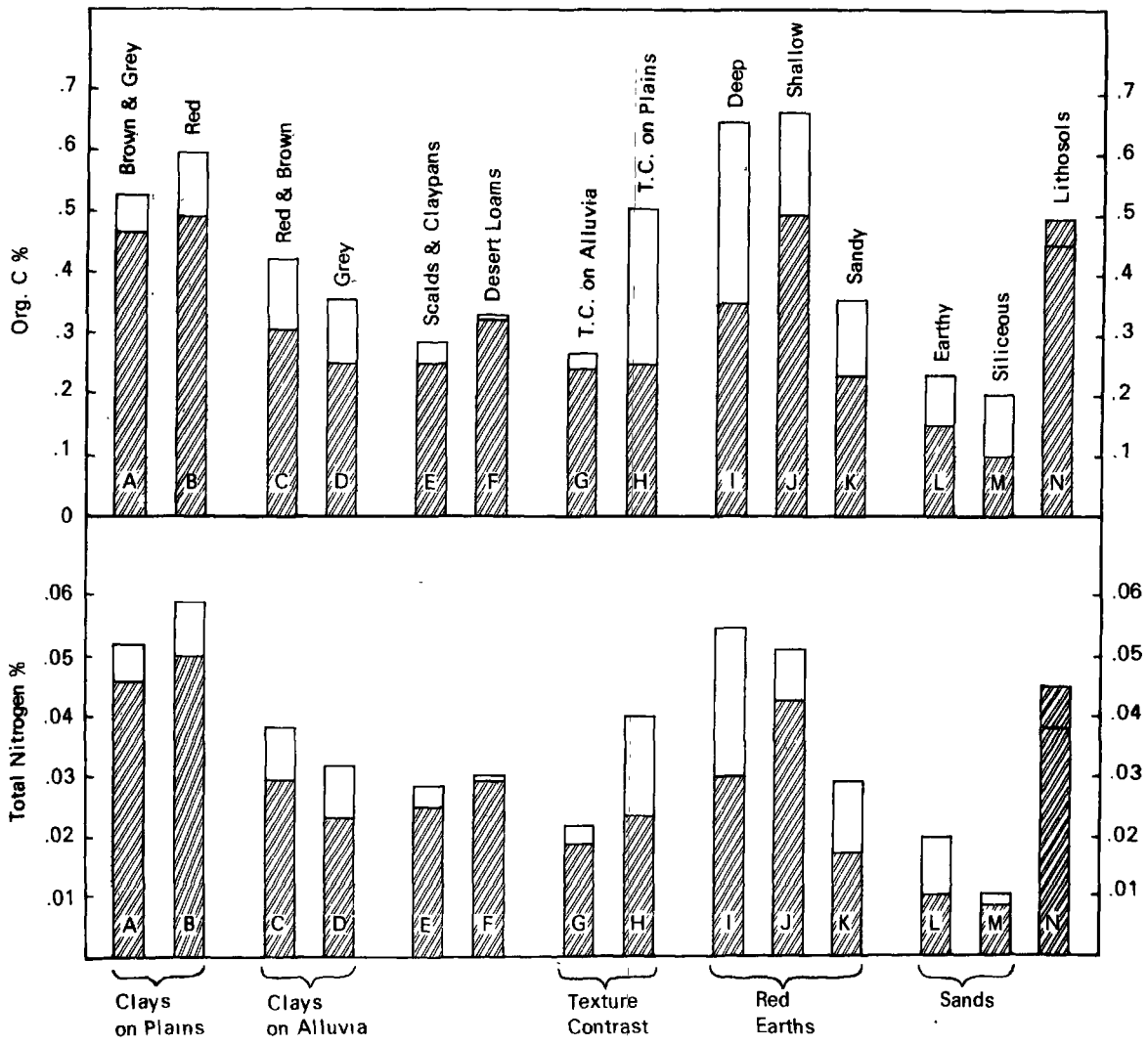
Ranges of organic carbon (C) and total nitrogen (N) values and C/N ratios for the soil groups and profile classes are shown in microfiche 2, Tables 3.6, 3.7, 3.8 and 3.6A, 3.7A and 3.8A.

Mean C value for all surface samples (0-10 cm) is 0.46%. This is similar to the 0.49% value recorded by Dawson and Ahern (1974) in the WARLUS I SURVEY, which adjoins this area to the south. It is considerably less than the figure of 0.73% recorded by Turner and Ahern (1978) in the higher rainfall WARLUS IV SURVEY which adjoins the eastern boundary of this area. Mean N value for all surface samples is 0.042%, again similar to the 0.045% recorded by Dawson and Ahern.

Mean C and N values of the soil groups are shown in Fig. 3.3. The means for the 10-20 cm depth are shown as shaded height. Except for the lithosols (N) and desert loams (F), mean C and N values are lower in the 10-20 cm than the 0-10 cm depth. Generally the clays (A, B, C, D,) and texture contrast soils on alluvia (G) show only a moderate decrease in C and N values at 10-20 cm depth.

However, the texture contrast soils on the plains (H), the deep loamy and sandy red earths (I, K) and earthy sands (L) show up to 50% drop in C and N values from 0-10 cm to the 10-20 cm depth. Management practices on these soils must be aimed at preventing erosion, as loss of surface soil could reduce C and N levels to half of their already low values.

Fig. 3.3 Mean Organic Carbon (Walkley and Black Values) and Total Nitrogen at Sample Depths 0-10 cm (full height) and 10-20 cm (shaded height) of the Soil Groups.



Lowest C and N values (mean C <0.3% mean N <0.03%) were recorded on the earthy sands (L), siliceous sands (M), texture contrast soils on alluvia (G) and the scalds and claypans (E), see Fig. 3.3.

Soils with the highest C and N values usually support dense *Acacia* shrublands (mulga, bendee, gidgee, brigalow), which are capable of symbiotic fixation of nitrogen. Highest values were recorded on Carlow, Bonnie, Essex and Wichilo SPC's, but these values (C <1.8%, N <0.15%) are still low compared to values for similar soils in the eastern and northern parts of the State.

Mean C/N ratio for all soils (0-10 cm) is 11.2 (CV = 19%). Correlation between C and N for all soils is highly significant, $r_{158} = 0.92^{***}$. It is also highly significant on each of the three broad soil types, the sedentary clays, alluvial clays and red earths in Table 3.2.

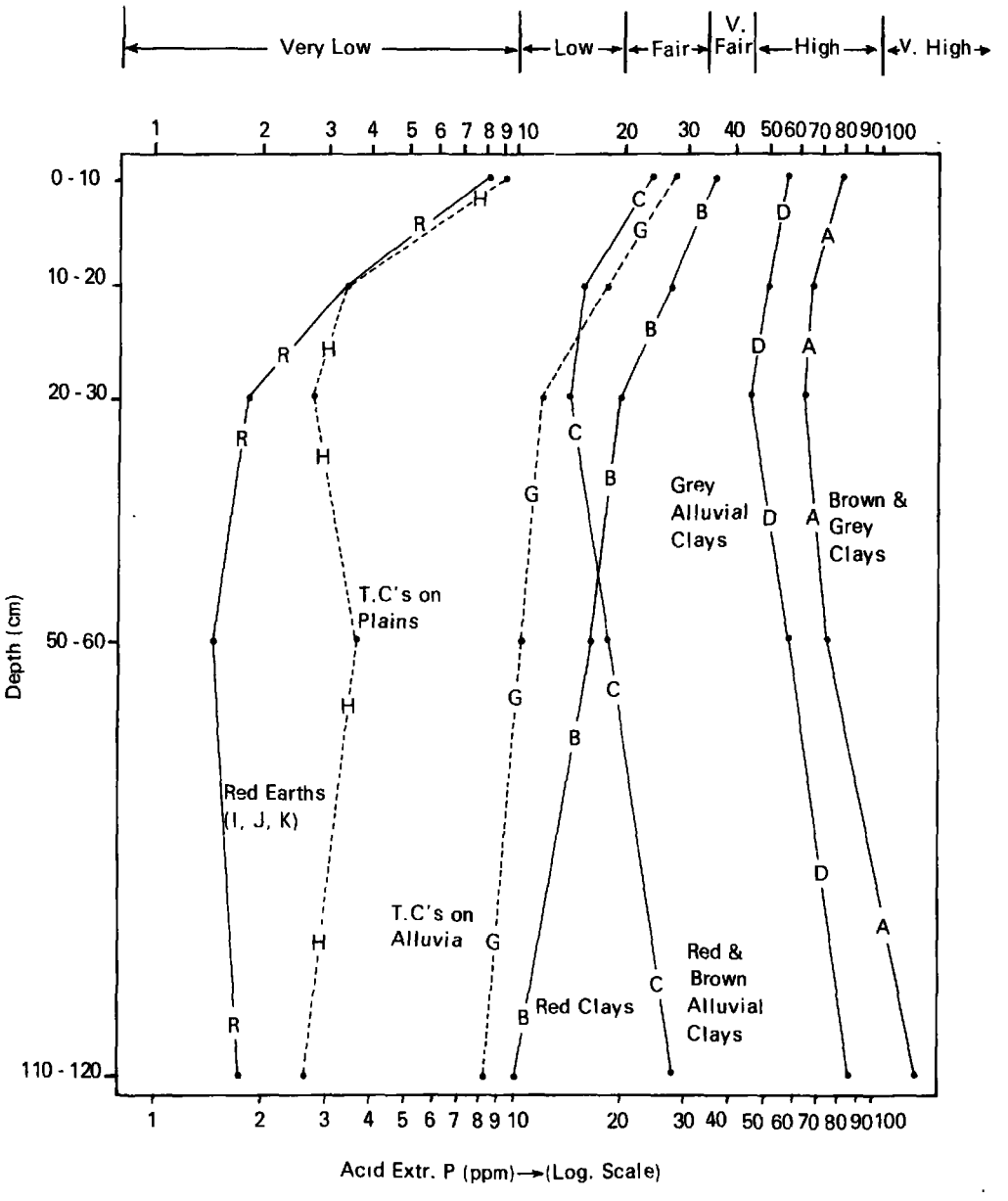
The low and very low C and N values recorded have important management implications on the red earths. Excessive clearing together with overgrazing exposes the soil to wind and water erosion resulting in a loss of surface soil and organic matter. The corresponding loss of nutrients such as N and P which are cycled by the *Acacia* community is critical in these low fertility soils. In addition the deep

and shallow loamy red earths (I, J) often form hard surfaces which lead to high runoff rates and further erosion when bare. On these soils adequate organic matter is essential to maintain favourable surface characteristics and infiltration rates.

PHOSPHORUS

Distributions of acid extractable phosphorus, bicarbonate extractable, and total phosphorus are given in microfiehe 2, Tables 3.10 to 3.12 for soil groups, and 3.10A to 3.12A for profile classes.

Fig. 3.4 Mean Acid Extractable Phosphorus at Sample Depths for Soil Groups.

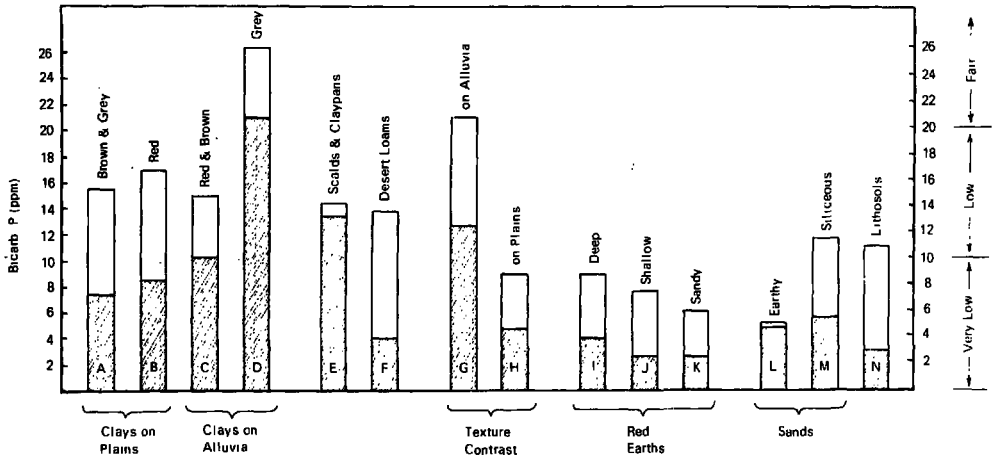


Mean values of acid P at sampled depths for most of the soil groups are shown in Fig. 3.4. Values are variable in most soil groups. It can be seen that the brown and grey clays on the plains (A), and the grey alluvial clays (D) have high mean acid P values throughout the profile.

The red clays (B), red and brown alluvial clays (C), and the texture contrast soils on alluvia (G) have fair to very fair mean acid P in the surface decreasing to low values by 60 cm.

The texture contrast soils on the plains (H) have very low mean acid P and a similar profile trend to the red earths (I, J, K) to 20 cm, but are 1 to 2 ppm P higher at the lower depths.

Fig 3.5 Mean Bicarbonate Extractable Phosphorus at 0-10 cm (full height) and 10-20 cm (shaded height) for the Soil Groups.



Mean values of bicarb. P at sample depths 0-10 and 10-20 cm for all soil groups are shown in Fig. 3.5. The alluvial grey clays (D) and texture contrast soils on alluvia (G) have the highest mean bicarb. P levels. The texture contrast soils on the plains (H), red earths (I, J, K) and earthy sands (L) all have very low mean bicarb. P levels.

On the brown and grey clays (A) surface total P correlated strongly with acid P ($r_{33} = 0.80^{***}$) and bicarb. P ($r_{33} = 0.75^{***}$) indicating that the higher extractable P values were associated with the higher total P values. Mean surface acid P value for the group of 81 ppm (CV = 87%) was considerably higher than the mean surface bicarb. P values of 16 ppm (CV = 73%). Mean bicarb./acid P ratio is 0.26 (CV = 57%). Correlation between acid and bicarb. P is poor, $r_{45} = 0.36^{*}$. This group has the highest mean pH 8.3 (CV = 5%). In the adjoining WARLUS I area Dawson and Ahern (1974) indicated that generally the more alkaline a soil the lower the bicarb./acid P ratio was. This trend appears to be the case in this area also.

Whitehouse (pers. comm.) has shown that bicarb. P values are the best indication of phosphorus available to crops such as wheat on alkaline cracking clays of the Darling Downs. However the growth of native pasture on the brown and grey clays in this low rainfall area is not likely to be limited by availability of P during normal seasons.

For the alluvial clays (C, D) surface values of total P correlated with acid P ($r_{21} = .53^{**}$) and bicarb. P ($r_{21} = .61^{**}$). A strong correlation exists between acid and bicarb. P ($r_{32} = .87^{***}$). Mean surface bicarb./acid P ratio was 0.58 (CV = 35%), which is considerably higher than the value of 0.26 on the more alkaline brown and grey clay group (A).

The red and brown alluvial clays (C) have considerably lower mean acid P (24 ppm surface) and bicarb. P (15 ppm) values than the grey alluvial clays (D) acid P = 58 ppm, bicarb. P = 26 ppm. Higher levels of extractable P are characteristic of group D soils in the swamps and channels of the Diamantina and Thomson Rivers and Cooper Creek. Those alluvial areas with the lower extractable P levels in

group C will probably experience some limitation due to P status when soil moisture levels are adequate for plant growth.

On the red earths (I, J, K), mean surface bicarb./acid P ratio was 0.85 (CV = 34%), which was considerably higher than that for the clay soils. A highly significant correlation between acid and bicarb. P ($r_{21} = 0.88^{***}$) was obtained. This is similar to the correlation ($r = 0.916^{***}$) recorded on the red earths by Dawson and Ahern (1974) in the adjoining WARLUS I survey, and ($r_{25} = 0.91^{***}$) on the red and yellow earths in the WARLUS IV survey of Turner and Ahern (1978).

The mean acid extractable P percentage of total P is only 2.5% in the surface of the red earths, and it declines with depth. A lower proportion of the total phosphorus is acid extractable on the red earths than the clays, probably due to the formation of insoluble organic and inorganic phosphorus compounds in these soils.

The red earths (I, J, K), earthy sands (L), siliceous sands (M) and lithosols (N) all have very low mean acid P levels in the surface, decreasing sharply to 2 ppm P or less by 60 cm. Most of these soils would be deficient in P except in micro-habitats in the canopy region of trees and shrubs, where recycling has resulted in higher local levels of P. Christie (1975) noted that buffel grass established readily beneath tree canopies of poplar box. He stated that a method of establishing limited improved pastures would be to sow buffel grass into these relatively fertile micro-habitats.

Mean acid, bicarb. and total P values for the red earths are considerably higher in the surface, than further down the profile, showing the extent of nutrient recycling on these soils. Management practices must be aimed at preventing loss of this surface soil and its nutrients which results in reduced quality and quantity of pasture, lowering the stocking capacity.

AVAILABLE SOIL WATER CAPACITY

Available soil water capacity (A.W.C.) was determined in the laboratory by calculating the difference between moisture held at $^1/_3$ and 15 bar. Distribution tables showing ranges of values for the soil groups and soil profile classes are given in microfiche 2, Tables 3.16, 3.16A.

A.W.C. is a laboratory measurement which is useful for comparison but is not an absolute measure of the quantity of moisture available to plants adapted to an arid environment. Winkworth (1973) has shown that plants in an arid environment have the ability to extract water held at higher tensions than 15 bar.

The $^1/_3$ and 15 bar moisture figures are strongly correlated to C.E.C. and clay for the all soils and each group in Table 3.2. A.W.C. gives a weaker correlation with C.E.C. for the all soils group, and is not significant on the clay soils (A). The relationship between moisture characteristics and particle size is discussed further in the section on particle size.

The scalds and claypans (E) and desert loams (F) have low mean available water capacity in the surface increasing to medium values at depth. These soils usually have bare and hard setting surfaces with low infiltration rates. This together with their lower available water capacity than the clays and higher salinity, would make plants trying to grow on them susceptible to moisture stress at a much earlier stage than would occur on the clays (A, B, C, D). This explains some of the difficulties of establishing permanent cover on these soils.

The clay soils of groups A, B, C and D generally have medium to very high capacities to store water. Cracking clay soils have high initial infiltration rates when dry and cracked. The infiltration rate drops rapidly once the soil swells after wetting and the cracks close. These heavy textured soils when dried beyond wilting point require heavy falls of rain to bring their moisture content to a level where plants can use this moisture. They do however have a high storage capacity (mean 11-15%) and if wet up to field capacity will supply plants with moisture for a considerable period of time. This is illustrated in the Channel Country where heavy clay soils, wet to field capacity by flooding, support active plant growth for a number of months without further rainfall.

The coarser textured sandy soils (in particular groups L and M) when dried out to or beyond wilting point require only light falls of rain to bring their moisture content to a level where plants can use it. This results in an immediate response by vegetation to light falls of rain. However, because the water storage capacity of these soils is very low, plants will soon suffer moisture stress again as soil moisture drops below wilting point, unless further falls of rain are received. These soils are often important during extended droughts, as plants can respond to light rain which is insufficient to break the drought on the clay soils.

Rainfall is unreliable and becomes increasingly lower and irregular from east to west across the area. The soils of the downs, wooded downs and gidgee lands in the east are the most productive in the area because of their higher fertility and better rainfall regime. These soils are predominantly the fine textured brown and grey clays of group A which have a high moisture storage capacity.

In the eastern parts of the area heavy falls of rain sufficient to wet soils to field capacity are generally expected by late summer. Rainfall throughout the winter and early summer is usually light and patchy but if these falls are sufficient to maintain the soil moisture above wilting point, further growth periods occur. Winter growth periods are important for the production of valuable herbage.

In between growth periods, stock rely on the standover value of the pasture. In dry seasons when the summer rains fail, or are insufficient to build up the soil moisture store appreciably, drought periods are fairly certain to follow, as the lighter falls of rain which can be expected later in the year, are not likely to be sufficient to wet the heavy clay soils above wilting point. This has important implications in determining drought strategies in areas where extensive tracts of these soils occur.

A policy of lowering stocking rates and preparing for drought conditions if summer rains fail to materialize by a certain date is reported to have been followed by the management of a large pastoral company with holdings in the Blackall district.

ELECTRICAL CONDUCTIVITY AND CHLORIDE VALUES

The distribution of electrical conductivity (E.C.) and chloride (Cl) values by soil groups and profile classes is given in microfiche 2, Tables 3.2, 3.2A and 3.3, 3.3A. The red earths (I, J, K), sands (L, M) and lithosols (N) have very low conductivity and chloride levels throughout the profile. They are non-saline . The mean values of conductivity and chloride at sample depths for the remaining soil groups are shown in Fig. 3.6 and 3.7 respectively.

The texture contrast soils (G, H) show similar mean profile trends for both conductivity and chloride. Values are low in the surface generally increasing down the profile. A few medium and high values were recorded at depth. These soils are non-saline.

The clay soils (A, B, C, D) show similar mean chloride trends down the profile, but have different mean conductivity trends, see Fig. 3.6, 3.7. Of these the alluvial clays (C, D) have similar mean profile trends for E.C. They are low in the surface increasing to some high and very high values at the base of the profile. The sharp increase in mean E.C. compared to chloride values beyond 60 cm is due to the occurrence of gypsum. These soils are non-saline in the surface with occasional saline subsoils at the base of the profile.

Gypsum occurs much higher in the profile of the brown and grey clays on the plains (A) and the red clays (B). This accounts for the sharp increase in mean E.C. just below the surface. The surfaces of these groups (A, B) are non-saline but approximately one third of the subsoils are saline at 60 cm or deeper. The higher E.C. values can be misleading when interpreting these groups as much of the value is due to gypsum, which due to its low solubility has only a small effect on the amount of salts actually present in the soil solution. The chloride levels give a more accurate assessment of salinity.

The desert loams (F) have low surface chloride values increasing sharply to high values in the 10-20 cm depth. The maximum mean value 0.23% Cl is reached by 60 cm. Conductivity values continue to increase beyond this depth due to increased gypsum content. The desert loams are usually non-saline in the surface 10 cm but the subsoils may be saline just below this depth.

The scalds and claypans (E) have high chloride values increasing sharply to 30 cm, where the maximum mean occurs. They are generally saline soils throughout the profile.

Both the desert loams (F) and the scalds and claypans (E) have low infiltration rates and water movement down the profile. This is reflected in maximum chloride levels occuring high in the profiles. As a result, permanent and economic reclamation of bare and scalded with high chloride levels will be difficult.

CATION EXCHANGE CAPACITY (C.E.C.)

The distributions of C.E.C./clay and C.E.C. values by soil groups and profile classes are given in microfiche 2, Tables 3.13, 3.14 and 3.13A and 3.14A.

The brown and grey clays (A) recorded a mean C.E.C./clay value in the surface of 81 m. equiv/100 g, (CV = 13%) with a mean for the rest of the profile of approximately 77 m. equiv/100 g, (CV = 15%). This indicates predominantly montmorillonite type clays occur in this group.

For the red and brown clays on alluvia (C) the seasonally scalded Powell SPC has a considerably lower C.E.C./clay (45 m. equiv./ 100 gm, CV = 12.4%) than the more stable and better grassed Blackwater SPC (57 m. equiv/100 gm CV = 8.6%). This is thought to be due to an increase in kaolinite type clay and a reduction in montmorillonite type. Little change in the content of any illite type clays is indicated since both profile classes have similar Total K/clay ratios.

Fig. 3.6 Mean Electrical Conductivity at Sample Depths for Soil Groups.

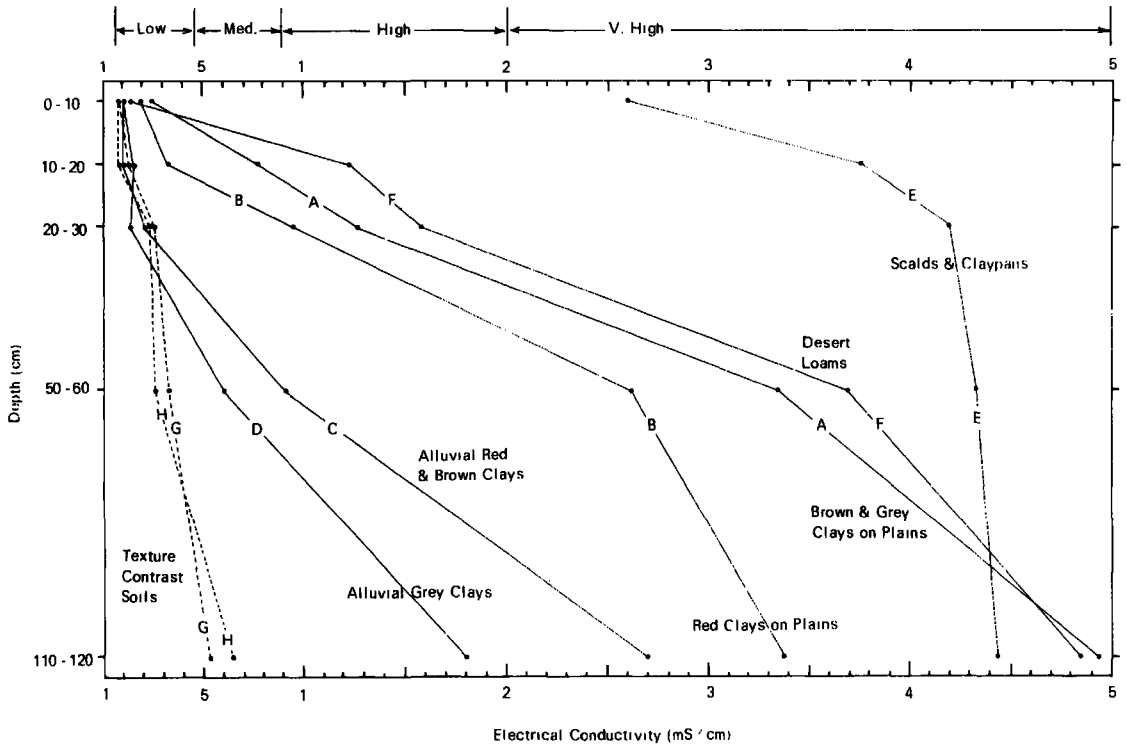
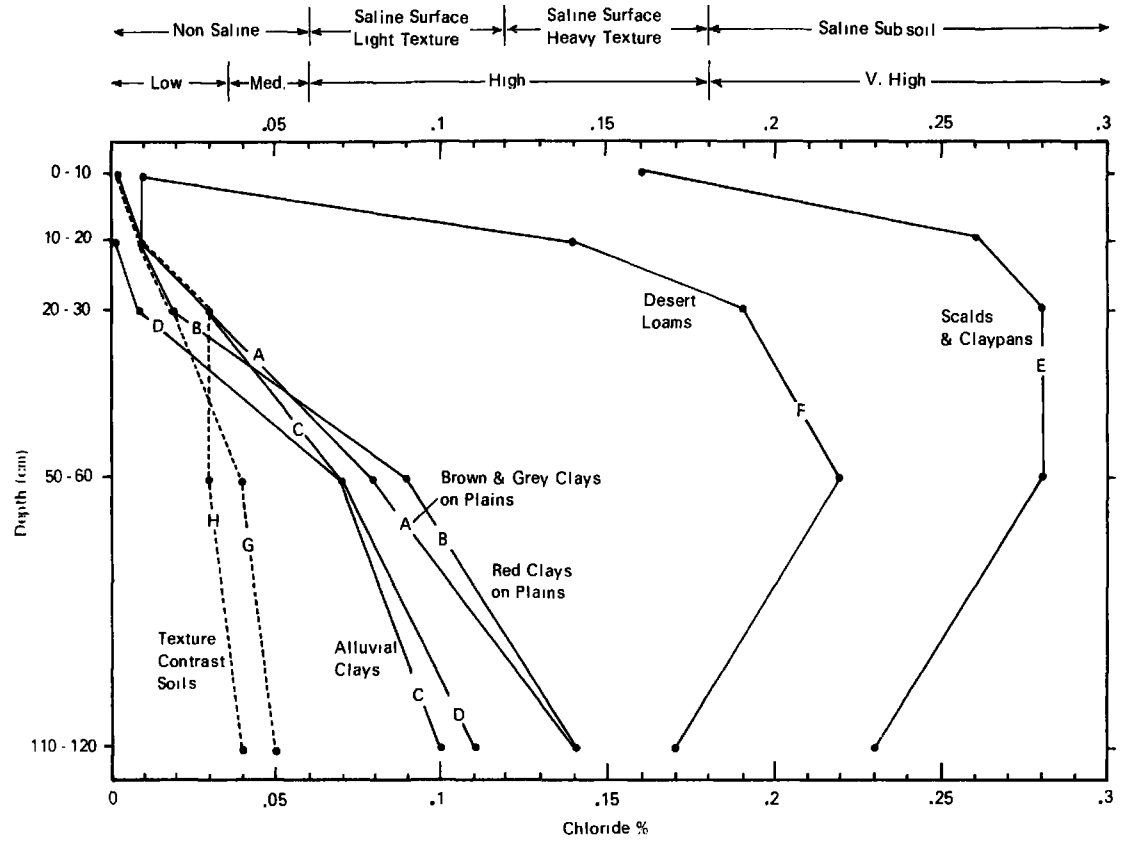


Fig. 3.7 Mean Chloride Values at Sample Depths for Soil Groups.



In the coarser textured soils, the contribution of organic matter to the C.E.C./clay ratio is much greater than in the fine textured soils. This accounts for the higher and more variable values encountered in the surface of these soils. Below the surface, the red earth soils (I, J, K), and earthy sands (L) have C.E.C./clay values <30 m. equiv/100 gm, indicating predominantly kaolinitic type clays. Some higher values were recorded at depth in Lynwood SPC in the deep red earths (I) associated with an increase in pH.

It is difficult to obtain accurate values on soils with low C.E.C. values. The C.E.C./clay ratio is subject to large errors when calculated on soils of low clay content. For this reason the siliceous and earthy sands have been omitted from Tables 3.13, 3.14, 3.13A, 3.14A in microfiche 2.

EXCHANGEABLE CATIONS

Distributions of exchangeable Ca, Mg, Na, K values by soil groups and profile classes as well as Ca/C.E.C., Mg/C.E.C. and Na/C.E.C. (E.S.P.) ratios are given in microfiche 2, Tables 3.9, 3.9A and 3.18, 3.18A - 3.23, 3.23A.

Calcium is the dominant cation in all soil groups. Calcium levels in the surface of the finer textured clay soils and most of the red earths are satisfactory for plant nutrition. The coarser textured soils of the Mons SPC of the texture contrast soils on alluvia (G) and the sandy red earths (K), earthy sands (L), siliceous sands (M) and lithosols (N), have low Ca and Mg levels. Deficiencies in these elements could occur in introduced pasture species on these soils.

Only 4% of surface exchangeable K values recorded were less than 0.2 m. equiv./100 gm, the value which Crack and Isbell (1970) consider necessary to avoid deficiency problems. Potassium deficiency is only likely on the coarser textured soils named above as possibly deficient in Ca and Mg.

Exchangeable Sodium Percentage (E.S.P) levels are negligible on the coarser textured soil of groups I-N. The finer textured soils group A-H are generally non-sodic in the surface, but values increase down the profile, most becoming sodic or strongly sodic by 120 cm. Sharpham and Essex SPC's and sites in Powell and Cumberoo SPC's were either sodic in the surface or sodic to strongly sodic by 30 cm. With the exception of Sharpham these SPC's generally have hardsetting surfaces. Careful management of surface cover on these soils is desirable to prevent sodicity increasing at or near the surface and causing further deterioration in surface condition.

PARTICLE SIZE ANALYSIS

Distributions of particle size values by soil groups and profile classes are given in Tables 3.15, 3.15A and 3.24 and 3.24A to 3.26 - 3.26A on microfiche 2.

For all soils groups, $^1/_3$ and 15 bar moisture values are strongly correlated with % clay, $r_{100} = 0.92^{***}$ and 0.91^{***} respectively. These factors were also strongly correlated for the red earth soils (I, J, K) the alluvial clays (C, D) and the brown and grey clays (A). However, available water capacity gave a lower correlation with clay % for all soils $r_{100} = 0.78^{***}$, than $^1/_3$ and 15 bar moisture, and was only weakly correlated with % clay for the alluvial clays (C, D) $r_{21} = 0.47^{*}$, and non-significant with the rest of the groups in Table 3.2.

In the red earth soils, silt was strongly correlated with $^1/_3$ and 15 bar moistures (r_{10} = 0.873*** and 0.887*** respectively), and less strongly with available water capacity (0.634*). This indicates that silt content influences the moisture characteristics of soils such as the red earths where clay contents are low.

The sandy red earths (K), earthy sands (L) and siliceous sands (M) have similar fine sand contents to the other soil groups but higher coarse sand contents. Coarse sand is usually >40% throughout the profile, with higher values (55-75%) in the surface. The high coarse sand content in the surface is thought to contribute to the relative stability of the sandplain areas. The coarse sand particles are relatively resistant to wind movement, and high infiltration rates minimize runoff and any associated water erosion.

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CHAPTER 4

VEGETATION

A thorough knowledge of vegetation is an essential pre-requisite to the formulation of sound land use policy in any country. This is particularly so in arid regions where the principal enterprise is a pastoral industry entirely dependent on maintaining the stability of acceptable native pastures.

Athough this area has been settled for over 100 years, little detailed data are available on the vegetation as a whole. The comments and notes on the vegetation by the early explorers formed a basis on which to build. Mitchell in 1846 during his fourth exploratory journey into arid Australia was the first known european to explore the area. Other notable explorers included Kennedy in 1848, Gregory in 1858, Landsborough in 1861-62, McKinlay in 1861-62, McIntyre in 1866, Gilmore in 1871 and Hodgkinson in 1876. Of these explorers, Mitchell and Gregory contributed most to our knowledge of vegetation.

Francis (1935) and Everist (1935) carried out the first vegetation studies in the area of any note when they investigated the problems associated with the inland pastures particularly in the Mitchell grass pastures in the east. However, the first major study was undertaken by Blake (1938) during his investigation of the vegetation of western Queensland. This study contained little quantitative data. Since then many other workers have added to our knowledge of the vegetation. The Mitchell grass (*Astrebla* spp.) pastures have been studied by Everist (1951, 1958, 1964) and Purcell and Lee (1970). A comprehensive review of existing knowledge of these pastures was published by Orr (1975). Little published data are available on the structure and floristics of the gidgee (*Acacia cambagei*) associations of the area. Bissett (1963) contributed to our knowledge of these associations as did Everist (pers. comm. and unpublished notes) but no published data are available from the latter worker. Everist (1949) and Boyland (1973) added to the knowledge of the mulga (*Acacia aneura*) lands and both these studies contained some quantitative data. Skerman (1947) carried out an investigation of the channel country and its adjoining lands contributing greatly to the descriptive knowledge of the vegetation but quantitative data were absent. Studies by Beeston (1978), Beeston and Webb (1977), Boyland (1974), Burrows and Beale (1969) and Roberts (1972) are also relevant to the vegetation of the area.

Many other investigators have carried out studies on the vegetation of the area. However, these studies have been orientated towards productivity of these associations in relation to the pastoral industry and contributed very little to the overall knowledge of the structure and floristics.

Several vegetation maps of the area have been prepared. Blake's account of the vegetation was accompanied by a map at a scale of 1: 2 800 000 (approximately). However, this map was preceeded by three other maps which covered the area as part of Australia. As pointed out by Blake (1938) these maps by Swain (1928), Prescott (1931) and McTaggart (1936) contain gross errors and inconsistency of nomenclature. Since 1938 many workers have mapped the vegetation of the area while mapping the vegetation of the Australian continent. These include Wood (1949), Williams (1955), Moore and Perry (1970) and Specht (1970). The most recent map was prepared by Carnahan (1976) at a scale of 1:6 000 000 and in spite of its scale is the most detailed to date.

The vegetation is composed of drought evading or drought resisting plants forming a number of vegetation types differing from each other in their appearance. Mainly they are low, structurally simple plant associations with a low projective foliage cover. The drought evading or drought resisting mechanisms exhibited by the plants to enable them to survive in the harsh climate include adaption of plant form, anatomical characters and physiological characters. These features have been discussed more fully by Shreve (1951), Everist (1964) and Kassas (1966).

ENVIRONMENTAL FACTORS

Climatic factors restrict which species may occur in the area but local distribution is controlled mainly by edaphic factors and topography.

As in other regions the most significant bioclimatic variable is the moisture regime which is a complex function of climatic, topographic and edaphic attributes. Precipitation and run-off are the principal sources of water. Flooding with run-off water from outside the area has a major influence in the channel country but is of little significance elsewhere. Dew as a moisture source is negligible.

Rainfall is highly variable in its incidence, total received and reliability. A considerable proportion of rainfall received occurs as isolated limited falls which are of no significance for plant growth. The importance of rainfall incidence as a factor governing the distribution of *Acacia aneura* has been postulated by Farmer, Everist and Moule (1947). Other workers including Davies (1968), Preece (1971) and Nix and Austin (1973) supplied additional evidence of the need for a winter component in the rainfall pattern if *Acacia aneura* is to survive. Other species which reflect the importance of the moisture regime include *Eucalyptus populnea* which tends to be replaced by *E. terminalis* with increasing aridity and similarly *Acacia harpophylla* is replaced by *A. cambagei*. The redistribution of rainfall in run-on areas is significant as evidenced by the increase in height and density of *Acacia aneura* in the run-on situation compared with *A. aneura* on adjacent lands with the same edaphic features. Skerman (1947) and to a lesser degree Boyland (1974) have discussed the effects of the incidence, type and duration of flooding on vegetation. Prolonged general flooding is more beneficial to the vegetation than localised flooding. Generally grasslands are the result of spring-summer flooding and forblands the product of autumn-winter flooding.

Sharp disjunctions between vegetation types are frequently associated with major changes in soil types so changes from *Acacia aneura* associations on red earths to *A. cambagei* associations on cracking clays are conspicuous. Sharp disjunctions between vegetation types are not always associated with major changes in soil type as evidenced in some alluvial situations by the prominent change from *Acacia harpophylla* associations to *A. cambagei* associations both growing on cracking clays. Past grazing pressures, fire, flooding, drought, chance establishment and the incidence of disease and pests must all be considered when explaining the distribution of plant associations in the area.

The nutrient status of the soils may limit the establishment of some species especially grasses but it is usually not as limiting as soil moisture. Generally the sand and loam textured soils are low in nutrients but the nutrient levels of clay soils are fair.

Fire has been part of the environment long before European settlement but it is likely that the frequency of fires has increased since settlement. In the west, fires are not a regular feature of the environment due to the paucity of dry matter in the ground layer and its poor ability to carry a fire. However in the east, fires are much more prevalent. The effect of fire depends on its intensity, the season of burning and the soil moisture status. There are no data available from definitive studies which would permit decisive statements to be made about the effects of fire on different vegetation. However from observations by other workers and those made during the investigation it is possible to comment on the effect of fire. The long term value of burning *Triodia basedowii* hummock grasslands is questionable as it may lead to loss in stability of the system. Usually the short term effect of burning is desirable from a grazing view point as it generally results in a wider range of species being available to stock. However, there is the threat of woody weed invasion by *Codonocarpus cotinifolius*, *Bodonaea* spp. and *Cassia* spp. or the establishment of undesirable grasses such as *Aristida* spp. as well as a possible loss of nutrients from the system. Observations by Everist (pers. comm.) indicate that burning *Astrebla* pastures is beneficial especially after a series of above

average rainfall seasons which result in a lack of forbs growing between the tussocks. Firing *Acacia aneura* associations and *Acacia cambagei* associations as a means of controlling young seedlings following mass germinations is practised in places with varying degrees of success. Fires can also destroy useful *A. aneura* pastures leaving an induced *Aristida* tussock grassland which is not as acceptable to some stock. Unquestionably burning and wise management is a useful tool but the timing of the burn is critical. The principles in the timing of the burn appear to be avoidance of detrimental effects on the seedset and establishment of desired species but at the same time lessening or destroying competition from other species (Moore, 1962).

The vegetation types conditioned as they are by climatic and edaphic factors could not have changed greatly during recent times. They may have lost or gained certain of the components with minor oscillations in climate but this would not have affected their permanancy or existence. However man as an ecological factor has had far reaching effects. The development associated with pastoral industries has resulted in the destruction of large areas of vegetation especially in *Acacia aneura* lands and *A. cambagei* lands leading to increased woody weed problems from *Eremophila gilesii* or *E. bowmanii* and *E. mitchellii* respectively. There is also the possibility of increasing the range of alien weeds such as *Xanthium pungens* and *X. spinosum* which reduce the productivity of pastures. Destruction of plants may result in a re-occupation of the area by sub-climax vegetation or in changes in composition. Changes in dominance such as *Eucalyptus populnea* becoming the dominant species in a previously *Acacia aneura, E. populnea* association may be caused by man's interference through cutting and overgrazing. Man is also capable of improving the grazing value of vegetation by manipulating the shrub and tree densities as shown by Beale (1973). However wise management and selective conservation is needed if representatives of all vegetation types are to persist in some semblence of the pristine state.

Classification of Vegetation

A unified classification of vegetation of far western Queensland is desirable so the approach used in WARLUS Part I has been adopted in Part II. Attributes useful in classifying vegetation are the stratification of communities, the spatial distribution of individuals and the presence and abundance of species. Considering these characters it was possible to recognize plant associations in the sense of Beadle and Costin (1952). Primary consideration was given to floristics and structural formation was considered to be of secondary importance. It is stressed that associations recognized are not discrete and species tend to overlap. Also,because arbitary divisions are applied to attributes of a continuous nature, this leads to a proliferation of associations as structural formation changes from woodlands through open woodlands to tall shrublands along environmental gradients. However this does not prevent the treatment of the vegetation from the association standpoint and in the present study this approach is considered highly desirable.

The structure of the vegetation at each site is classified using a modification (Table 4.1) of the scheme proposed by Specht (1970). This modification is not perfect but is a workable compromise. Modification was necessary to overcome some minor problems in using the scheme. Other workers (Pedley, 1974; Nix, 1977) also experienced difficulties in applying the scheme. However as pointed out by Nix, confusing and conflicting nomenclature has been eliminated from Specht's scheme and there is an excellent prospect of the scheme becoming widely accepted. In spite of this,observations in far western Queensland suggest there is a need for further divisions in the height categories of shrublands, a re-examination of the limits of projective foliage cover and also some further categories are necessary in order to cover phenomena such as patchy plains.

Emphasis has been placed on the distribition of the perennial species where practical as these tend to be of a more permanent nature and less likely to reflect minor variations in seasonal conditions. However, some non-woody perennial species such as *Astrebla* spp. and

Dichanthium spp. may reflect minor variations in seasonal conditions. In situations where perennial species are absent or sparse, classification was based on annual species. In these instances it is emphasized that variation in abundance and composition is dependent on seasonal conditions and also grazing to a lesser degree.

Where two or more strata are present, the associations are further qualified by a term describing the nature of the stratum which is secondary in contributing to the biomass. Terms used are wooded (referring to the presence of scattered trees in grassland), shrubby (shrubs conspicuous), grassy, herby and forby.

TABLE 4.1 STRUCTURAL FORMATIONS RECORDED (BASED ON SPECHT (1970))

LIFE FORM AND HEIGHT PREDOMINANT STRATUM *	PROJECTIVE FOLIAGE COVER OF PREDOMINANT STRATUM		
	Mid-dense (30-70)%	Sparse (10-30)%	Very Sparse (<10)%
Trees 10-30 m	open forest	woodland	open woodland
Trees < 10 m		low woodland	low open woodland
Shrubs 2-8 m		tall shrubland	tall open shrubland
Shrubs < 2 m		low shrubland	low open shrubland
Hummock grasses 0-2 m		hummock grassland	open hummock grassland
Tussock grasses		tussock grassland	open tussock grassland
Herbs	herbfield	open herbfield	sparse herbfield
Forbs	forbland	open forbland	sparse forbland

Predominant stratum is the layer which contributes most to the biomass. Tree is a woody plant more than 5 m tall usually with a single stem. Shrub is a woody plant less than 8 m tall either multi-stemmed or branched close to the ground level, infrequently with a single stem.

Major Structural Formations

Nineteen structural formations are present. These formations range from sparse herbfield to open forest (Table 4.1). Structural development of vegetation is closely related to available moisture. Open forests are confined to the main channels of major rivers where the moisture levels are highest while sparse hummock grasslands and sparse forblands occur on the crests of dunes in the west where the available moisture is minimal. Tall shrublands and tall open shrublands are the most widely distributed structural formations and together occupy 35% of the total area. Tussock grasslands and open tussock grasslands cover about 20% of the area with low shrublands and low open shrublands occupying about 15%. Both the woodlands and herbfields each cover about 10%. Forblands are the only other formation of any areal significance but would occupy less than 5% of the area. The approximate percentage of each broad structural formation occurring on the various major soil grouping according to Mills (see soil map) is given in Table 4.2. The woodlands reach their best development on clay soils whereas the shrublands are best developed on the red earths. The tussock grasslands are associated with the clays and the hummock grassland is restricted to the earthy sands and siliceous sands.

TABLE 4.2 DISTRIBUTION OF MAJOR STRUCTURAL FORMATIONS ON MAJOR SOIL GROUPINGS

(EXPRESSED AS PERCENT OF THE TOTAL AREA OF EACH FORMATION)

MAJOR SOIL GROUPINGS	MAJOR STRUCTURAL FORMATION GROUPINGS						
	Woodlands	Tall Shrublands	Low Shrublands	Hummock Grasslands	Tussock Grasslands	Herbfields	Forblands
Brown and grey clays on gently undulating plains	40	15	0	0	70	50	0
Red clays and desert loams	0	2.5	0	0	2.5	15	0
Red, brown and grey clays on alluvia and alluvial texture contrast soils	45	7.5	0	0	27.5	0	0
Grey clays of the Channel Country	2.5	0	15	0	0	35	50
Deep, red earths	5	15	0	0	0	0	0
Shallow, red earths	2.5	40	35	0	0	0	0
Sandy, red earths	0	10	0	0	0	0	0
Earthy sands and siliceous sands	0	5	0	100	0	0	50
Lithosols	5	5	50	0	0	0	0

Absolute uniformity is foreign to vegetation and pattern exists in vegetation at various scales. These scales range from large scale pattern between associations to small scale pattern within the association at the species level. In some situations both *Acacia aneura* and *A. harpophylla* exhibited characteristic patterns which were readily visible. As in WARLUS PART I (Boyland 1974), *A. aneura* formed groves which were distinct in some associations and diffuse in others. This groving was associated with differences in soil depths and other physical attributes. In very limited areas, *A. harpophylla* formed clumps on *Astrebla* tussock grassland giving an effect known locally as patchy plain brigalow. On these patchy plains there appeared to be no major physical differences between the soils supporting the *A. harpophylla* and those supporting *Astrebla* spp. However chemical analyses showed that the soils supporting *Acacia harpophylla* had higher salt levels at depth, higher bicarbonate extractable phosphorus and lower surface pH. No explanation for this phenomena is readily available.

Floristics and Phytogeography

Floristically the area is poor. Undoubtedly there are species which occur in the area that were not recorded because of their ephemeral nature, the limited field time and the fact that the area was not completely traversed and collected in detail. However, it is believed that major conclusions derived would not be affected greatly by these omissions.

Monocotyledons and dicotyledons predominate comprising 99% of the flora (Table 4.3). Pteridophyta are poorly represented and no Gymnosperms were recorded which is expected as Gymnosperms contribute little to the Australian flora as a whole. Thallophyta and Bryophyta were not considered in this study. Nomenclature followed is that used by the Queensland Herbarium (Catalogue of Plants, unpublished data).

TABLE 4.3 NO. OF FAMILIES, GENERA AND SPECIES RECORDED

	No. of families	No. of Genera	No. of Species	No. of Perennials
Dicotyledons	72	209	549	322
Monocotyledons	9	63	153	107
Pteridophyta	4	4	7	7
Total	85	276	709	436

Within the area 709 taxa (Appendix III) were recorded. These represent 276 genera belonging to 85 families. Of the species 436 are perennials. Gramineae and Leguminosae are the largest families being represented by 45 and 23 genera and 119 and 97 species respectively. Other families with relatively large species representation include Compositae, Chenopodiaceae, Malvaceae, Cyperaceae, Amaranthaceae and Myoporaceae. Families with five or more species recorded for the area are listed in Table 4.4 in order of numbers of species recorded. These 27 families contain 595 species which is in excess of 80% of species recorded. Of these 595 species, 361 are perennials which is approximately 80% of perennials recorded for the area.

Overall species density is about 1 species per 140 km^2. The equivalent figures for the Western Arid Region Land Use Study area (WARLUS I) and the Alice Springs area are 1 species per 240 km^2 (Boyland, 1974) and 1 species per 510 km^2 (Perry and Lazarides, 1962) respectively.

TABLE 4.4 FAMILIES REPRESENTED BY FIVE OR MORE SPECIES

Family	No. of Genera	No. of Species	No. of Perennials
Gramineae	45	119	86
Leguminosae	23	97	88
Compositae	25	66	1
Chenopodiaceae	11	61	42
Malvaceae	6	28	26
Cyperaceae	7	21	13
Amaranthaceae	4	20	3
Myoporaceae	2	20	20
Myrtaceae	4	16	16
Convolvulaceae	7	13	7
Goodeniaceae	4	13	8
Euphorbiaceae	3	13	4
Solanaceae	3	13	6
Cruciferae	5	11	0
Labiatae	8	10	7
Zygophyllaceae	2	9	4
Sterculiaceae	5	8	8
Umbelliferae	4	8	0
Aizoaceae	5	7	1
Proteaceae	2	7	7
Campanulaceae	3	6	0
Portulacaceae	2	6	2
Sapindaceae	3	6	6
Capparidaceae	2	5	5
Cucurbitaceae	3	5	1
Haloragidaceae	1	5	0
Scrophulariaceae	3	5	3

The distribution of the numbers of families, genera and species in the various land zones is illustrated in Table 4.5. A large percentage of the species recorded occur in the alluvial land zones although other land zones contribute substantially. This is not unexpected as a relationship usually exists between moisture-favoured sites and species diversity. More than 20% of species recorded in both the dunefields and the dissected residual land zones are restricted to their respective land zones. This reflects to some degree the need for adaption by species to exist in these specialized habitats.

In broad terms the flora is typical of other arid areas in Australia. The four families Gramineae, Leguminosae, Compositae and Chenopodiaceae contain almost 50% of the species recorded. As it lies to the immediate north of the WARLUS I, the flora is very similar to the flora of that area (Boyland, 1974) but the undulating downs land zone is more floristically diverse. This land zone is larger in extent and extensive areas of this zone in the east lie in a more favourable climatic area than in Part I. These facts combine with the series of above average rainfall seasons prior to the survey probably account for the larger number of species recorded. The overall composition of the flora is similar to that of the Alice Springs area (Perry and Lazarides, 1962) and that of the Simpson Desert and its immediate environs (Symon, 1969).

TABLE 4.5 DISTRIBUTION OF THE NUMBER OF FAMILIES, GENERA AND SPECIES IN THE VARIOUS LAND ZONES

Land Zone	Dunefields	Mulga Sand Plains	Soft Mulga	Hard Mulga	Dissected Residuals	Undulating Gidgee	Undulating Downs	Alluvial Plain Woodlands	Channel Country	Other Alluvia
No. of Families	53	31	45	45	39	38	47	59	30	46
No. of Genera	145	78	115	97	79	101	125	155	73	123
No. of Species	261	118	217	162	154	171	212	301	106	218
% of Total Species Recorded	36.9	16.7	30.7	23.0	21.8	24.2	30.0	42.6	15.0	30.7
No. of Species Recorded only from One Zone	67	4	10	2	35	8	23	36	3	15
% of Species Restricted to a Zone	25.7	3.4	4.6	1.2	22.7	4.7	10.8	12	2.8	6.9
Approx. Area of Land Zone km^2	7360	3140	5080	6550	18490	10310	23300	9040	8900	6460

Although less than 10% of the Queensland flora has been recorded from this area it is of phytogeographic interest. Within the area major disjunctions of vegetation types occur and several species reach their distributional limits. In a comprehensive account of the phytogeography of Australia based on climatic and detailed taxonomic data, Burbidge (1960) places most of the area (approximately 65%) in the Eremaean Zone. The remainder lies in an interzone between the Eremaean zone and the Tropical zone. More recently in a much broader study using dominant and characteristic species of the vegetation, Doing (1970) allocated approximately 70% of the area to the Northern Mulga Province, most of the remainder falling in the Eastern Mulga Province and less than 1% in the Eastern Desert Province.

According to Burbidge (1960) the flora of the Eremaea, has certain features which suggest that many of its characteristic elements may be of relatively recent development. Observations within the area support this statement of Burbidge. There is a low number of endemic species which tends to reflect that little speciation has occurred and most species have migrated from adjoining areas to fill available niches. A large number of species are eremaean wides with sub-humid eastern Australian species and tropical or sub-tropical northern species contributing to a lesser degree. Temperate species are not prominent in the vegetation but some do occur as do a limited number of widespread species which appear to have no affinities with any specific climatic zone.

The composition of the genus *Acacia* reflects the overall composition of the flora to a large degree. The species of *Acacia* present can be divided into several broad groups based on the regions where that species is best developed according to Pedley (pers. comm.). These groups are the northern element, the eremaean element, both northern and southern, the eastern element, an endemic element and a wide spread element with no specific affinities. Over 33% of the *Acacia* species fall into the eremaean element, about 25% belong to the eastern element and 17.5% to the northern element. About 10% are widespread species occurring in a wide range of climatic zones. There are no true endemics to the area but *A. petraea, A. ensifolia* and *A. cyperophylla* could be considered as endemics as these species are confined to the area and its immediate environs. A large percentage of the northern element reach their southern distribution limit in the area and most of the eastern element attain their western distributional limit. The eremaean element is a mixture with species such as *A. aneura, A. murrayana* and *A. clivicola* being widespread and the area having no significance with regard to the limits of their range. However, some species with southern eremaean affinities, *A. brachystachya* and *A. calcicola*, do reach their northern limit and *A. dictyophleba* and *A. kempeana*, with northern eremaean affinities reach their eastern limit. *A. sparsiflora* is of particular interest as it occurs well west of its usual range in a gorge, the microclimate of which, appeared more humid than that of the surrounding country. This occurrence is probably a relic of a much wider distribution in the past.

Acacia is the dominant tree or shrub genus occurring as a dominant in plant associations which cover approximately 60% of the total area. Although 35 species of *Acacia* were recorded only five species, *A. aneura, A. cambagei, A. cana, A. clivicola* and *A. harpophylla*, are significant in terms of areal extent. These five species are either dominants or co-dominants in 95% of the *Acacia* predominant associations. The area dominated by these species is given in Table 4.6. Of these five species *A. aneura* is the most common. Besides having a wide geographical range it tolerates a wide range of soil types from siliceous sands to red clays but is best developed on the red earths.

TABLE 4.6 AREAS DOMINATED BY *ACACIA* SPECIES

Species	Area of Associations Dominated by Species km^2	Area of Associations in which Species is Co-dominant km^2	% OF TOTAL AREA IN WHICH SPECIES IS DOMINANT OR CO-DOMINANT
Acacia aneura	16 300	12 600	29
Acacia cambagei	14 300	4 000	18
Acacia clivicola	3 600	7 500	11
Acacia cana	2 400	3 000	5
Acacia harpophylla	600	150	<1

Eucalyptus predominant associations occupy less than 5% of the area. Only 13 species were recorded for the area which lends support to the observation of Perry and Lazarides (1962) that in general *Eucalyptus* spp. are not well represented in that part of Australia north of the southern 250 mm (winter maximum) isohyet and south of the northern 375 mm (summer maximum) isohyet. Of the 13 species only *E. camaldulensis, E. microtheca, E. ochrophloia, E. populnea* and *E. terminalis* dominate or co-dominate plant associations of any areal significance. Of these *E. microtheca* is most commonly associated with alluvial land zones but *E. terminalis* would be the most widespread occurring on most soil types except for the deep cracking clays. Species including *E. exserta, E. melanophloia, E. normantonensis, E. polycarpa, E. tessellaris* and *E. thozetiana* are restricted to specific habitats and occur very infrequently. Most species recorded have extensive distributions further north or to the east but unlike the genus *Acacia* there are no species with southern temperate affinities.

The genus *Eremophila* is well represented with 18 species recorded. The genus occurs in all land zones but reaches its best expression in the dunefields and hard mulga land zones where 8 species were recorded for each zone. Members of this genus are the major problem species of the region. *E. gilesii* and *E. bowmanii* are associated with the mulga land zones and *E. mitchellii* is associated with the gidgee land zone. All are capable of substantially reducing the productivity from a grazing viewpoint.

Grasses occur in almost all plant associations except some forblands developed on salinas and playas. *Astrebla* is the most important grass genus as it is predominant in the ground layer over about 30% of the total area. *Astrebla* spp. are dominant in tussock grasslands which occupy about 20 000 km^2 and in the ground layer of various open woodlands covering about 8 000 km^2. Although *Triodia basedowii* is the principal component grass in hummock grasslands which are about 6 500 km^2 in extent, *Aristida* spp. and *Eragrostis* spp., the predominant species in the ground layer of *Acacia aneura* associations, probably cover more area. *Eragrostis* (16 spp.) and *Aristida* (15 spp.) are the genera with the most number of species recorded. Forbs also are abundant and large genera include *Bassia* (21 spp.), *Cyperus* (14 spp.), *Atriplex* (13 spp.), *Ptilotus* (13 spp.) and *Calotis* (11 spp.). Many forbs are ephemerals, especially members of Compositae, and their presence is dependent on seasonal conditions.

DESCRIPTION OF VEGETATION

The basic unit of description is the plant association. These associations are placed in one of the following major floristic groupings and ordered according to structural formation.

Eucalyptus spp. predominant associations
Acacia cambagei predominant associations
Acacia aneura predominant associations
Other *Acacia* predominant associations
Shrubby Chenopod predominant associations
Triodia spp. predominant associations
Astrebla spp. predominant associations
(a) non-wooded
(b) wooded
Forb, short grass predominant association
Miscellaneous associations.

Floristic associations within each major grouping are given in Table 4.7 with reference to their structural formation range, height range, projective foliage cover, tree and shrub density and frequently occurring species. Broad habitat preferences and principal soil groups are outlined. It is intended that the various land unit descriptions supplement this account and cross reference is given. To avoid a lengthy and complex account unusual vegetation types of minor areal extent have been covered in closely related plant associations. Also where a floristic grouping occurs mainly as one structural formation but does exhibit other formations in limited areas then the floristic grouping is not further divided on structural grounds. However, the range of structural formations is given. If a floristic grouping has extensive areas of various formations then these are dealt with separately. Discussion is limited to natural vegetation. Little data were collected on induced associations of bore drains or stock routes.

The vegetation map included with this report is based on an amalgamation of various land systems containing similar predominant vegetation. The land systems recognized usually have one major vegetation group predominant with other vegetation associations making only a minor contribution. Because of this and the scale of the map, 1:1 000 000, the amalgamation of various land systems based on the predominant vegetation type is acceptable. In land systems where two vegetation types make a significant contribution to the vegetation this is mapped as a complex. In these instances it is not practical to distinguish the two types because of the scale of the map.

Eucalyptus spp. predominant associations.

Associations dominated by various species of *Eucalyptus* occupy less than 5% of the area but contribute significantly to the flora of the region.

These associations (Table 4.7) occur mainly on the alluvial plains on red, brown and grey clays and alluvial texture contrast soils. They are best developed along the Bulloo, Barcoo, Thomson, Diamantina Rivers and Cooper Creek but occur in varying degrees of complexity along all rivers and major creeks of the area. Limited areas of *Eucalyptus* associations are found on pediments and eroded slopes of the dissected residuals, on red and brown texture contrast soils of mulga land zones and also associated with claypans in the dunefields.

Structurally these associations range from open forest to low open woodland with open woodland the most common formation. Various other strata may be conspicuous and these vary from a pronounced grass ground layer to a tall shrubland or a combination of several giving a layered effect. The structural development of these associations is closely related to available moisture and the low open woodlands are developed in areas subject to the greatest seasonal moisture stresses.

Various species of *Eucalyptus* predominate depending on local variation in habitat. The most extensive association is the *E. camaldulensis, E. microtheca* open woodland. Floristically these associations are relatively rich with approximately 45% of all species recorded for the study area occurring in these associations. However, species diversity of the associations declines rapidly with increasing aridity.

TABLE 4.7 DESCRIPTION OF FLORISTIC ASSOCIATIONS

Floristic Association	Structural Formation Range, Height, PFC, Density Data	Other Frequently Occurring Species	Comments
PREDOMINANT ASSOCIATIONS			
Eucalyptus camaldulensis, E. microtheca	Open woodland to open forest infrequently low open woodland. Height: 14 ± 6 m. PFC: 15 ± 10%. Density: Trees/ha: 300 ± 200. Tall shrubs/ha: 40 ± 20. Low shrubs/ha: 40 ± 30.	Trees: *Lysiphyllum gilvum, Melaleuca linariifolia.* Tall shrubs: *Acacia stenophylla, Eremophila bignoniiflora.* Low shrubs: *Cassia nemophila* var. *nemophila, Chenopodium auricomum, Muehlenbeckia cunninghamii, Myoporum acuminatum.* Graminoids: *Chloris pectinata, Chrysopogon fallax, Cyperus bifax, C. dactylotes, C. difformis, C. exaltatus, C. iria, C. victoriensis, Dichanthium sericeum, Eragrostis* spp., *Eulalia fulva, Leptochloa digitata, Lomandra longifolia, Paspalidium jubiflorum.* Forbs: *Aeschynomene indica, Alternanthera nodiflora, Atriplex* spp., *Bassia* spp., *Boerhavia diffusa, Centipeda thespidioides, Hakea* spp., *Psoralea* spp.	Widespread on the levees and banks of major drainage channels. Soils are very deep, grey and brown clays and alluvial soils. Floristics and structure vary. A well defined tall shrub layer is usually present but a well developed low shrub layer is rarely conspicuous. Ground cover varies greatly. Floristic composition variable. Characteristic of unit 70. Occurs in land systems W1, W2, W4, C1, C3.
Eucalyptus microtheca	Low open woodland to woodland. Height: 10 ± 5 m. PFC: 7.5 ± 2.5%. Density: Trees/ha: 80 ± 40. Tall shrubs/ha: (variable) <40. Low shrubs/ha: (variable) 60 ± 60.	Trees: *Lysiphyllum gilvum.* Tall shrubs: *Acacia stenophylla, Eremophila bignoniiflora.* Low shrubs: *Acacia farnesiana, A. victoriae, Chenopodium auricomum, Muehlenbeckia cunninghamii.* Graminoids: *Astrebla lappacea, Brachyachne convergens, Cyperus betchei, C. bifax, C. victoriensis, Chloris pectinata, Dactyloctenium radulans, Dichanthium* spp., *Eragrostis setifolia, L. tenellula, Iseilema membranaceum, I. vaginiflorum, Leptochloa digitata, Panicum decompositum, Sporobolus actinocladus, S. mitchellii.* Forbs: *Aeschynomene indica, Alternanthera nodiflora, Bassia quinquecuspis, Boerhavia diffusa, Centipeda thespidioides, Commelina cyanea, Malvastrum americanum, Hakea* spp., *Portulaca* spp., *Salsola kali.*	Widespread; associated with braided channels on alluvial plains. Soils are deep, grey and brown cracking clays. Sand and silt bands are common in the profile. Scattered tall shrubs and low shrubs occur, the low shrubs forming a well defined layer in places. Floristics are variable. Characteristic of units 71, 76. Occurs mainly in land systems W1, W3, with minor occurrences in land systems W2, W6, W7, A1, A2, A5, A6, C3, S1.
Eucalyptus ochrophloia	Low open woodland to woodland. Height: 8 ± 3 m. PFC: 15 ± 10%. Density: Trees/ha: 250 ± 200. Low shrubs/ha: 700 ± 500.	Tall shrubs: *Acacia cambagei, Eremophila mitchellii.* Low shrubs: *Cassia nemophila* var. *nemophila, Eremophila mitchellii, E. maculata.* Graminoids: *Chloris pectinata, Dactyloctenium radulans, Enteropogon acicularis, Eragrostis setifolia, Eriochloa pseudoacrotricha.* Forbs: *Hakea* spp., *Bassia* spp., *Boerhavia diffusa, Malvastrum americanum; Hakea drummondii, Salsola kali, Solanum* spp.	Limited in extent. Associated with flat alluvial plains and with braided channels. Soils are a complex of deep to very deep, red and brown alluvial texture contrast soils and brown, grey clays on alluvia. In places a well developed lower shrub layer occurs. *Arthrocnemum* spp. and *Pachycornia tenuis* may form a well defined lower shrub layer usually with little ground cover present. Ground cover is variable but usually not greater than 10% PFC. Characteristic of unit 84. Occurs mainly in land system W6 with minor occurrences in M2 and W4.
Eucalyptus terminalis	Low open woodland. Height: 8 ± 2 m. PFC: 1%. Density: Trees/ha: 40 ± 20. Low shrubs/ha: <50.	Trees: *Atalaya hemiglauca* (in places), *Grevillea striata.* Shrubs: *Acacia tetragonophylla, Cassia oligophylla.* Graminoids: *Brachyachne convergens, Chloris pectinata, Dactyloctenium radulans, Eragrostis eriopoda, E. tenellula, Aristida dichotoma, Iseilema membranaceum, Sporobolus australasicus, Thareda australis.* Forbs: *Amaranthus mitchellii, Atriplex vesicaria, A. vesicarioides, A. spongiosa, Acalypha eremorum, Boerhavia diffusa, Euphorbia drummondii, Ipomoea polymorpha, Malvastrum americanum, Pimelea trichostachya, Ptilotus macrocephalus, P. polystachyus.*	Limited in extent. Associated with flat plains found in run-on situations. Soils are shallow to moderately deep, red clays with small areas of texture contrast soils where sand encroaches. The tree, tall shrub layer is usually well defined but in places the association approaches a wooded open tussock grassland. Low shrubs are scattered and rarely form a well defined layer. Ground flora is variable depending on seasonal conditions. Characteristic of unit 89. Occurs in land systems S3 and A7.
Eucalyptus trivalvis, Acacia microsperma	Open woodland. Height: 13 ± 2 m. PFC: <5%. Density: Trees/ha: 175 ± 75. Tall shrubs/ha: 300 ± 200. Low shrubs/ha: 1000 ± 800.	Tall shrubs: *Acacia aneura.* Low shrubs: *Acacia aneura, Apophyllum anomalum, Cassia nemophila* var. *nemophila, Enchylaena tomentosa, Eremophila mitchellii.* Graminoids: (infrequent) *Digitaria* spp., *Enteropogon acicularis, Sporobolus australasicus.* Forbs: *Bassia* spp., *Hibiscus sturtii, Maireana* spp., *Salsola kali, Solanum* spp.	Limited in extent. Restricted to the lower slopes of dissected tablelands, mesas and buttes. Soils are very shallow, gravelly red earths. Strata are well defined; the low shrub layer being quite dense in places. Ground flora is sparse composed mainly of forbs. Characteristic of unit 33. Occurs in land systems R1, R6, G2 and G4.

Table 4.7 Description of Floristic Associations

Floristic Association	Structural Formation Range, Height, PFC, Density Data	Other Frequently Occurring Species	Comments
Eucalyptus populnea	Open woodland (rarely low open woodland). Height: 11 ± 2 m. PFC: 3 ± 2%. Density: Trees/ha: 40 ± 20. Tall shrubs/ha: 40 ± 20. Low shrubs/ha: usually < 10, in places up to 1000.	Tall shrubs: *Eremophila mitchellii.* Low shrubs: *Cassia artemisioides.* Graminoids: *Aristida* spp., *Bothriochloa ewartiana, Chloris pectinata, Eragrostis kennedyae, Themeda australis.* Forbs: *Alternanthera nodiflora, Bassia birchii, Evolvulus alsinoides, Malvastrum americanum, Solanum* spp.	Limited in extent. Associated with run-on areas and drainage lines on gently undulating plains of low relief. Soils are deep to very deep, red texture contrast soils. In places a tall shrub layer may be conspicuous. Scattered low shrubs usually occur and in places form a well defined low shrub layer. In situations where the association has been disturbed *Eremophila mitchellii* becomes very conspicuous with densities up to 1150/ha. Characteristic of unit 13. Occurs in land system S1 and H4 with limited occurrences in M2.
Eucalyptus populnea, Acacia aneura	Low open woodland to woodland. Height: 10 ± 2 m. PFC: 10 ± 5%. Density: Trees/ha: 300 ± 200. Tall shrubs/ha: (variable) 300 ± 300. Low shrubs/ha: 25 ± 20.	Tall shrubs: *Eremophila mitchellii.* Low shrubs: *Eremophila gilesii.* Graminoids: *Aristida armata, A. ingrata, Digitaria ammophila, D. brownii, Enteropogon acicularis, Eragrostis kennedyae, E. setifolia, Fimbristylis dichotoma, Monachather paradoxa, Panicum decompositum, Tripogon loliiformis.* Forbs: *Bassia bicornis, B. quinquecuspis, Boerhavia diffusa, Cheilanthes sieberi, Convolvulus erubescens, Evolvulus alsinoides, Goodenia lunata, Ptilotus macrocephalus, Solanum esuriale, Vittadinia sulcata.*	Restricted to the east. Associated with run-on areas on flat plains of very low relief. Soils are deep to very deep, red and brown texture contrast soils with acid loamy-surfaced soils overlying clay subsoils. In places a well defined tall shrub layer is conspicuous. Scattered low shrubs occur. Ground cover is variable. In places *A. aneura* becomes dominant or co-dominant. Characteristic of unit 12. Occurs in land system M2 with minor occurrences in R1.
Eucalyptus normantonensis, Triodia spp.	Tall open shrubland. Height: 4.5 ± 1.5 m. PFC: < 5%. Density: Tall shrubs/ha: 125 ± 75. Low shrubs/ha: < 50.	Trees: *Eucalyptus papuana* (in places), *E. thozetiana* (in places). Tall shrubs: *Acacia ensifolia* (scattered). Low shrubs: *Acacia ligulata* (broad leaf form), *Cassia helmsii.* Graminoids: *Aristida contorta, Enneapogon polyphyllus, Eriachne mucronata, E. pulchella, Triodia longiceps* (in places), *T. pungens.* Forbs: *Maireana triptera, M. villosa, Salsola kali.*	Limited in extent. Restricted to the slopes of dissected residuals. Soils are very shallow, stony lithosols with areas of weathered rock outcropping. In places *Eucalyptus papuana* and less frequently *E. thozetiana* may occur. The lower shrub layer is usually poorly developed. A variant of unit 28. Occurs in land systems R3 and R7.
Eucalyptus cambageana, Acacia aneura	Low open woodland to open woodland. Height: 9 ± 3 m. PFC: 6 ± 3%. Density: Trees/ha: 100 ± 50. Tall shrubs/ha: (variable) 150 ± 100. Low shrubs/ha: usually < 50.	Low shrubs: *Cassia artemisioides, C. nemophila* var. *nemophila, Enchylaena tomentosa.* Graminoids: *Aristida* spp., *Enteropogon acicularis, Eragrostis* spp. Forbs: *Bassia birchii, B. paradoxa, Sida* spp., *Salsola kali.*	Limited in extent. Restricted to the north east on lower slopes of gentle rises and dissected residuals. Soils are red, texture contrast soils with some stone in places. A low shrub layer is not usually well defined. Ground flora is usually poor with limited cover. Occurs in land system M2 with minor occurrences in M4 and G6.
ACACIA CAMBAGEI PREDOMINANT ASSOCIATIONS			
Acacia cambagei	Shrubby open woodland rarely low open woodland. Height: 11 ± 2 m. PFC: 5 ± 4%. Density: Trees/ha: 250 ± 175. Low shrubs/ha: 800 ± 700.	Trees: *Flindersia maculosa, Lysiphyllum gilvum, Ventilago viminalis.* Low shrubs: *Apophyllum anomalum, Carissa ovata, Cassia artemisioides, C. oligophylla, Enchylaena tomentosa, Eremophila mitchellii.* Graminoids: *Brachyachne convergens, Chloris pectinata, Dactyloctenium radulans, Enteropogon acicularis, Eragrostis setifolia, Sporobolus actinocladus, S. caroli, Tragus australianus, Tripogon loliiformis.* Forbs: *Abutilon otocarpum, Atriplex spongiosa, Bassia cornishiana, B. lanicuspis, B. ventricosa, Boerhavia diffusa, Chenopodium rhadinostachyum, Evolvulus alsinoides, Portulaca* sp. aff. *P. oleracea, Salsola kali, Trianthema triquetra.*	Occurs on flat alluvial plains associated with the major rivers in the north east and central north. Soils are very deep, texture contrast soils predominantly with loamy sands and sandy loams overlying sandy clays. Low shrubs especially *Carissa ovata* are usually conspicuous forming a well defined layer. Ground cover is variable, composed of grasses and forbs. Characteristic of unit 93. Occurs mainly in land system S5 with minor occurrences in W4, W6, W7 and A4.
Acacia cambagei	Low open woodland to low woodland. Height: 7 ± 2 m. PFC: 12.5 ± 7.5%. Density: Trees/ha: 1125 ± 875. Tall shrubs/ha: 100 ± 100. Low shrubs/ha: 30 ± 20.	Trees: *Flindersia maculosa, Geijera parviflora, Heterodendrum oleifolium, Santalum lanceolatum.* Tall shrubs: *Eremophila mitchellii.* Low shrubs: *Apophyllum anomalum, Enchylaena tomentosa.* Graminoids: *Astrebla lappacea, Brachyachne convergens, Dactyloctenium radulans, Enneapogon avenaceus, E. pallidus, E. polyphyllus, Enteropogon acicularis, Eragrostis setifolia, Paspalidium constrictum, Sporobolus australasicus, S. caroli.*	Occurs in the north east on flat to gently undulating plains commonly with weak gilgai development. Soils are deep to very deep, brown cracking clays. Usually scattered tall shrubs and low shrubs occur and infrequently the tall shrubs form a well defined layer. Ground cover is variable. Characteristic of unit 38. Occurs in land systems T1 and T3.

Table 4.7 Description of Floristic Associations

Floristic Association	Structural Formation Range, Height, PFC, Density Data	Other Frequently Occurring Species	Comments
		Forbs: *Abutilon malvifolium, Atriplex muelleri, Bassia divaricata, B. quinqueouspis, Boerhavia diffusa, Commelina cyanea, Euphorbia drummondii, Flaveria australasica, Justicia procumbens, Phyllanthus maderaspatensis, Portulaca* sp.aff. *P. oleracea, Ptilotus exaltatus, Salsola kali, Sida fibulifera, S. trichopoda, Trianthema triquetra.*	
Acacia cambagei, Eremophila mitchellii	Shrubby low open woodland. Height: 8 ± 2 m. PFC: <5%. Density: Trees/ha: 125 ± 75. Tall shrubs/ha: 80 ± 40. Low shrubs/ha: 400 ± 350.	Low shrubs: *Apophyllum anomalum, Cassia artemisioides, C. nemophila* var. *nemophila, Enyahlaena tomentosa, Eremophila polyclada, Myoporum deserti.* Graminoids: *Dactyloctenium radulans, Enteropogon acicularis, Iseilema membranaceum, Sporobolus australasicus, Tripogon loliiformis.* Forbs: *Bassia birchii, Boerhavia diffusa, Malvastrum americanum, Portulaca* sp. aff. *P. oleracea, Ptilotus* spp., *Salsola kali.*	Occurs on flat to sloping plains at the foot of scarp retreat zones in the south east. Soils are mainly shallow red clays but brown cracking clays also occur. Tall shrubs and low shrubs are conspicuous and the latter frequently forms a distinct layer. In places *Myoporum deserti* tends to be co-dominant particularly associated with the brown cracking clays. Ground flora is variable but usually the cover is sparse. Characteristic of units 45 and 44. Mainly occurs in land systems R6 and M2 with minor occurrences in land system G2.
Acacia cambagei	Shrubby tall open shrubland infrequently low open woodland. Height: 5.5 ± 1.5 m. PFC: 7.5 ± 2.5% in places <5%. Density: Tall shrubs/ha: 300 ± 200. Low shrubs/ha: 300 ± 300.	Trees: *Eucalyptus microtheca* (in flooded situations). Low shrubs: *Cassia desolata, C. oligophylla, Eremophila bignoniiflora, E. maculata.* Graminoids: *Cyperus gilesii, Chloris pectinata, Dactyloctenium radulans, Eragrostis tenellula, Sporobolus actinocladus, S. mitchellii, Uranthoecium truncatum.* Forbs: *Abutilon malvifolium, Atsmanthera nodiflora, Bassia lanicuspis, Boerhavia diffusa, Portulaca* sp. aff. *P. oleracea, Trianthema triquetra.*	Occurs on flat alluvial plains with low ridges and in places numerous braided channels. It is widespread throughout the area but best expressed in western situations. Some sites are subject to periodic flooding and these areas support *Eucalyptus microtheca* and *Acacia stenophylla.* Soils are very deep to deep, red and brown cracking clays. Density of both tall and low shrubs varies greatly. The ground flora is very variable and depends greatly on seasonal conditions. Following favourable seasons *Astrebla* spp. may be conspicuous. *Chenopodium auricomum* may occur in flooded depressions. Characteristic of units 79 and 82. Occurs in land systems W4, W6, W7 and R7 with minor occurrences in land systems A1, A2, A4 and A5.
Acacia cambagei	Tall open shrubland to tall shrubland. Height: 5.5 ± 1.5 m. PFC: 10 ± 5%. Density: Tall shrubs/ha: 700 ± 500. Low shrubs/ha: 25 ± 25.	Trees,tall shrubs: *Flindersia maculosa, Santalum lanceolatum.* Low shrubs: *Enchylaena tomentosa, Eremophila mitchellii.* Graminoids: *Dactyloctenium radulans, Enneapogon pallidus, E. polyphyllus, Enteropogon acicularis, Sporobolus actinocladus, S. caroli.* Forbs: *Abutilon malvifolium, A. oxycarpum, Amaranthus mitchellii, Atriplex muelleri, Bassia divaricata, B. lanicuspis, Boerhavia diffusa, Hibiscus trionum, Portulaca* sp. aff. *P. oleracea, Salsola kali, Sida fibulifera, S. trichopoda, Trianthema triquetra.*	Occurs on gently undulating to undulating plains with varying degrees of gilgai microrelief. It is best expressed in the north east. Soils are deep to very deep, reddish-brown to brown cracking clays with stony surfaces in places. Density of the shrub layer varies greatly. Scattered low shrubs occur but do not form a well defined layer. Ground cover is very variable. Both grasses and forbs occur with the latter tending to be pre-dominant. Characteristic of units 39, 40 and 41. Occurs in land systems G2 with known occurrences in land systems G1, R1, R5 and T5.
Acacia cambagei	Shrubby tall open shrubland to tall shrubland. Height: 4.5 ± 1.5 m. PFC: 7 ± 5%. Density: Tall shrubs/ha: 300 ± 250. Low shrubs/ha: 450 ± 450.	Trees,tall shrubs: *Eremophila mitchellii* (in the east). Low shrubs: *Cassia artemisioides, C. desolata, C. phyllodinea, Eremophila oppositifolia* var. *rubra.* Graminoids: *Brachyachne convergens, Chloris pectinata, Dactyloctenium radulans, Enneapogon polyphyllus, Sporobolus actinocladus, S. australasicus, Tripogon loliiformis.* Forbs: *Abutilon malvifolium, Atriplex lindleyi, Bassia bicornis, B. cornishiana, B. divaricata, B. lanicuspis, B. tricuspis, Chenopodium rhadinostachyum, Maireana triptera, Portulaca* sp. aff. *P. oleracea, Salsola kali, Trianthema triquetra.*	Occurs mainly in the west on undulating to flat plains with weak gilgai microrelief. Soils are variable, shallow to moderately deep, reddish brown cracking clays to shallow gravelly red desert loams. A low shrub layer is well developed in places. Ground flora is variable depending on seasonal conditions. Characteristic of units 42 and 43. Occurs in land system G3 with minor occurrences in land systems H1, R3, R4, F2, F3 and F4.

Table 4.7 Description of Floristic Associations

Floristic Association	Structural Formation Range. Height, PFC, Density Data	Other Frequently Occurring Species	Comments
Acacia cambagei	Tall open shrubland. Height: 3.5 ± 0.5 m. PFC: <5%. Density: Tall shrubs/ha: 100 ± 50.	Graminoids: *Aristida jerichoensis, Eragrostis xerophila, Bothriochloa ewartiana, Sporobolus actinocladus, S. australasicus.* Forbs: *Atriplex lindleyi, A. spongiosa, Bassia divaricata, B. lanicuspis, Portulaca* sp. aff. *P. oleracea, Salsola kali, Sida trichopoda, Threlkeldia proceriflora, Trianthema triquetra.*	Occurs on flat to gently undulating plains in the west. Soils are shallow brown cracking clays. Tall shrubs are stunted. Low shrubs are not usually present. Ground cover is variable depending on seasonal conditions. Characteristic of unit 47. Occurs in land system R7.
Acacia harpophylla, A. cambagei	Shrubby low open woodland. Height: 8 ± 2 m. PFC: 7.5 ± 2.5 %. Density: Trees/ha: 550 ± 110. Low shrubs/ha: 700 ± 500.	Trees: *Flindersia maculosa.* Low shrubs: *Apophyllum anomalum, Enchylaena tomentosa, Eremophila mitchellii, Rhagodia parabolica.* Graminoids: *Enneapogon pallidus, Enteropogon acicularis.* Forbs: *Salsola kali, Sida trichopoda, Trianthema triquetra.*	Occurs in the east on gently undulating plains with weak gilgai microrelief. Soils are deep to very deep, brown cracking clays. Low shrubs are present and frequently form a well defined layer. Ground cover is variable composed of grasses and forbs. *Cenchrus ciliaris* is conspicuous in places. Characteristic of unit 46. Occurs in land system G1.
ASSOCIATED COMMUNITIES			
Acacia harpophylla	Shrubby low woodland to woodland. Height: 10 ± 2 m. PFC: 15 ± 5%. Density: Trees/ha: 350 ± 100. Low shrubs/ha: 900 ± 600.	Trees, tall shrubs: *Acacia cambagei.* Low shrubs: *Apophyllum anomalum, Carissa ovata, Eremophila mitchellii.* Graminoids: *Chloris pectinata, Dactyloctenium radulans, Enteropogon acicularis, Eragrostis setifolia, Sporobolus actinocladus, S. caroli.* Forbs: *Amaranthus mitchellii, Atriplex elachophylla, A. muelleri, Bassia bicornis, B. quinquecuspis, Boerhavia diffusa, Malvastrum americanum, Portulaca* sp. aff. *P. oleracea, Salsola kali.*	Occurs on alluvial plains with braided channels and some low ridge and swale microrelief. Soils are very deep, grey and brown cracking clays with silt and sand intermixed. Low shrubs are present and form a well defined low shrubby layer. Ground cover is variable composed of grasses and forbs. Characteristic of unit 86. Minor occurrences and found in land systems M2, G4, T5 and W3.
Acacia harpophylla	Low open woodland. Height: 6 ± 1 m. PFC: 7.5 ± 2.5%. Density: Trees/ha: 300 ± 200. Low shrubs/ha: 600 ± 300.	Low shrubs: *Acacia harpophylla*, (regrowth). *Apophyllum anomalum, Cassia nemophila, Enchylaena tomentosa, Eremophila mitchellii.* Graminoids: *Dactyloctenium radulans, Enneapogon polyphyllus, Enteropogon acicularis, Sporobolus actinocladus.* Forbs: *Abutilon otocarpum, Dipteracanthus primulaceus, Portulaca* sp. aff. *P. oleracea, Ptilotus obovatus, Salsola kali, Sida fibulifera, S. trichopoda.*	Occurs on very gently undulating plains usually at the base of scarp retreat zones mainly in the east. Soils are moderately deep to deep, red cracking clays and associated areas of desert loams. Scattered low shrubs and tall shrubs occur and in places the low shrubs form a well defined layer particularly where disturbance has occurred. Ground flora is variable. Characteristic of unit 48. Occurs in land system G4 with minor occurrences in R1 and T5.
Acacia harpophylla, Eucalyptus cambageana	Open woodland to low open woodland. Height: 10 ± 3. PFC: 7.5 ± 2.5%. Density: Trees/ha: 250 ± 150. Tall shrubs/ha: <25. Low shrubs/ha: 30 ± 20	Trees: *Eucalyptus populnea.* Tall shrubs: *Eremophila mitchellii.* Low shrubs: *Capparis lasiantha, Enchylaena tomentosa, Myoporum deserti.* Graminoids: *Astrebla lappacea, Digitaria ammophila, Enteropogon acicularis, Iseilema membranaceum, Sporobolus caroli.* Forbs: *Abutilon oxycarpum, Malvastrum americanum, Salsola kali.*	Occurs on flat to gently sloping plains usually forming valley floors mainly in the south east. Soils are reddish brown, texture contrast soils with hard setting sandy clay loam surfaces and clay subsoils. There is no well defined tall or low shrub layer but scattered shrubs occur. Ground cover is variable composed of grasses and forbs. Characteristic of unit 49. Occurs in land system G4.
Acacia cana ± *A. cambagei*	Low open woodland. Height: 8 ± 2 m. PFC: <5%. Density: Trees/ha: 80 ± 60. Low shrubs/ha: 250 ± 100.	Low shrubs: *Eremophila dalyana, E. maculata, Senevola spinescens.* Graminoids: *Astrebla pectinata, Dactyloctenium radulans, Sporobolus actinocladus, S. caroli.* Forbs: *Atriplex lindleyi, A. spongiosa, Bassia calcarata, B. lanicuspis, Lepidium rotundum, Zygophyllum ammophilum, Z. apiculatum.*	Occurs on undulating plains in the central south. Soils are red and brown cracking clays. Frequently *A. cana* forms pure stands. Dead trees of *A. cana* may be abundant. Seedlings of *A. cana* are rare. Very limited in extent. It is not described as a separate unit, but is included in unit 51. Occurs in land system T2 with minor occurrences in G1, G2, T3, P6 and P7.
ACACIA ANEURA PREDOMINANT ASSOCIATIONS			
Acacia aneura, Eucalyptus populnea	Low open woodland to woodland. Height: 10 ± 2 m. PFC: 10 ± 5%. Density: Trees/ha: 350 ± 150. Tall shrubs/ha: 350 ± 300. Low shrubs/ha: 25 ± 20.	Tall shrubs: *Eremophila mitchellii.* Low shrubs: *Eremophila gilesii.* Graminoids: *Aristida armata, A. ingrata, Digitaria ammophila, D. brownii, Enteropogon acicularis, Eragrostis kennedyae, E. setifolia, Fimbristylis dichotoma, Monachather paradoxa, Panicum decompositum, Tripogon loliiformis.* Forbs: *Bassia bicornis, B. quinquecuspis, Boerhavia diffusa, Cheilanthes sieberi, Convolvulus erubescens, Evolvulus alsinoides, Goodenia lunata, Ptilotus macrocephalus, Solanum esuriale, Vittadinia sulcata.*	Occurs in the south-east on run-on areas on flat plains of low relief. Soils are deep to very deep, red and brown texture contrast soils with a loamy surface overlying clay subsoil. In places *Eucalyptus populnea* may appear to predominate. A tall shrub layer is conspicuous in places. Scattered low shrubs occur but rarely form a well defined layer unless the association has been disturbed. Characteristic of unit 12. Occurs in land system M2 with minor occurrence in R1.

Table 4.7 Description of Floristic Associations

Floristic Association	Structural Formation Range Height PFC, Density Data	Other Frequently Occurring Species	Comments
Acacia aneura, Eucalyptus populnea	Tall open shrubland to tall shrubland. Height: 7.5 ± 2.5 m. PFC: 7.5 ± 2.5% rarely 15%. Density: Trees, tall shrubs/ha: 450 ± 200. Low shrubs/ha: 50 ± 50.	Low shrubs: *Eremophila gilesii.* Graminoids: *Aristida armata, A. jerichoensis, Bothriochloa decipiens, Digitaria brownii, Enteropogon acicularis, Panicum decompositum, Themeda australis.* Forbs: *Abutilon otocarpum, A. oxycarpum, Cassia florifera, C. glutinosa, Salvadora persica, Solanum ferocissimum, S. ellipticum.*	Occurs mainly in the east on flat to gently undulating plains usually in a run-on situation. Soils range from deep loamy red earths to red and brown clays. In places *Acacia aneura* forms well defined groves with the intergrove area supporting open tussock grassland with isolated low shrubs. Density of low shrubs may increase if the association has been disturbed. Characteristic of units 14 and 15. Occurs in land system M4 with minor occurrences in M3 and H2.
Acacia aneura, Eucalyptus populnea	Tall open shrubland. Height: 7 ± 3 m. PFC: 2.5 ± 2%. Density: Trees, tall shrubs/ha: 90 ± 60. Low shrubs/ha: (variable) <1000.	Low shrubs: *Acacia ammobia* (in the east), *Eremophila gilesii, E. sturtii* (in places). Graminoids: *Aristida contorta, A. jerichoensis* var. *subspinulifera, Digitaria armophila, Enneapogon polyphyllus, Eriachne mucronata, E. pulchella, Fimbristylis dichotoma, Tripogon loliiformis.* Forbs: *Boerhavia diffusa, Cheilanthes sieberi, Chenopodium nitrariaceum, Evolvulus alsinoides, Vittadinia pustulata, Sida fibulifera.*	Occurs mainly in the east on shallow red earths with hardsetting surfaces and gravel or ironshot cover. Limited areas occur in the west but *Eucalyptus populnea* is infrequently present. In places *Eremophila* spp. form a well defined, dense low shrub layer. Ground flora varies with grasses usually predominating. Characteristic of unit 23. Occurs mainly in land system M2.
Acacia aneura	Tall shrubland to tall open shrubland. Height: 5 ± 1 m. PFC: 10 ± 5%. Density: Tall shrubs/ha: 800 ± 400. Low shrubs/ha: <25.	Trees, tall shrubs: *Codonocarpus cotinifolius.* Graminoids: *Aristida ingrata, Digitaria armophila, D. brownii, Eragrostis eriopoda, Monachather paradoxa, Neurachne munroi, Thyridolepis mitchelliana, Tripogon loliiformis.* Forbs: *Abutilon otocarpum, Euphorbia tannensis* ssp. *eremophila* var. *eremophila, Vittadinia pustulata, Sida fibulifera, S. platycalyx, Trachymene ochracea.*	Occurs mainly in the south-east on flat to very gently undulating plains. Soils are deep sandy red earths. *Acacia aneura* forms dense stands with some scattered *Eucalyptus* spp. emerging. Low shrubs are isolated unless the *A. aneura* has been thinned or destroyed either naturally or by man. In these situations dense stands of *Cassia* spp. and *Eremophila Lowmanii* may occur. *Codonocarpus cotinifolius* is very conspicuous in places after fire. Ground cover is variable. Characteristic of unit 7. Occurs mainly in land system S1.
Acacia aneura, Eucalyptus terminalis	Shrubby tall open shrubland. Height: 5 ± 1 m. PFC: 7.5 ± 2.5%. Density: Trees, tall shrubs/ha: 425 ± 300. Low shrubs/ha: 550 ± 500.	Low shrubs: *Eremophila bowmanii, E. gilesii.* Graminoids: *Aristida contorta, A. inaequiglumis, A. ingrata, Digitaria brownii, Eragrostis eriopoda, Tripogon loliiformis.* Forbs: *Cassia cornishiana, Evolvulus alsinoides, Vittadinia pustulata, Sida platycalyx.*	Occurs mainly in the central north on flat to very gently undulating plains. Soils are very deep sandy red earths. *Acacia aneura* forms distinct groves with the intergrove supporting open herbfield or infrequently a low shrubland of *Eremophila gilesii* or rarely *Cassia* spp. Ground cover is variable. Characteristic of unit 6. Occurs mainly in land system S2 with minor occurrences in M1 and R2.
Acacia aneura, Eucalyptus terminalis, Themeda spp.	Tall shrubland to tall open shrubland. Height: 8 ± 2 m. PFC: 7.5 ± 2.5%. Density: Trees, tall shrubs/ha: 225 ± 100. Low shrubs/ha: 60 ± 60.	Low shrubs: *Eremophila gilesii.* Graminoids: *Aristida contorta, Chloris pectinata, Cyperus iria, Dactyloctenium radulans, Dichanthium sericeum, Digitaria armophila, D. brownii, Enneapogon polyphyllus, Eragrostis cilianensis, E. leptocarpa, E. pergracilis, E. setifolia, Eriachne pseudoachnatherica, Sulalia fulva, Paramastelis dichotoma, Iseilema membranaceum, Paspalidium rarum, Themeda avenacea, T. australis, Tragus australianus, Tripogon loliiformis.* Forbs: *Alternanthera denticulata, A. nodiflora, Cassia cornishiana, C. nicorais, C. divaricata, Calotis hispidula, Convolvulus erubescens, Goodenia lunata, Parietina* spp., *Pittosporum macrocephalum, P. phillyraeoides, Salsola kali, Sida platycalyx, Zelleria glabrata.*	Occurs mainly in the central north on flat to gently undulating plains of low relief. Soils are deep to very deep, red clays and red texture contrast soils in the groves. Gilgai micro-relief is also associated with the groves. Soils in the intergrove areas are deep to moderately deep, red earths. *Acacia aneura* predominates in the groves with a well developed ground cover of predominately grasses. *Themeda* spp. are conspicuous and are associated with the gilgais giving this association a distinctive appearance. Scattered low shrubs occur but rarely form a well defined layer. The intergrove supports open herbfield to herbfield with scattered low shrubs. Characteristic of unit 11. Occurs in land system M11.
Acacia aneura, Eucalyptus terminalis	Sparse tall open shrubland Height: 3.5 ± 1.5 m. PFC: <1%. Density: Tall shrubs/ha: 50 ± 30. Low shrubs/ha: 80 ± 40.	Tall shrubs: *Acacia tetragonophylla, Eremophila longifolia.* Low shrubs: *Cassia desolata, C. helmsii.* Graminoids: *Aristida contorta, A. jerichoensis, Digitaria brownii, Enneapogon polyphyllus, Eriachne mucronata, E. pulchella, Tripogon loliiformis.* Forbs: *Bassia cornishiana, B. divaricata, B. eriacantha, Erodium crinitum, Euphorbia drummondii, Lepidium rotundum, Vittadinia pustulata, Portulaca* sp. aff. *P. oleracea, Ptilotus gaudichaudii, P. macrocephalus, Salsola kali, Sida cunninghamii, S. platycalyx, Zygophyllum amophilum.*	Occurs mainly in the south-east on slightly undulating convex plains. Soils are shallow to very shallow loamy red earths with stone and silcrete gravel cover. There is no well defined low shrubby layer but scattered low shrubs occur. Ground cover is sparse. Characteristic of unit 24. Occurs in land system H4.

Table 4.7 Description of Floristic Associations

Floristic Association	Structural Formation Range. Height, PFC, Density Data	Other Frequently Occurring Species	Comments
Acacia aneura, Eucalyptus papuana	Tall open shrubland, rarely tall shrubland. Height: 4.5 ± 1.5 m. PFC: (variable) 7 ± 5%. Density: Trees, tall shrubs/ha: 500 ± 400. Low shrubs/ha: 500 ± 500.	Low shrubs: *Cassia helmsii, C. oligophylla, Eremophila bowmanii, E. cordatisepala.* Graminoids: *Aristida contorta, A. jerichoensis* var. *subspinulifera, Bulbostylis barbata, Digitaria brownii, Eragrostis eriopoda, E. lacunaria, E. pergracilis, Eriachne pulchella, Monachather paradoxa, Themeda australis.* Forbs: *Bassia cornishiana, Evolvulus alsinoides, Portulaca* sp. aff. *P. oleracea, Sida cunninghamii, S. platycalyx.*	Occurs mainly on flat to slightly undulating plains of low relief associated with tablelands. Soils are shallow to very shallow, red earths and lithosols. *Acacia aneura* forms distinct groves. Low shrubs occur forming well defined layers in places. Ground flora is composed of grasses and forbs. Characteristic of unit 19. Occurs mainly in land system H2 with minor occurrences in R2 and R8.
Acacia aneura, A. kempeana	Tall open shrubland. Height: 4 ± 1 m. PFC: 5 ± 2.5%. Density: Trees, tall shrubs/ha: 400 ± 300. Low shrubs/ha: (variable) usually < 250 up to 1000 in places.	Trees: *Eucalyptus terminalis.* Low shrubs: *Acacia tetragonophylla* (in places), *Cassia notabilis* (in places), *C. oligophylla, Eremophila bowmanii* (in places). Graminoids: *Aristida armata, A. browniana, A. contorta, A. ingrata, Dactyloctenium radulans, Enneapogon polyphyllus, Eragrostis eriopoda, Eriachne aristidea, E. pulchella, Neurachne munroi.* Forbs: *Bassia cornishiana, Boerhavia diffusa, Chenopodium rhadinostachyum, Convolvulus erubescens, Euphorbia drummondii, E. tannensis* ssp. *eremophila* var. *eremophila, Evolvulus alsinoides, Goodenia lunata, Heliotropium tenuifolium, Helipterum floribundum, Ptilotus polystachyus, Sida cunninghamii, S. platycalyx, Velleia glabrata.*	Occurs mainly in the north west on flat to gently undulating plains usually in run-on situations. Soils are moderately deep to deep, red earths with accumulations of loose sand on the surface. Scattered trees may occur. Low shrubs are usually present and in places form a well defined layer. Ground cover is variable composed of grasses and forbs. Characteristic of unit 10. Occurs mainly in land system S3 with minor occurrences in D1, D2, S6 and H5.
Acacia aneura, A. olivicola	Tall open shrubland. Height: 4 ± 1 m. PFC: 3 ± 2%. Density: Tree, tall shrubs/ha: 65 ± 60. Low shrubs/ha: 300 ± 200.	Trees: (isolated) *Eucalyptus terminalis.* Low shrubs: *Acacia tetragonophylla, Cassia helmsii, Eremophila latrobei.* Graminoids: *Aristida contorta, A. ingrata, Digitaria brownii, Enneapogon polyphyllus, Eragrostis eriopoda, Eriachne pulchella, Fimbristylis dichotoma, Tripogon loliiformis.* Forbs: *Bassia convexula, B. cornishiana, B. lanicuspis, Chenopodium rhadinostachyum, Euphorbia boophthona, E. drummondii, Evolvulus alsinoides, Portulaca* sp. aff. *P. oleracea, Ptilotus gaudichaudii, Salsola kali, Sida cunninghamii, S. filiformis.*	Occurs mainly in the north west on gently undulating to undulating plains. Soils are shallow red earths, moderately deep red hard pan soils with silcrete gravel cover or lithosols. Scattered low shrubs occur and form a well defined layer in places. Ground cover is usually sparse. Characteristic of unit 25 and to a lesser degree unit 17. Occurs in land systems H1 and H3.
Acacia aneura, Triodia pungens	Tall open shrubland. Height: 5.5 ± 1.5 m. PFC: 7.5 ± 2.5%. Density: Trees, tall shrubs/ha: 300 ± 150. Low shrubs/ha: (variable) 1000 ± 750.	Low shrubs: *Cassia pruniosa, Dodonaea petiolaris, Eremophila latrobei.* Graminoids: *Digitaria brownii, Enneapogon polyphyllus, Eriachne pulchella, Triodia longiceps.* Forbs: *Boerhavia diffusa, Evolvulus alsinoides, Maireana triptera, M. villosa, Ptilotus exaltatus.*	Very limited in extent. Occurs mainly in the north west on the upper slopes and less frequently, the flat tops of dissected residuals. Soils are very shallow lithosols with surface pavement of silcrete stone and gravel. Low shrubs occur and usually form a distinct layer. Ground cover is variable. Characteristic of unit 27. Occurs in land systems R3 and R7.
Acacia aneura, A. cambagei	Tall open shrubland. Height: 4 ± 1 m. PFC: < 5%. Density: Trees, tall shrubs/ha: 75 ± 40. Low shrubs/ha: 250 ± 200.	Low shrubs: *Canthium latifolium, Eremophila latrobei.* Graminoids: *Enneapogon polyphyllus, Eriachne pulchella, Fimbristylis dichotoma, Sporobolus actinocladus.* Forbs: *Bassia convexula, B. lanicuspis, Maireana villosa.*	Limited in extent. Occurs in the west on lower slopes of dissected residuals. Soils are very shallow stony, lithosols with silcrete and ironstone gravel pavements. Low shrubs may form a well defined layer. Characteristic of unit 29. Occurs in land system R8
ASSOCIATED COMMUNITIES			
Eragrostis eriopoda, Acacia aneura	Open tussock grassland. Height: 0.5 m. PFC: 15 ± 10%. Density: Trees, tall shrubs/ha: < 25. Low shrubs/ha: (variable) 600 ± 550.	Trees/tall shrubs: *Eucalyptus terminalis* Low shrubs: *Dodonaea angustissima, Eremophila bowmanii.* Graminoids: *Aristida armata, A. contorta, A. jaeculiformis, A. ingrata, Eriachne helmsii, E. mucronata, Monochather paradoxa, Themeda australis, Thyridolepis mitchelliana.* Forbs: *Boerhavia diffusa, Brachyscome ciliaris* var. *lanuginosa, B. curvicarpa, Chenopodium rhadinostachyum, Euphorbia drummondii, Evolvulus alsinoides, Helipterum floribundum, Maireana villosa, Ptilotus polystachyus, Sida cunninghamii, S. platycalyx, Trachymene glaucifolia, T. ochracea, Velleia glabrata.*	Limited in extent. Occurs mainly in the central north on gently undulating to flat plains. Soils are deep to very deep sandy red earths. Low shrubs occur and following disturbance form a well defined layer. Ground flora is variable depending on seasonal conditions. Composites may become very conspicuous following favourable rains. In places this association approaches a tall open shrubland with *Acacia aneura* tending to predominate. Characteristic of unit 9. Occurs in land system M1.

Table 4.7 Description of Floristic Associations

Floristic Association	Structural Formation Range, Height, PFC, Density Data	Other Frequently Occurring Species	Comments
Eriachne mucronata, Acacia aneura ± *Eucalyptus terminalis*	Open tussock grassland. Height: 0.5 m. PFC: <5%. Density: Tree, tall shrubs/ha: < 40. Low shrubs/ha: 150 ± 100.	Low shrubs: *Cassia artemisioides, C. helmsii.* Graminoids: *Amphipogon caricinus, Aristida contorta, A. jerichoensis, Eragrostis eriopoda, Eriachne pulchella, Thryidolepis mitchelliana.* Forbs: *Brunonia australis, Euphorbia drummondii, Mairsana villosa, Ptilotus macrocephalus, Sida filiformis, Vellaia glabrata.*	Limited in extent. Occurs mainly in the south on gently undulating plains, usually convex, on the higher parts of the landscape. Soils are very shallow to shallow red earths with dense stone cover. Scattered trees and low shrubs usually occur. Ground cover is usually sparse. Characteristic of unit 22. Occurs in land systems H4 and H5.
Acacia ramulosa, A. aneura	Tall shrubland to tall open shrubland. Height: 5 ± 1 m. PFC: 7.5 ± 5%. Density: Trees, tall shrubs/ha: 425 ± 300. Low shrubs/ha: 800 ± 700.	Trees, tall shrubs: *Grevillea striata.* Low shrubs: *Cassia desolata, C. oligophylla, C. sturtii.* Graminoids: *Aristida contorta, A. ingrata, A. jerichoensis, Chloris pectinata, Dactyloctenium radulans, Eragrostis eriopoda.* Forbs: *Bassia cornishiana, Chenopodium rhadinostachyum, Evolvulus alsinoides, Heliotropium tenuifolium, Pterigeron adscendens, Ptilotus macrocephalus, Sida filiformis, S. platycalyx.*	Limited in extent. Occurs in the north west on gently undulating plains of low relief. Soils are moderately deep, red texture contrast soils with sandy loams overlying sandy clays. In places *Acacia ramulosa* may form almost pure stands. Usually a lower shrub layer is well defined. Ground cover is variable. Characteristic of unit 16. Occurs in land system H3.
Eucalyptus melanophloia, Acacia aneura	Woodland. Height: 10 ± 1 m. PFC: 15 ± 5%. Density: Trees/ha: 150 ± 50. Shrubs/ha: 250 ± 100.	Trees: *Eucalyptus populnea.* Shrubs: *Cassia artemisioides, C. nemophila* var. *nemophila.* Graminoids: *Aristida inaequiglumis, A. jerichoensis, Chrysopogon fallax, Themeda australis.* Forbs: *Abutilon otocarpum, Sida filiformis, S. platycalyx.*	Limited in extent. Occurs in the south east in run-on situations. Soils are shallow loamy red earths. A shrub layer is well defined in places. Ground cover is poor, composed of grasses and forbs. Occurs in land system M2 and to a lesser degree in R6.
OTHER *ACACIA* PREDOMINANT ASSOCIATIONS			
Acacia catenulata	Low open woodland. Height: 6 ± 1 m. PFC: 5 ± 2.5%. Density: Trees, tall shrubs/ha: 400 ± 300. Low shrubs/ha: 60 ± 30.	Trees: *Eucalyptus thosetiana.* Low shrubs: *Canthium latifolium, Dodonaea petiolaris, Eremophila latrobei, Ptilotus obovatus.* Graminoids: *Digitaria ammophila, Enneapogon polyphyllus, Eriachne mucronata, E. pulchella, Paspalidium clementii* (in the west), *P. gracile, Sporobolus australasicus, Tripogon loliiformis.* Forbs: *Boerhavia diffusa, Chenopodium rhadinostachyum, Cheilanthes vellea, Isotoma petraea, Mairsana villosa, Portulaca* sp. aff. *P. oleracea, Salsola kali, Trianthema triquetra.*	Limited in extent. Associated with scarp retreats and to a lesser degree flat tops of dissected tablelands, mesas and buttes. Soils are shallow red loamy lithosols with surface cover of stone. Density varies and is governed by local habitat variation and rainfall. Scattered low shrubs are usually present but rarely form a well defined layer. Ground cover is usually sparse. Characteristic of unit 31. Occurs in land systems R1, R5, R6 and R8.
Acacia petraea	Low open woodland to low woodland. Height: 6 ± 3 m. PFC: 12.5 ± 7.5%. Density: Trees/ha: 500 ± 400. Low shrubs/ha: 500 ± 400.	Trees: *Acacia aneura, A. ensifolia.* Low shrubs: *Canthium latifolium, Dodonaea adenophora, D. petiolaris, Eremophila cordatisepala* (in places), *E. latrobei, E. oppositifolia* var. *rubra, Scaevola spinescens.* Graminoids: *Aristida contorta, A. jerichoensis, Eriachne mucronata, E. pulchella, Fimbristylis dichotoma, Tripogon loliiformis.* Forbs: *Mairsana georgei, M. triptera, M. villosa, Ptilotus gaudichaudii, P. helipteroides, P. leucocoma, P. obovatus, Salsola kali, Sida aprica, S. filiformis.*	Occurs throughout on flat to slightly undulating tops and upper scarps of dissected residuals. Soils are very shallow loamy lithosols with large areas of weathered rocks exposed. In places *Acacia petraea* can form almost pure stands. Usually low shrubs are present forming a well defined layer. Ground cover is sparse composed of grasses and forbs. This association may form a complex with *Acacia catenulata* low open woodland, and/or *A. aneura* tall open shrubland and/or *A. clivicola* low open shrubland. In these situations it is difficult to delineate boundaries. Characteristic of unit 26. Occurs in land systems R1, R2, R3, R5, R6, R7, R8 and H3.
Acacia ensifolia, Triodia pungens	Low open woodland. Height: 5.5 ± 1.5 m. PFC: <5%. Density: Trees/ha: 110 ± 60. Low shrubs/ha: 450 ± 350.	Low shrubs: *Cassia helmsii, Dodonaea petiolaris, Eremophila latrobei.* Graminoids: *Aristida contorta, Digitaria brownii, Enneapogon polyphyllus, Paspalidium rarum, Triodia longiceps* (in places). Forbs: *Bassia lanicuspis, Mairsana triptera, M. villosa, Ptilotus schwartzii, Salsola kali, Sida filiformis.*	Limited in extent. Occurs mainly on the lower and upper slopes of dissected residuals with minor occurrences on associated undulating plains. Soils are very shallow stony lithosols with areas of weathered rock outcropping. Scattered low shrubs usually form a well defined layer. Ground flora is variable with grasses or forbs predominating. Characteristic of unit 28(a). Occurs in land systems R3 and R7.

Table 4.7 Description of Floristic Associations

Floristic Association	Structural Formation Range, Height, PFC, Density Data	Other Frequently Occurring Species	Comments
Acacia clivicola	Sparse low open shrubland to low shrubland. Height: 1.5 ± 0.5 m. PFC: 5 ± 4%. Density: Low shrubs/ha: 250 ± 200.	Shrubs: *Hakea collina.* Graminoids: *Enneapogon polyphyllus, Eriachne pulchella, Fimbristylis dichotoma, Tripogon loliiformis.* Forbs: *Brunonia australis, Maireana villosa, Salsola kali, Sida cunninghamii.*	Restricted to dissected residuals and associated undulating plains. Soils are lithosols with areas of parent rock exposed. In places *Acacia clivicola* forms pure stands. Ground cover is sparse. A variant of unit 26. Occurs mainly in land system R2 but is associated with the dissected residual land zone and some of the hard mulga land zone.
Acacia clivicola, Eucalyptus exserta	Low open shrubland to low shrubland. Height: 1.5 ± 0.5 m. PFC: 8 ± 7%. Density: Trees, tall shrubs/ha: 80 ± 70. Low shrubs/ha: 450 ± 400.	Trees: *Eucalyptus papuana.* Tall shrubs: *Acacia catenulata* (in places), *Alstonia constricta* (in places). Low shrubs: *Canthium latifolium, Cassia helmsii, Dodonaea adenophora, Eremophila latrobei, Hakea collina, Prostanthera megacalyx* (in places), *P. suborbicularis, Westringia rigida.* Graminoids: *Digitaria armophila, Enneapogon polyphyllus, Eriachne mucronata, E. pulchella, Fimbristylis dichotoma, Tripogon loliiformis.* Forbs: *Bassia convexula, Brunonia australis, Chenopodium rhadinostachyum, Cheilanthes sieberi, Maireara villosa, Portulaca* sp. aff. *P. oleracea, Salsola kali.*	Very limited in extent. Restricted to the flat to slightly undulating tops of dissected residuals. Soils are very shallow, loamy lithosols with areas of weathered rocks exposed. The lower shrub layer is usually well developed. Ground flora is sparse. Characteristic of unit 26(b). Occurs mainly in land system R5.
Acacia clivicola, A. aneura	Low open shrubland. Height: 1.5 ± 0.5 m. PFC: 2.5 ± 2%. Density: Tall shrubs/ha: <25. Low shrubs/ha: 250 ± 200.	Trees: *Eucalyptus terminalis.* Low shrubs: *Acacia tetragonophylla, Cassia helmsii, Eremophila latrobei.* Graminoids: *Aristida contorta, Digitaria brownii, Eragrostis eriopoda, Eriachne pulchella, Tripogon loliiformis.* Forbs: *Brunonia australis, Maireara villosa, Salsola kali, Sida cunninghamii, Velleia glabrata.*	Limited in extent. Occurs on flat to gently undulating crests of dissected plains. Soils are shallow red earthy loams and clay loams. Silcrete gravel and stone occur on the surface and throughout the profile. In places *Cassia* spp. become conspicuous. Ground cover is sparse. Characteristic of unit 26. Occurs mainly in land system R4.
Acacia kempeana	Low open shrubland. Height: 1.5 ± 0.5 m. PFC: <5%. Density: Low shrubs/ha: 175 ± 100.	Low shrubs: *Cassia desolata, C. oligophylla.* Graminoids: *Aristida contorta, Dactyloctenium radulans, Enneapogon polyphyllus, Fimbristylis dichotoma.* Forbs: *Bassia cornishiana, B. lanicuspis, Portulaca* sp. aff. *P. oleracea, Salsola kali.*	Limited in extent. Occurs on flat to gently sloping plains. Soils are shallow red earths. In places *Cassia* spp. tend to become co-dominant. Ground cover is usually sparse. Characteristic of unit 20. Occurs in land system F1.
Acacia brachystachya	Low open shrubland. Height: 1.5 ± 0.5 m. PFC: < 5%. Density: Low shrubs/ha: 150 ± 100.	Low shrubs: *Acacia clivicola* (in places), *Cassia oligophylla, C. sturtii.* Graminoids: *Aristida* spp., *Eragrostis eriopoda, Eriachne pulchella.* Forbs: *Maireana georgei, Ptilotus leucocoma, P. obovatus, Sida* spp.	Very limited in extent. Occurs on the lower slopes associated with the hard mulga lands. Soils are shallow red earths. Scattered trees of *Eucalyptus populnea, E. terminalis* and *Acacia aneura* may occur. Ground cover is usually sparse. No site was studied in detail.
SHRUBBY CHENOPOD PREDOMINANT ASSOCIATIONS			
Chenopodium auricomum	Low open shrubland to low shrubland. Height: 1.0 ± 0.5 m. PFC: 8 ± 7%. Density: Low shrubs/ha: 3000 ± 2000	Graminoids: *Cyperus difformis, C. gymnocaulis* (in places), *Eleocharis pallens, Elytrophorus spicatus, Eragrostis tenellula, Sporobolus mitchellii.* Forbs: *Alternanthera nodiflora, Aeschynomene indica, Bassia stelligera, Marsilea drummondii, Minuria leptophylla, Portulaca* sp. aff. *P. oleracea.*	Limited in extent. Occurs on depressions on flat alluvial plains or on inter-dune flats. Soils are deep, grey cracking clays. Representative of unit 73. Occurs in land system C3 with minor occurrences in D2, D4, W2, W3, A1, A2 and L1.
Chenopodium auricomum, Muehlenbeckia cunninghamii	Low open shrubland to low shrubland. Height: 1.0 ± 0.5 m. PFC: 8 ± 7%. Density: Low shrubs/ha: 3000 ± 2000	Low shrubs: *Eremophila bignoniiflora.* Graminoids: *Dactyloctenium radulans, Echinochloa turnerana* (in places), *Eleocharis pallens, Elytrophorus spicatus, Eragrostis australasica, E. setifolia, E. tenellula, Sporobolus mitchellii.* Forbs: *Aeschynomene indica, Alternanthera nodiflora, Calotis hispidula, C. multicaulis, Centipeda thespidioides, Damasonium minus, Marsilea* spp., *Plantago pritzelii, Ranunculus pentandrus* var. *platycarpus.*	Associated with flooded depressions in alluvial plains. Soils are deep grey cracking clays. Either *Chenopodium auricomum* or *Muehlenbeckia cunninghamii* may predominate. Following general floods *Echinochloa turnerana* tends to predominate in places. *Eucalyptus microtheca* low open woodland may fringe this association. Characteristic of unit 73. Occurs in land systems C1, C3, W2, W3, A1, A2 and L1.
Atriplex nummularia	Low open shrubland to low shrubland: Height: 1.5 ± 0.5 m. PFC: 8 ± 7%. Density: Shrubs/ha: 4000 ± 3500.	Low shrubs: *Chenopodium auricomum.* Graminoids: *Aristida anthoxanthoides, Chloris pectinata, Eragrostis dielsii, E. leptocarpa, E. setifolia, Panicum decompositum, P. laevi, Sporobolus actinocladus, S. mitchellii.* Forbs: *Atriplex holocarpa, A. spongiosa, Boerhavia diffusa, Centipeda thespidioides, Helipterum floribundum, H. strictum.*	Limited in extent. Occurs in the west on alluvial flats subject to periodic flooding. Soils are a complex of very deep, grey and brown clays and associated alluvial texture contrast soils. *Atriplex nummularia* may form pure stands. Ground cover is usually sparse. Characteristic of unit 98. Occurs in land system C2.

Table 4.7 Description of Floristic Associations

Floristic Association	Structural Formation Range, Height, PFC, Density Data	Other Frequently Occurring Species	Comments
Maireana aphylla	Low open shrubland. Height: 0.75 ± 0.25 m. PFC: 5 ± 2.5%. Density: Shrubs/ha: 1000 ± 500.	Graminoids: *Brachyachne convergens, Chloris pectinata, Dactyloctenium radulans, Eragrostis dielsii, E. setifolia, Iseilema* spp., *Sporobolus actinocladus, S. caroli.* Forbs: *Atriplex spongiosa, Bassia divaricata, B. lanicuspis, B. quinquecuspis, Maireana coronata, Salsola kali, Trianthema triquetra.*	Very limited in extent. Occurs in the west on flat alluvial plains or on alluvia associated with drainage lines on the undulating downs. Soils are deep, brown clays with limited areas of red and grey clays. *Maireana aphylla* tends to form almost pure stands in places. Representative of a variant of unit B3. Occurs in land systems F1, F2, W6, W7 and A5.
ASSOCIATED COMMUNITIES			
Muehlenbeckia cunninghamii	Low open shrubland. Height: 1.5 ± 0.5 m. PFC: 5 ± 4%. Density: Shrubs/ha: 500 ± 400.	Graminoids: *Eragrostis australasica, E. dielsii, E. setifolia.* Forbs: *Alternanthera nodiflora, Centipeda thespidioides, Marsilea* spp.	Associated with depressions on alluvial plains of the major drainage systems. Very limited in extent. Soils are deep, grey cracking clays. May be considered a variant of the *Chenopodium auricomum, Muehlenbeckia cunninghamii* association found in land systems W2, C1 and C3.
Channel country complex	Open herbfield to low shrubland. Herbfield: Height: 0.75 ± 0.25 m. PFC: (variable) 1-50%. Shrubland: Height: 1.25 ± 0.5 m. PFC: 20 ± 15%. Density: Shrubs/ha: (variable) <4000.	Trees: *Eucalyptus microtheca* (scattered). Shrubs: *Chenopodium auricomum, Muehlenbeckia cunninghamii.* Graminoids: *Brachyachne convergens, Chloris pectinata, Dactyloctenium radulans, Echinochloa turnerana, Eragrostis australasica, E. setifolia, E. tenellula, Sriochloa* spp., *Iseilema* spp., *Panicum whitei.* Forbs: *Atriplex* spp., *Bassia* spp., *Calotis hispidula, Calostemma luteum, Craspedia pleiocephala, Helipterum corymbiflorum, H. floribundum, Plantago pritzelii, Senecio lautus, Trigonella suavissima.*	Occurs on the flood plains of Diamantina River, Cooper Creek and distributaries and to a lesser degree the Barcoo River. Soils are deep grey, cracking clays. Composition varies and is dependent on the season, the incidence and type of flooding. After local summer flooding, *Dactyloctenium radulans, Panicum whitei, Chloris pectinata* and *Iseilema* spp. usually predominate. *Atriplex* spp. and *Bassia* spp. and members of Compositae are conspicuous after local winter flooding. *Echinochloa turnerana* tends to predominate in places after general early summer flooding. General autumn or winter flooding is required before *Trigonella suavissima* becomes conspicuous. Low shrublands of *Chenopodium auricomum* and/or *Muehlenbeckia cunninghamii* may be present. Scattered low open woodland of *Eucalyptus microtheca* occur. The main channels are fringed by *Eucalyptus camaldulensis, E. microtheca* open woodland. Occurs in land systems C1, C2 and C3.
ASSOCIATED COMMUNITIES			
Aggeratia paradoxa	Open hummock grassland. Height: <1.5 m. PFC: <2.5%.	Shrubs: *Acacia ligulata* (in places), *Grevillea stenobotrya* (in places). Graminoids: *Eriachne aristidea, Plagiosetum refractum.* Forbs: *Crotalaria cunninghamii, C. eremaea, Glaucodia pterosperma, Euphorbia* spp., *Ptilotus latifolius, P. polystachyus, Salsola kali, Trichodesma zeylanica.*	Restricted to the mobile crests of sand dunes in the west. Soils are red siliceous sands. *Aggeratia paradoxa* forms scattered clumps usually with areas of bare sand between them. Stunted *Acacia ligulata* occurs on the crest and *Grevillea stenobotrya* is found in more protected situations. Floristically the association is poor. Characteristic of unit 1(b). Occurs in land system D1, D2 and D4.
Crotalaria eremaea	Open forbland. Height: < 0.75 m. PFC: (variable) usually <5% up to 20% in places. Density: Tall shrubs/ha: usually <30. Low shrubs/ha: < 25.	Tall shrubs: *Grevillea stenobotrya.* Low shrubs: *Acacia ligulata, A. tetragonophylla* (in places). Graminoids: *Aristida browniana, Eragrostis eriopoda, Eriachne aristidea, Plagiosetum refractum, Aggeratia paradoxa* (rare). Forbs: *Calotis erinacea, C. inermis, Crotalaria cunninghamii, Ptilotus polystachyus, Salsola kali, Senecio gregorii, Trachymene glaucifolia, Trichodesma zeylanica, T. occidentalis.*	Occurs on the crests and upper slopes of longitudinal and reticulate dunes in the west and south west. Soils are red siliceous sands. Composition of vegetation dependent on seasonal conditions. Compositae may predominate in places. The shrubs may become dense up to the equivalent of 350/ha in some situations. A variation of this unit occurs where *Grevillea stenobotrya* becomes predominant forming a tall open shrubland. *Crotalaria eremaea* is usually not as conspicuous. Other floristic composition is similar to that of this association. Characteristic of unit 1(a). Occurs in land systems D1, D2, D3 and D4.
Salsola kali	Sparse forbland. Height: 0.75 ± 0.25 m. PFC: <2.5%.	Shrubs: (scattered) *Hakea leucoptera, Owenia acidula.* Graminoids: *Eragrostis setsdowii, E. cumingii, E. eriopoda, Triraphis mollis.* Forbs: *Bassia* spp., *Crotalaria cunninghamii, C. eremaea, Sida* sp., *Tribulus occidentalis, T. terrestris.*	Very limited in extent in the west and south west. Occurs on isolated dunes associated with alluvia. Soils are earthy sands. Floristic composition is dependent on seasonal conditions. Vegetation is sparse. Occurs in L1 and D3.

Table 4.7 Description of Floristic Associations

Floristic Association	Structural Formation Range, Height, PFC, Density Data	Other Frequently Occurring Species	Comments
Eragrostis eriopoda, Crotalaria eremae	Open tussock grassland. Height: < 0.75 m. PFC: 12.5 ± 7.5%. Density: Tall shrubs/ha: < 25. Low shrubs/ha: < 25.	Trees, tall shrubs: *Lysiphyllum gilvum*. Low shrubs: *Acacia tetragonophylla, Dodonaea angustissima.* Graminoids: *Aristida armata, A. browniana, Eragrostis basedowii.* Forbs: *Boerhavia diffusa, Calandrinia balonensis, Helipterum floribundum, H. moschatum, Ipomoea polymorpha, Myriocephalus stuartii, Ptilotus obovatus, P. polystachyus, Portulaca* sp. aff. *P. oleracea, Salsola kali, Tribulus occidentalis.*	Limited in extent. Occurs in the west and south west on the upper flanks and in places on the extended flanks of dunes found on alluvial plains. Soils are very deep, red or yellow siliceous sands and earthy sands. In places the low shrubs become predominant with densities approaching 1000/ha. Composition of the ground layer depends on seasonal conditions. Composites become very conspicuous after favourable rains. Characteristic of unit 3. Occurs in land system D3 with minor occurrences in S1.
Eragrostis australasica	Open tussock grassland. Height: 1.25 ± 0.25 m. PFC: 5 ± 4%.	Shrubs: *Chenopodium auricomum, Muehlenbeckia cunninghamii.* Graminoids: *Cyperus fulvus, C. rigidellus, Aplachne muelleri, Eleocharis pallens, Elytrophorus spicatus, Sporobolus mitchellii, Urantiocium truncatum.* Forbs: *Aeschynomene indica, Alternanthera nodiflora, Atriplex fissivalvis, A. spongiosa, Bassia biconnis, B. divaricata, B. paradoxa, Centipoda thespidioides, Marsilea* spp.	Occurs on flat poorly drained claypans associated with alluvia. Soils are very deep, grey and brown cracking clays. *Chenopodium auricomum* and *Muehlenbeckia cunninghamii* may be present in places. *Eragrostis australasica* tends to form pure stands in some situations. Ground flora is variable depending on seasonal conditions. Characteristic of unit 87. Occurs in land systems D4, S4, C1, C3 and L1.
TRIODIA PREDOMINANT ASSOCIATIONS			
Triodia basedowii	Open hummock grassland to hummock grassland. Height: < 1 m. PFC: 25 ± 15%. Density: Trees, tall shrubs/ha: (variable) < 70. Low shrubs/ha: 600 ± 500.	Trees: *Atalaya hemiglauca, Eucalyptus papuana, E. terminalis, Grevillea juncifolia.* Shrubs: *Acacia coriacea, Hakea chordophylla, H. divaricata, H. leucoptera.* Low shrubs: *Acacia ligulata, A. murrayana, A. tetragonophylla, Cassia artemisioides, C. desolata, C. nemophila* var. *zygophylla, C. oligophylla, C. notabilis, C. pleurocarpa, Dodonaea angustissima, Enchylaena tomentosa, Eremophila duttonii, L. obovata.* Graminoids: *Aristida armata, A. browniana, A. inyrata, Dactyloctenium radulans, Enneapogon polyphyllus, Eragrostis basedowii, E. curingii, E. eriopoda, Eriachne aristidea, E. helmsii, E. mucronata.* Forbs: *Brunonia australis, Calandrinia balonensis, Calocephalus multiflorus, Calotis erinacea, C. multicaulis, C. porphyroglossa, Crotalaria eremaea, Euphorbia drummondii, E. wheeleri, Evolvulus alsinoides, Goodenia mitchellii, Helipterum floribundum, H. moschatum, Ipomoea polymorpha, Lepidium rotundum, Kennedia prorepens, Maogregoria racemigera, Myriocephalus stuartii, Nicotiana velutina, Portulaca* sp. aff. *P. oleracea, Ptilotus obovatus, P. polystachyus, Salsola kali, Scaevola depauperata, S. ovalifolia, Senecio gregorii, Trachymene glaucifolia, Tribulus terrestris.*	Widespread in the south west. Occurs on flat to very gently undulating plains associated with the sandplains and dunefields. Soils are deep to very deep, red earthy sands occasionally red siliceous sands. Both density of trees and shrubs and the floristic composition vary. The *Eucalyptus* spp. are more frequently associated with the sandplains and *Acacia ligulata, A. murrayana, Dodonaea angustissima* and *Hakea leucoptera* with the dunefields. Local variation in habitat governs the distribution of many of these species. Composition of the ground flora is dependent on seasonal conditions and to a lesser degree the current and past land use. Although not frequent, fire has a marked effect on the vegetation and floristic composition of this association. The results of fire are noticeable for many years. In places shrubs and scattered trees tend to predominate and the association approaches a tall open shrubland. This is a very heterogenous association and with more detailed study it may be possible to divide it into more homogenous associations. Characteristic of unit 5 and to a lesser degree unit 2. It occurs in land systems D1, D2, D4, S4 and S6.
Triodia pungens	Open hummock grassland to hummock grassland. Height: < 1 m. PFC: 15 ± 10%. Density: Trees/ha: < 10. Low shrubs/ha: (variable) < 50.	Trees: *Eucalyptus papuana* (rare), *E. thonetiana* (rare). Low shrubs. *Acacia olivacea, Eremophila latrobei.* Graminoids: *Aristida contorta, Eriachne mucronata, E. pulchella, Triodia longiceps.* Forbs: *Maireana triptera, M. villosa, Salsola kali.*	Very limited in extent and not studied in detail. Occurs on undulating plains and slopes of dissected residuals. Soils are very shallow, stony lithosols with areas of weathered rock outcropping. Scattered trees of *Eucalyptus papuana* and *E. thonetiana* may be present. Occurs in land system R7.

Table 4.7 Description of Floristic Associations

Floristic Association	Structural Formation Range, Height, PFC, Density Data	Other Frequently Occurring Species	Comments
ASTREBLA SPP. PREDOMINANT ASSOCIATIONS			
NON WOODED			
Astrebla pectinata, forbs ± short grasses.	Open tussock grassland to sparse herbfield rarely tussock grassland. Height: 0.75 ± 0.25 m. PFC: 15 ± 14% rarely up to 45%. Density: Trees: isolated, Low shrubs/ha: 40 ± 40.	Low shrubs: *Cassia oligophylla, C. phyllodinea.* Graminoids: *Aristida anthoxanthoides, Brachyachne convergens, Dactyloctenium radulans, Enneapogon avenaceus, E. polyphyllus, Eragrostis* spp., *Iseilema membranaceum, I. vaginiflorum, Panicum whitei, Sporobolus actinocladus, Tragus australianus.* Forbs: *Abutilon malvifolium, Amaranthus mitchellii, Atriplex lindleyi, A. spongiosa, Bassia bicornis, B. calcarata, B. lanicuspis, Boerhavia diffusa, Euphorbia drummondii, Maireana coronata, M. villosa, Portulaca* sp. aff. *P. oleracea, Psoralea cinerea, Rhynchosia minima, Salsola kali, Sida fibulifera, S. trichopoda, S. virgata, Threlkeldia proceriflora, Trianthema triquetra.*	Occurs in the west on flat to gently undulating plains. Soils are stony, deep to moderately deep, red and brown cracking clays; rarely desert loams. Gilgais occur in places. Dense stone pavements are common. Where dense stone cover occurs plants, with the exception of *Bassia* spp., *Trianthema triquetra* and *Portulaca* sp. aff. *P. oleracea* do not grow. Composition depends on seasonal conditions with either forbs/short grasses or *Astrebla pectinata* predominating. Past history of use also has considerable influence on plant composition. *Astrebla lappacea* may occur and becomes more conspicuous following a run of above average rainfall seasons. *Astrebla elymoides* and *A. squarrosa* occur infrequently, associated with the gilgais or in more mesic situations. During droughts *Astrebla pectinata* may be found in the gilgai situation. In places *Iseilema* spp. become co-dominant after very late summer rains. Isolated trees of *Atalaya hemiglauca* may be conspicuous but usually trees are absent. *Acacia farnesiana* may be associated with drainage lines and in places tend to form a dense stand. Characteristic of units 60, 61, 62, 68. Occurs in land systems F1, F3, F4 and F8.
Astrebla lappacea	Open tussock grassland to tussock grassland infrequently sparse herbfield to herbfield. Height: 1 ± 0.25 m. PFC: 25 ± 25% but usually 20 ± 5%. Density: Trees: isolated. Low shrubs/ha: < 20.	Trees: (isolated) *Acacia cana, Atalaya hemiglauca, Flindersia maculosa, Heterodendrum oleifolium, Ventilago viminalis.* Low shrubs: *Acacia farnesiana, Cassia phyllodinea* (in alluvial situations only). Graminoids: *Aristida latifolia, A. leptopoda, Astrebla elymoides, A. squarrosa, Bothriochloa ewartiana, Brachyachne convergens, Chloris pectinata, Cyperus bifax, Dactyloctenium radulans, Dichanthium sericeum, Enneapogon avenaceus, E. polyphyllus, Eragrostis setifolia, Iseilema membranaceum, I. vaginiflorum, Panicum decompositum, P. whitei, Sporobolus actinocladus, Tragus australianus.* Forbs: *Abutilon malvifolium, Amaranthus mitchellii, Atriplex lindleyi, A. muelleri, A. spongiosa, Bassia anisacanthoides, B. bicornis, B. bicornis* var. *horrida, B. calcarata, B. divaricato, B. lanicuspis, B. quinquecuspis, Boerhavia diffusa, Convolvulus erubescens, Daucus glochidiatus, Desmodium campylocaulon, D. muelleri, Euphorbia drummondii, Goodenia strongfordii, G. subintegra, Ipomoea lonchophylla, Maireana coronata, Malvastrum americanum, Polymeria longifolia, P. marginata, Portulaca* sp. aff. *P. oleracea, Psoralea cinerea, Pterigeron adscendens, Rhynchosia minima, Salsola kali, Sida fibulifera, S. trichopoda, S. virgata, Threlkeldia proceriflora, Trianthema triquetra.*	Occurs mainly in the eastern and contral regions in two situations. The major occurrence is on flat to undulating plains derived from weathered Cretaceous sediments but is also associated with flat alluvial plains. Soils range from moderately deep to deep, brown cracking clays; infrequently shallow. Limited areas of red and grey clays occur. In places black ironstone shot and silcrete gravel form a surface pavement. Incipient gilgais occur in some situations. Composition of ground flora is governed by seasonal conditions and past land use. Following a run of below average rainfall seasons forbs tend to dominate. In places, short grasses mainly *Iseilema* spp. become co-dominant after late summer rains. *Dichanthium sericeum* tends to become co-dominant or pre-dominant in the more easterly regions after a series of above average seasons. *Aristida latifolia* becomes co-dominant in places probably the result of a series of below average rainfall seasons and light stocking practices. *Acacia farnesiana* becomes conspicuous in some situations. *A. victoriae* is common in some alluvial areas. Trees are isolated. Characteristic of units 58, 63, 64, 65, 66, 67, 77, 80, 83, 94 and 96. Occurs in land systems F5, F6, F7, A3, A5, W1, W2, W3, W6, W7, with minor occurrences in F1, F3, F8, T1, T3, T4, G2, A1, A2, A5 and A6.

Table 4.7 Description of Floristic Associations

Floristic Association	Structural Formation Range, Height, PFC, Density Data	Other Frequently Occurring Species	Comments
Astrebla spp., Chenopod	Open herbfield to open tussock grassland. Height: 0.75 ± 0.25 m. PFC: 20 ± 10%. Density: Trees/ha: rare.	Graminoids: *Aristida anthoxanthoides, Astrebla pectinata, A. squarrosa, Brachyachne convergens, Chloris pectinata, Dactyloctenium radulans, Iseilema membranaceum, I. vaginiflorum, Panicum whitei, Sporobolus actinocladus, Tragus australianus.* Forbs: *Amaranthus mitchellii, Bassia anisacanthoides, B. divaricata, E. eriacantha, B. paradoxa, Boerhavia diffusa, Euphorbia drummondii, Lepidium rotundum, Neptunia dimorphantha, Pimelea trichostachya, Portulaca filiformis, P. sp. aff. P. oleracea, Trianthema portulacastrum, T. triquetra.*	Limited in extent. Occurs on gently undulating to undulating convex plains. Soils are deep to very deep, very stony red and brown cracking clays. Weakly developed gilgais occur. Composition is governed by seasonal conditions. *Astrebla* spp. are present in the gilgais and during good seasons become a significant component of the pasture. Trees, tall shrubs and low shrubs are rare. Characteristic of unit 69. Occurs in land systems I2 and F4.
WOODED			
Astrebla spp., *Acacia cana*	Open tussock grassland to tussock grassland or open woodland. Grassland Height: 1 ± 0.25 m. PFC: 30 ± 20%. Density: Trees/ha: 20 ± 10. Low shrubs/ha: 100 ± 100. Woodland Height: 10 ± 2 m. PFC: 5 ± 2.5%. Density: Trees/ha: 120 ± 80. Low shrubs/ha: 100 ± 100.	Trees: *Acacia cambagei, Flindersia maculosa, Heterodendrum oleifolium.* Low shrubs: *Acacia farnesiana, Apophyllum anomalum, Eremophila mitchellii.* Graminoids: *Astrebla elymoides, A. lappacea, A. pectinata, A. squarrosa, Brachyachne convergens, Chrysopogon fallax, Dactyloctenium radulans, Dichanthium sericeum, Enneapogon avenaceus, Iseilema membranaceum, Panicum decompositum, P. whitei, Sporobolus actinocladus, S. caroli.* Forbs: *Abutilon malvifolium, Amaranthus mitchellii, Atriplex lindleyi, A. muelleri, Bassia bicornis, B. bicornis var. horrida, B. calcarata, Boerhavia diffusa, Desmodium campylocaulon, Euphorbia boophthona, E. racemigera, Malvastrum americanum, Portulaca sp. aff. P. oleracea, Polymeria longifolia, P. marginata, Ptilotus exaltatus, Rhynchosia minima, Salsola kali, Sida trichopoda, S. virgata, Trianthema triquetra.*	Occurs on flat to gently undulating plains, in places fringing alluvia. Soils are moderately deep to deep, brown cracking clays. The composition of the ground flora depends on seasonal conditions. Scattered low shrubs occur but usually do not form a well defined layer. Regeneration of *Acacia cana* is rare. Characteristic of units 51, 53 and 55. Occurs in land systems T1, T2 and T3 with minor occurrences in G1, G2, T4, F5, F6, F7, W5 and A1.
Astrebla spp.	Open tussock grassland to tussock grassland rarely open herbfield. Height: 0.9 ± 0.35 m. PFC: 30 ± 20%. Density: Trees/ha: 20 ± 10 rarely 40. Low shrubs/ha: 50 ± 40.	Trees: *Acacia cambagei, A. cana, A. pendula, Flindersia maculosa, Heterodendrum oleifolium, Lysiphyllum gilvum, Ventilago viminalis.* Low shrubs: *Acacia farnesiana, Apophyllum anomalum, Eremophila mitchellii.* Graminoids: *Aristida latifolia, A. leptopoda, Astrebla elymoides, A. lappacea, Bothriochloa ewartiana, Cyperus bifax, Dactyloctenium radulans, Dichanthium sericeum, Enneapogon avenaceus, E. polyphyllus, Iseilema membranaceum, Panicum decompositum, P. whitei, Sporobolus actinocladus, S. caroli, Tragus australianus, Tripogon loliiformis.* Forbs: *Abutilon malvifolium, Atriplex muelleri, A. spongiosa, Bassia anisacanthoides, B. bicornis var. horrida, B. calcarata, B. quinquecuspis, Boerhavia diffusa, Euphorbia drummondii, Ipomoea lonchophylla, Maireana coronata, Malvastrum americanum, Portulaca sp. aff. P. oleracea, Ptilotus exaltatus, Rhynchosia minima, Salsola kali, Sida fibulifera, S. virgata, Tribulus terrestris, Trianthema triquetra.*	Occurs in two situations; most extensive areas occur on flat to gently undulating plains derived from weathered Cretaceous sediments but it is also found on flat alluvial plains usually on the levees of braided channels. Soils are moderately deep to very deep, brown cracking clays. Composition of the ground flora depends on seasonal conditions and land use both past and present. Following a series of above average rainfall seasons *Dichanthium* spp. are more conspicuous in the pasture. *Aristida* spp. are noticeable in some situations. Probably this is a reflection of seasonal conditions and light grazing strategies. Scattered low shrubs occur and in places form a well defined layer. Characteristic of units 50, 52, and 78. Occurs in land systems T1, T2, T3 with minor occurrences in T5, F5, F6 and F7.
Astrebla spp. with clumps of *Acacia harpophylla*	Open tussock grassland with patches of low open woodland to low woodland. Open tussock grassland. Height: <1 m. PFC: 15 ± 5%. Woodland Height: 8 ± 2 m. PFC: (variable) 7.5 ± 5%. Density: Trees/ha: 80 ± 40. Low shrubs/ha: <20.	GRASSLAND. Trees: *Acacia harpophylla.* Low shrubs: *Acacia farnesiana.* Graminoids: *Aristida latifolia, Astrebla elymoides, Bothriochloa ewartiana, Dichanthium sericeum, Enneapogon avenaceus, Panicum whitei, Sporobolus caroli.* Forbs: *Abutilon malvifolium, Bassia quinquecuspis, B. tetracuspis, Boerhavia diffusa, Evolvulus alsinoides, Malvastrum americanum, Oxalis corniculata, Sida trichopoda, S. virgata.* WOODLAND. Low shrubs: *Eremophila mitchellii.* Graminoids: *Chloris divaricata, Enteropogon acicularis, Eriochloa pseudoacrotricha, Paspalidium constrictum, Sporobolus caroli.* Forbs: *Abutilon oxycarpum, Bassia birchii, B. tetracuspis, Boerhavia diffusa, Zygophyllum apiculatum.*	Occurs on undulating to very gently undulating plains in the east. Soils are deep, red clays. Composition of the ground flora is governed by climatic conditions. There appears to be no pronounced physical differences between the soils supporting grassland and those supporting *Acacia harpophylla*. However, there are chemical differences with the soils supporting *A. harpophylla* having higher levels of P, C, N and pH at the surface and higher levels of TSS at depth. Characteristic of unit 54. Occurs in land system T5 with a minor occurrence in G4.

Table 4.7 Description of Floristic Associations

Floristic Association	Structural Formation Range Height, PFC, Density Data	Other Frequently Occurring Species	Comments
Mixed trees, tussock grasses	Open woodland to tall open shrubland. Height: 10 ± 4 m. PFC: 3 ± 2% rarely 7.5%. Density: Trees/ha: 150 ± 125. Low shrubs/ha: 80 ± 70.	Trees: *Acacia sowa, A. acradisa, A. tetragonophylla, Atalaya hemiglauca, Eucalyptus terminalis, Heterodendrum oleifolium, Lysiphyllum gilvum, Ventilago viminalis.* Low shrubs: *Acacia farnesiana, Eremophila mitchellii.* Graminoids: *Aristida contorta, Astrebla lappacea, Bothriochloa ewartiana, Dactyloctenium radulans, Enneapogon avenaceus, Eragrostis setifolia, Sporobolus australasicus, Tragus australianus.* Forbs: *Cassia sturtii, C. lanigera, Heliotropium tenuifolium, Portulaca* sp. aff. *P. oleracea, Salsola kali, Trianthema triquetra.*	Restricted to the east on crests of low rises associated with the *Jurgurda Formation* sediments. Soils are very shallow reddish brown clays usually grading into calcareous sandstone. It is variable in composition with any of the tree species predominating depending on local conditions. Both *Eucalyptus melanophloia* and *Flindersia maculosa* may be conspicuous in places. Scattered low shrubs are usually present rarely forming a distinct layer. Ground flora is variable. In places this association approaches a wooded open tussock grassland. Characteristic of unit 56. Occurs in land system T4.
Eucalyptus microtheca, Astrebla spp.	Low open woodland. Height: 8 ± 2 m. PFC: < 5% rarely 10%. Density: Trees/ha: 300 ± 200. Low shrubs/ha: (variable) 200 ± 200.	Trees: *Acacia cambagei, Melaleuca glomerata, Terminalia oblongata.* Low shrubs: *Eremophila bignoniiflora, E. mitchellii.* Graminoids: *Astrebla elymoides, A. lappacea, Cyperus difax, Dactyloctenium radulans, Eragrostis setifolia, Panicum decompositum, P. whitei, Sporobolus mitchellii.* Forbs: *Alternanthera nodiflora, Cassia hicorma, C. quinquecuspis, Boerhavia diffusa, Salsola kali.*	Associated with flat alluvial plains. Soils are very deep, grey cracking clays, with sand bands at depth. Scattered low shrubs occur and in places form a well defined layer. On some of the sandier terraces *Eremophila bignoniiflora* becomes very conspicuous and *E. microtheca* is rare if at all present. This association approaches a wooded open tussock grassland in some situations. Characteristic of unit 76. Minor occurrences in land systems W1, A1 and A3.
ASSOCIATED COMMUNITIES			
Acacia cyperophylla	Tall open shrubland. Height: 7 ± 2 m. PFC: usually 1% up to 5% in places. Density: Trees, tall shrubs/ha: 150 ± 100. Low shrubs/ha: < 25.	Low shrubs. *Acacia farnesiana, A. tetragonophylla, Cassia meinsii, C. nemophila, C. oligophylla.* Graminoids: *Astrebla pectinata, Bothriochloa ewartiana, Brachiaria miliiformis, Chloris pectinata, Dactyloctenium radulans, Enneapogon polyphyllus, Eragrostis setifolia, Panicum decompositum, P. whitei.* Forbs: *Atriplex spongiosa, Cassia divaricata, C. lanicuspis, Mairena coronata, M. villosa.*	Limited in extent. Occurs on drainage lines on undulating plains mainly west of Cooper Creek. Infrequently found on low hills associated with the undulating downs. Soils are shallow to moderately deep sandy clay loams to clay loams. *Acacia cyperophylla* may form almost pure stands in places. Scattered trees of *A. cambagei* and *Eucalyptus coolabahensis* may occur. Isolated low shrubs are usually present but rarely form a well defined layer. Ground cover is variable and its composition depends on seasonal conditions. Characteristic of unit 85. Occurs in land systems F2, F3, F4 and A5 with very minor occurrences in W7, K4, R7 and R8.
FORB/SHORT GRASS PREDOMINANT ASSOCIATIONS			
Forbs/Short grass	Sparse herbfield to herbfield. Height: 0.75 ± 0.25 m. PFC: 30 ± 30%. Density: Trees/ha: < 10. Shrubs/ha: < 25.	Trees, tall shrubs: *Acacia cambagei, Eucalyptus microtheca.* Low shrubs: *Cassia phyllodinea, C. oligophylla, C. sturtii, Chenopodium auricomum, Eremophila polyclada.* Graminoids: *Aristida* spp., *Astrebla elymoides, A. lappacea, A. pectinata, A. squarrosa, Brachyachne convergens, Chloris pectinata, Cyperus gilesii, Dactyloctenium radulans, Digitaria muelleri, Eragrostis dielsii, E. setifolia, E. tenellula, Iseilema membranaceum, Panicum whitei, Sporobolus actinocladus, Tranthoseria truncatum.* Forbs: *Aeschynomene indica, Alternanthera nodiflora, Atriplex elachophylla, A. holocarpa, A. lindleyi, A. spongiosa, Babbagia sclerocarpa, Cassia divaricata, Boerhavia diffusa, Centipeda thespidioides, Commelina cyanea, Ipomoea lonchophylla, I. muelleri, Tribulus* spp., *Morgania floribunda, Portulaca* sp. aff. *P. oleracea, Psoralea cinerea, Ptilotus murrayi, Salsola kali, Sida fibulifera, S. goniocarpa, S. trichopoda, Teucrium racemosum, Threlkeldia proceriflora, Trianthema triquetra.*	Widespread; associated with the floodplains and interchannel alluvia of the major streams and their distributaries. Soils are mainly deep to very deep, grey and brown cracking clays with limited areas of texture contrast soils. Scattered trees and shrubs may occur. Composition is dependent on seasonal conditions and on the incidence, type and degree of flooding. Forbs or grasses predominate. The abundance of *Astrebla* spp. varies greatly and reflects the history of the past seasons as well as the present season. In places *Astrebla* spp. may predominate. These associations are discussed elsewhere. Occurs in land systems C1, C2, A3, A4, D1, D3 and L1 with minor occurrences in all land systems in the alluvial land zone.

Table 4.7 Description of Floristic Associations

Floristic Association	Structural Formation Range, Height, PFC, Density Data	Other Frequently Occurring Species	Comments
MISCELLANEOUS ASSOCIATIONS			
Albizia basaltica	Low open woodland to open woodland. Height: 10 ± 3 m. PFC: 5 ± 4% usually <5% . Density: Trees/ha: 275 ± 200. Tall shrubs/ha: 200 ± 150. Low shrubs/ha: 150 ± 100.	Trees: *Ataluya hemiglauca, Eucalyptus papuana* (in places), *Flindersia maculosa, Grevillea striata, Lysiphyllum gilvum* (in places). Tall shrubs: *Geijera parviflora, Ventilago viminalis.* Low shrubs: *Apophyllum anomalum, Capparis lasiantha.* Graminoids: *Aristida browniana, A. contorta, A. ingrata, Chrysopogon fallax, Dactyloctenium radulans, Enneapogon polyphyllus, Enteropogon acicularis, Eragrostis eriopoda, Eriachne mucronata, Perotis rara, Tragus australianus.* Forbs: *Abutilon otocarpum, Bassia bicornis, B. cornishiana, Boerhavia diffusa, Evolvulus alsinoides, Portulaca* sp. aff.*P. oleracea, Salsola kali, Tribulus terrestris.*	Occurs in the north east on outer alluvial plains fringing major rivers. Soils are very deep texture contrast soils with coarse sand to coarse sandy loam overlying sandy clay subsoils. Small areas of earthy sands and sandy red earths also occur. The density and floristic composition vary. In places, both a well defined tall shrub layer and a low shrub layer occur. The presence of ground layer species depends on seasonal conditions. Two variants of this association occur. Species found in both variants and this association are similar but the predominant species differ. (a) *Flindersia maculosa* predominates forming a low open woodland with *Lysiphyllum gilvum* conspicuous. This is associated with sandy levees. (b) *Eucalyptus papuana* also forms a low open woodland with scattered *Grevillea striata, Acacia coriacea* and less frequently *A. aneura.* A low shrubby layer mainly *Cassia* spp. is well defined. *Aristida* spp. predominate the ground flora but *Plectrachne pungens* is conspicuous. This variant is very restricted in extent in the area. Characteristic of unit 92. Occurs in land system S5 with minor occurrences in S2, R1 and W2.
Grevillea striata	Low open woodland. Height: 9 ± 3 m. PFC: <5%. Density: Trees/ha: (variable) 75 ± 70. Shrubs/ha: < 200.	Trees: *Capparis nummularia* var. *spinosa, Clerodendrum floribundum* (in places), *Owenia acidula, Pittosporum phillyraeoides.* Low shrubs: *Acacia tetragonophylla, Capparis lasiantha, Carissa lanceolata* (in places), *Cassia nemophila* var. *nemophila.* Grasses: *Aristida browniana, Eragrostis eriopoda, E. leptocarpa, Eriachne helmsii, Themeda avenacea.* Forbs: *Bassia cornisiana, Euphorbia drummondii, Portulaca* sp. aff. *P. oleracea, Ptilotus polystachyus.*	Very limited in extent. Occurs in depressions in *Triodia basedowii* sand plains in the central east. Soils are sandy red earths to earthy sands. Low shrub layers are well developed in places. Characteristic of unit 30. Occurs in land system S4.
Acacia calcicola	Tall open shrubland. Height: 3 ± 1 m. PFC: < 5%. Density: Tall shrubs/ha: 250 ± 150. Low shrubs/ha: 150 ± 50.	Tall shrubs: *Acacia aneura.* Low shrubs: *Cassia artemisioides, C. phyllodinea.* Graminoids: *Enteropogon acicularis, Enneapogon polyphyllus, Eragrostis setifolia, Tripogon loliiformis.* Forbs: *Bassia convexula, B. divaricata, Ptilotus polystachyus, Salsola kali.*	Very limited in extent. Occurs on lower slopes of fringing minor alluvia associated with hard land zones west of Adavale. Soils are shallow, red texture contrast soil with clay loams overlying medium clays. Low shrubs are present but usually do not form a well defined layer. Ground flora is variable composed of grasses and forbs. Characteristic of unit 90. Occurs in land system A6.
Eremophila mitchellii, Acacia excelsa	Tall open shrubland. Height: 6 ± 3 m. PFC: 7.5 ± 2.5%. Density: Trees/ha: < 100. Tall shrubs/ha: 300 ± 100.	Trees: *Grevillea striata, Eucalyptus populnea* (in places). Low shrubs: *Cassia nemophila* var. *nemophila, Eremophila glabra, E. maculata.* Graminoids: *Eragrostis eriopoda, E. kennedyae, Tripogon loliiformis.* Forbs: *Bassia bicornis, B. birchii, Boerhavia diffusa, Sida platycalyx.*	Very limited in extent. Occurs in run-on situations associated with sand plains supporting *Acacia aneura* in the south east. Soils are texture contrast soils. Shrub layers are well defined. Ground cover is variable frequently low and composed of grasses and forbs. Characteristic of unit 22. Occurs in land system S1.
Eremophila sturtii	Low open shrubland to low shrubland. Height: 1.25 ± 0.75 m. PFC: (variable) usually <5% up to 20%. Density: Trees/ha: <25 Low shrubs/ha: 800 ± 700.	Trees: scattered *Eucalyptus terminalis, Grevillea striata.* Low shrubs: *Acacia tetragonophylla.* Graminoids: *Aristida browniana, Dactyloctenium radulans, Enneapogon polyphyllus, Eragrostis eriopoda.* Forbs: *Abutilon otocarpum, Atriplex spongiosa, Bassia* spp., *Boerhavia diffusa, Helipterum floribundum, H. moschatum.*	Occurs mainly on the west on the edge of the sandplains or dunefields and adjacent alluvia. Soils are very deep, red and brown texture contrast soils with loamy coarse sands overlying sandy mottled clays. Ground flora is dependent on seasonal conditions. Following adequate rainfall composites would be more plentiful. Representative of a variant of unit 4. Occurs in land systems D1, D3 and S4.
Cassia phyllodinea	Low open shrubland. Height: 1.25 ± 0.5 m. PFC: 3 ± 2%. Density: Trees/ha: <5. Low shrubs/ha: 350 ± 300.	Trees: *Atalaya hemiglauca.* Shrubs: *Cassia desolata, C. oligophylla, Eremophila glabra, Maireana aphylla.* Graminoids: *Chloris pectinata, Dactyloctenium radulans, Enneapogon polyphyllus, Eragrostis setifolia, Iseilema membranaceum, Sporobolus actinocladus, Tripogon loliiformis, Tragus australianus.* Forbs: *Bassia cornishiana, B. lanicuspis, Chenopodium nadiroostachyum, Goodenia subintegra, Portulaca* sp. aff. *P. oleracea, Salsola kali, Sida fitulifera, Trianthema triquetra.*	Limited in extent. Occurs mainly in the west on flat alluvial plains adjacent to the undulating downs. Soils are very deep to moderately deep, red alluvial texture contrast soils. Scattered trees occur. In places the density of low shrubs is such that structurally the association tends towards an open herbfield. Ground flora depends on seasonal conditions with either grasses or forbs predominating. Characteristic of unit 81. Occurs in land systems W4, C2, A2, A5, A6, F8 with minor occurrences in M3 and H5.

In alluvial situations, broad ecotones are noticeable between these associations and adjoining associations. However abrupt disjunctions occur on the eroded lower slopes of the dissected residuals.

Acacia cambagei associations

These associations (Table 4.7) occur throughout and occupy approximately 12.5% of the area. Although they occur in three different situations, namely on alluvial plains, on mantled pediments of dissected residuals and on flat to gently undulating plains of Cretaceous sediments these associations are best developed on the flat to gently undulating plains. Blake (1938) stated that *Acacia cambagei* enjoys the widest range of habitats of all trees and shrubs in western Queensland but observations in this area suggest that *A. aneura* had adapted to more habitats than *A. cambagei*. *A. cambagei* does not exhibit a wide range of soil tolerances and associations are mainly confined to red and brown clays with some occurrences on texture contrast soils. The soils vary in depth from shallow to very deep with the clays usually exhibiting some gilgai microrelief. Their nutrient status is variable but compared with other soils in the area nutrient levels are relatively high. High salt levels are common at depth.

Structurally these associations range from low woodland to tall open shrubland with tall shrubland and low open woodland the most frequently occurring formations. Various other strata may occur and contribute significantly to the biomass. If the association has been disturbed then a dense shrubby layer may be developed.

Approximately 35% of species recorded occur in these associations with species of Chenopodiaceae making a major contribution as in Part I (Boyland, 1974). There is a relatively low number of species restricted to these associations.

A. cambagei may form complexes with *Eucalyptus* spp. in alluvial situations and with *A. aneura* on mantled pediments. They frequently fringe *Astrebla* spp. tussock grasslands on the undulating downs and in some situations give the impression of invading the downs. This was also observed by Blake (1938).

Because of the limited extent of *Acacia harpophylla* associations, these associations have been treated under this major floristic grouping as associated communities. Structurally *A. harpophylla* associations range from low open woodland to woodland but occur mainly as low open woodland or shrubby open woodland. A large percentage of these limited associations is found in naturally unstable situations totally unsuitable for pasture development. Floristically these associations are relatively poor compared to other major groupings in the area. These associations form complexes with *A. cambagei* in places and also *Astrebla* tussock grassland.

Acacia aneura predominant associations

These associations (Table 4.7) occur in the west and south east covering about 15% of the total area. Although these associations are best developed on the deep loamy red earths in the south east, the *A. aneura* associations may occur on a wide range of soils from siliceous sands and lithosols to deep, red cracking clays.

Structurally these associations vary from low open woodland to sparse tall open shrubland. The most frequently occurring structural formation is the tall open shrubland. The structural complexity of these associations is a reflection of the available moisture which is influenced by climate, position in the landscape, soil depth and soil type. However, density of *A. aneura* also varies greatly under similar topography, soil conditions and climate. It is felt that other factors such as natural catastrophes, actions of man and his grazing animals have a major influence on *A. aneura* density. Boyland (1973) has discussed *A. aneura* associations and their relationship to landscape in south west Queensland.

The floristic composition of these associations varies considerably. It is dependent on seasonal conditions but in the east the composition is also influenced by the density of *A. aneura*. In dense stands of *A. aneura* the ground storey development is poor. This is probably a reflection of competition for moisture and nutrients as light does not appear to be a limiting factor. Although more than a third of the species recorded for the area was observed in these associations only a few species were restricted to these associations.

A. aneura occurs as the dominant or co-dominant in the upper storey layer associated with a wide range of lower storey species. The upper storey layer appears to be distributed independently of the lower storey species. As a result of this,wide ecotones between some plant associations within the area exist. This apparent behaviour complicates the division of *Acacia aneura* dominant plant communities into plant associations. Where difficulties were experienced in subdividing plant associations, the practice to divide rather than group was adopted because of the importance of *A. aneura* to the pastoral industry.

Other *Acacia* predominant associations

These associations (Table 4.7) are found throughout and are restricted to the scarps and slopes of dissected residuals or the associated undulating to flat tops of tablelands and mesas. They are extensive occupying approximately 20% of the total area. Soils range from stony lithosols to shallow loamy red earths with parent rock frequently outcropping.

Structurally these associations range from low open shrubland to low woodland. The most common structural formations are low shrubland or low open shrubland and these formations would account for more than 80% of the associations. The low woodlands and low open woodlands occur mainly on the upper slopes of dissected residuals associated with the cuestas.

Approximately 20% of the species listed for the area were observed in these associations. The floristic diversity appears unusually high considering the harsh environment. More than 20% of species occurring in the area are restricted to these associations. This figure is relatively high compared to other major floristic groupings of associations. Probably this is a reflection of the specific adaption of species required to persist in this harsh environment. The number of species of Compositae listed for these associations is relatively low. This was also observed in WARLUS Part I (Boyland, 1974) but again it may only be a reflection of seasonal conditions.

Delineation of these associations is difficult in some situations. There appears to be a well defined relationship between topography, the degree of weathering and vegetation types. The gradational change from lower slopes through upper slopes and scarp to the old Tertiary land surface is reflected in the vegetation. Where changes in slope or the degree of weathering are abrupt there is a corresponding well-defined boundary between vegetation types. If changes in slope and the degree of weathering are gradual then plant associations tend to grade into one another forming a complex.

Shrubby chenopod predominant associations

These associations (Table 4.7) are best developed in the channel country but are associated with depressions or periodically flooded areas on alluvia throughout the area. Depressions in dunefields and sandplains also support these associations. Soils are mainly deep, grey cracking clays but limited areas of deep, brown cracking clays occur.

Structurally these associations range from low open shrubland to low shrubland. Frequently these associations form complexes with *Eucalyptus microtheca* low open woodland and various herbfields.

Floristically these associations do not exhibit a great diversity. The number of species restricted to this association is very low. It is possible that a number of species which occur in this land zone were not recorded as access to this land zone is difficult after flooding when

the maximum number of species would probably be growing. Also floods during different seasons result in the growth of different species. The area was not intensively sampled following floods.

In the channel country these various associations frequently grade into one another making delineation difficult. In these situations it is convenient to consider the resulting association as a complex.

Triodia spp. predominant associations

Two species, *Triodia basedowii* and *T. pungens* characterize associations in the area. However the *T. pungens* plant associations which are found on the slopes of dissected residuals are so restricted in extent that they contribute very little to the vegetation of the area.

Triodia basedowii associations occur on the dunefields and sandplains in the west and cover approximately 7.5% of the area. *T. basedowii* associations are usually restricted to the lower slopes of dunes and adjacent flat plains. Rarely are these communities found on the mobile crests of the dunes. Soils are deep, red siliceous sands to earthy sands.

Structurally these associations range from open hummock grassland to hummock grassland. Scattered trees and shrubs are usually conspicuous in the associations developed on the sandplains and in places the emerging shrubby stratum is well defined. Scattered trees and shrubs are also associated with these communities in the dunefields but rarely does the shrubby stratum tend to become predominant.

Floristically these associations are variable depending on present seasonal conditions, seasonal history, natural catastrophies as well as current and past land use. In the pristine state *T. basedowii* forms almost pure stands with only scattered shrubs and isolated ephemerals between the clumps even in above average rainfall seasons. Where this association has been disturbed by fire or grazing, floristic diversity increases greatly. This diversity increase is desirable from a grazing viewpoint but excessive manipulation of these associations could lead to depletion of basal cover of *T. basedowii* to such a level that loss of stability of the association may result. More than a third of the species listed for the area as a whole occurs in these associations and approximately three quarters of these species are ephemerals which is not unexpected. Approximately 25% of species observed in this land zone were not recorded elsewhere which reflects the special adaptation species have developed to persist in this land zone characterized by a harsh climate and low nutrient status soils.

The *Triodia basedowii* associations are a heterogenous grouping and undoubtedly more intense sampling would have permitted the association to be divided into more homogenous groups. However, the expenditure of additional time on studying these associations in more detail was not considered warranted.

The *Zygochloa paradoxa* association which is restricted to the mobile crests of dunes has been placed under this floristic grouping. This shrub-like grass forms an open hummock grassland which is floristically very poor. Other plant communities associated with the dunefields have also been included under this floristic grouping. These plant associations are limited in extent.

Astrebla spp. predominant associations

(a) Non-wooded

These associations (Table 4.7) are extensive covering approximately 25% of the total area. Although these associations occur throughout the region they are best developed in the east. The *Astrebla* spp. predominant associations are found in three situations, the rolling downs in the east, the stony downs in the west both of Cretaceous origin and the recent alluvial plains occurring along some of the major rivers. Soils are restricted to grey and brown cracking clays with limited areas of red cracking clays. The nutrient status of these soils is relatively high in comparison to the soils of this area and is not a limiting factor to plant growth.

Structurally these associations range from sparse open herbfields to tussock grasslands depending on seasonal conditions and location. Although the associations of the stony downs in the west have been included they should not be considered true Mitchell grass downs. *Astrebla* spp. only predominates following a series of above average rainfall seasons and then only in areas where stone cover is not formed into a solid pavement. Forbs especially *Bassia* spp. and *Atriplex* spp. and/or other short grasses especially *Iseilema* spp. frequently contribute more to the pasture in normal seasons. These tussock grasslands are characterized by an even, sparsely distributed stand of *Astrebla* spp. the basal cover of which varies from less than 0.5% up to 6% depending on seasonal conditions and current and past land use. Other species which are found in these associations vary greatly because of both seasonal conditions and the geographic distribution of the various associations. Generally *Astrebla lappacea* tends to predominate in the east and *A. pectinata* predominates in the west. *A. squarrosa* is more conspicuous in moister situations, especially those areas that are subject to periodic flooding.

About 30% of the species listed for the area occur in these associations. Only 10% of these species are restricted to these associations. Considering the extensiveness of these associations the floristic richness is low compared to other major associations in the area.

(b) Wooded

These associations (Table 4.7) occur mainly in the eastern and central region. They are found in two situations, usually on flat to gently undulating plains derived from weathered Cretaceous sediments and also on flat alluvial plains. Soils are mainly moderately deep to very deep, brown cracking clays with texture contrast soils occurring to a limited extent.

Structurally the associations range from open woodland to tall open shrubland. In places these associations grade into tussock grassland with scattered trees.

Floristically the associations are very similar to the non-wooded *Astrebla* associations. The occurrence and density of the species appears to be governed by local variation in habitat. Some species such as *Acacia pendula, Albizia basaltica, Lysiphyllum gilvum* and *Ventilago viminalis* are restricted to the east and this is probably due to climatic requirements for survival. Other species including *Acacia cana, A. cambagei* and *Atalaya hemiglauca* are widespread. The composition of the ground storey is variable. Seasonal conditions and tree or shrub density appear to govern what species occur. Where tree or shrub density is relatively high frequently occurring grasses include *Dactyloctenium radulans, Enneapogon avenaceus, Enteropogon acicularis* and *Sporobolus* spp. *Astrebla* spp. tend to dominate in other situations.

Forb, short grass predominant association

This association (Table 4.7) is found in alluvial situations throughout the area, occupying about 7% of the total area. Soils are mainly deep, grey and brown cracking clays but limited areas of texture contrast soils also occur.

Structurally this association ranges from a sparse herbfield to herbfields with either grasses or forbs predominating. Floristic composition depends mainly on seasonal conditions but edaphic factors also influence the composition. Past history of both land use and seasonal conditions may also explain some of the variation in this association. Almost a third of the species recorded for the area may be found in this association. However the number of species restricted to this association is relatively low.

Because of the great variation in floristic composition this association was treated as one heterogenous unit. Time did not permit sufficient sampling required to further subdivide this association on a meaningful basis.

Miscellaneous

A limited number of plant associations occur which are not readily classified into one of the major floristic groupings. These have been aggregated under this heading (Table 4.7).

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HYDROLOGY

by Officers of the Water Resources Commission.

Supplies of groundwater are obtainable throughout this area at depths ranging from less than 15 to more than 2 000 metres. Yields are generally low, particularly in the shallower aquifers, but are sufficient for stock water purposes. The deeper aquifers usually produce larger flowing supplies. Licensing conditions do not permit irrigation from bores penetrating the aquifers of the Great Artesian Basin.

LOCATION

Underground water is available in some quantity from most of the formations above the Palaeozoic basement.

The Jurassic *Hutton Sandstone*, where it is present, can supply artesian and sub-artesian water, but is rarely used because of its depth. The depth to the top of this formation ranges from about 1 100 to 1 650 metres.

The Jurassic *Adori Sandstone*, which is located directly above the *Hutton Sandstone*, produces similar supplies but it also is rarely tapped as other aquifers are encountered before it is reached.

The Jurassic *Hooray Sandstone* is a major aquifer of the Great Artesian Basin but is seldom tapped in this area because of its depth.

The Cretaceous *Wallumbilla Formation* also produces artesian and sub-artesian supplies with the *Coreena Member* the main aquifer. However, few bores have penetrated the aquifer, except in the north-east and north-west where the top of the formation is located at about 400 metres below the surface.

The Cretaceous *Winton Formation* contains the most utilised aquifers in this area. The average thickness of the Formation is about 600 metres, but this varies from about 200 metres in the west to about 900 metres in the central and eastern part of the area. The supplies obtained from this formation are generally sub-artesian.

Shallow sub-artesian supplies are obtained from the Tertiary and Quaternary sediments. The Tertiary *Glendower Formation* is present over most of the area, at depths down to about 150 metres, which does not contain continuous aquifers. Consequently, although many bores succeed in tapping supplies from these shallow beds, there are many others which fail to locate a supply. The alluvium and associated Quaternary deposits are mainly superficial. However the alluvium along some of the major streams reaches sufficient depth to produce useful stock water.

YIELD

The deeper aquifers, the *Hutton Sandstone*, the *Adori Sandstone* and the *Hooray Sandstone* can produce artesian flows. However, of the few bores which tap these aquifers, some have ceased to flow and in others the flow has reduced considerably. Flows from these formations range from trickles to about 5.0 litres per second. Adequate amounts of stock water can be pumped from the aquifers of these formations.

Some ideally located bores tapping aquifers in the *Wallumbilla Formation* and the deeper aquifers of the *Winton Formation* can produce small artesian supplies. However, supplies of up to 1.26 litres per second are available by pumping. Shallow aquifers of the Tertiary and Quaternary sediments will usually yield supplies from about 0.13 to 1.0 litres per second.

QUALITY

Water of suitable quality for stock use is obtained from all the major aquifers. Small quantities of saline waters are obtained from some sediments between the main aquifers but these can be cased and cemented out.

Generally, the waters from the deeper aquifers have a total dissolved solids content of between 500 and 3 000 mg/litre, with most samples in the range of 1 000 to 1 500 mg/litre. The fluoride content in the deeper bores ranges from 1 to 5 mg/litre and averages about 3 mg/litre.

Shallow supplies are more variable in quality but most are still suitable for stock use. The range of total dissolved solids is from 300 to more than 5 000 mg/litre. The shallow water has a very low fluoride content.

POTENTIAL FUTURE DEVELOPMENT - IRRIGATION

The alluvial deposits of the major streams contain the only potential water supplies for irrigation in this area. As hydrological data are very limited, little is known of the likelihood of irrigation supplies being available. However, the extent and depth of the alluvial deposits do offer some potential for the future development of small scale irrigation projects. Surface water supplies and their distribution are discussed in Chapter 8.

LAND SYSTEMS

by J.R. Mills *

The survey area covers 100 000 km^2 of land in south-western Queensland. Most of the area falls within the arid (less than 500 mm) rainfall zone and is used for grazing purposes. The southern boundary adjoins Part 1 of the Western Arid Land Use survey reported upon by Dawson (1974).

The objectives of the survey were to provide an inventory of the resources in the area, to interpret and assess the collected data, and to identify factors influencing land use and the long term effects of current methods of land use.

SURVEY METHODS

The survey procedures follow those described by Dawson (1974). Mapping units were delineated on 1969 to 1972 black and white aerial photographs with a scale of 1:84 000. In some instances the mapping units correspond to individual land units, and in other instances to assemblages of land units involving one or more land systems.

Field sampling activities were carried out at two intensity levels during the course of the survey. Sampling was carried out in detail at 271 sites (See Chapter 3 for location diagram). This sampling was carried out in 1972 and 1973.

After preliminary photo-interpretation and field checking, sections of traverses across the various land units to be sampled were selected. These traverses included typical areas of the various land units, to show the relationship of the units to each other in a particular land system, and the position of each land system in the landscape. Actual site locations were selected in the field along predetermined sections of each of the traverses.

Approximately 800 reconnaissance sites were recorded at the less detailed level. Most of this sampling was undertaken during preliminary field traversing of the area. At these sites notes were recorded about land form, and readily apparent soil and vegetation characteristics. Sampling sites were selected in relatively undisturbed areas where possible. Due to the limited time available in the field, soil and vegetation samples were generally collected in readily accessible areas within reach of the existing roads and tracks.

The number of detailed sampling sites recorded for each land unit was related to relative importance in terms of productivity and land use. Where possible, sites were spread over the geographic distribution of the land unit, with three or more representative detailed

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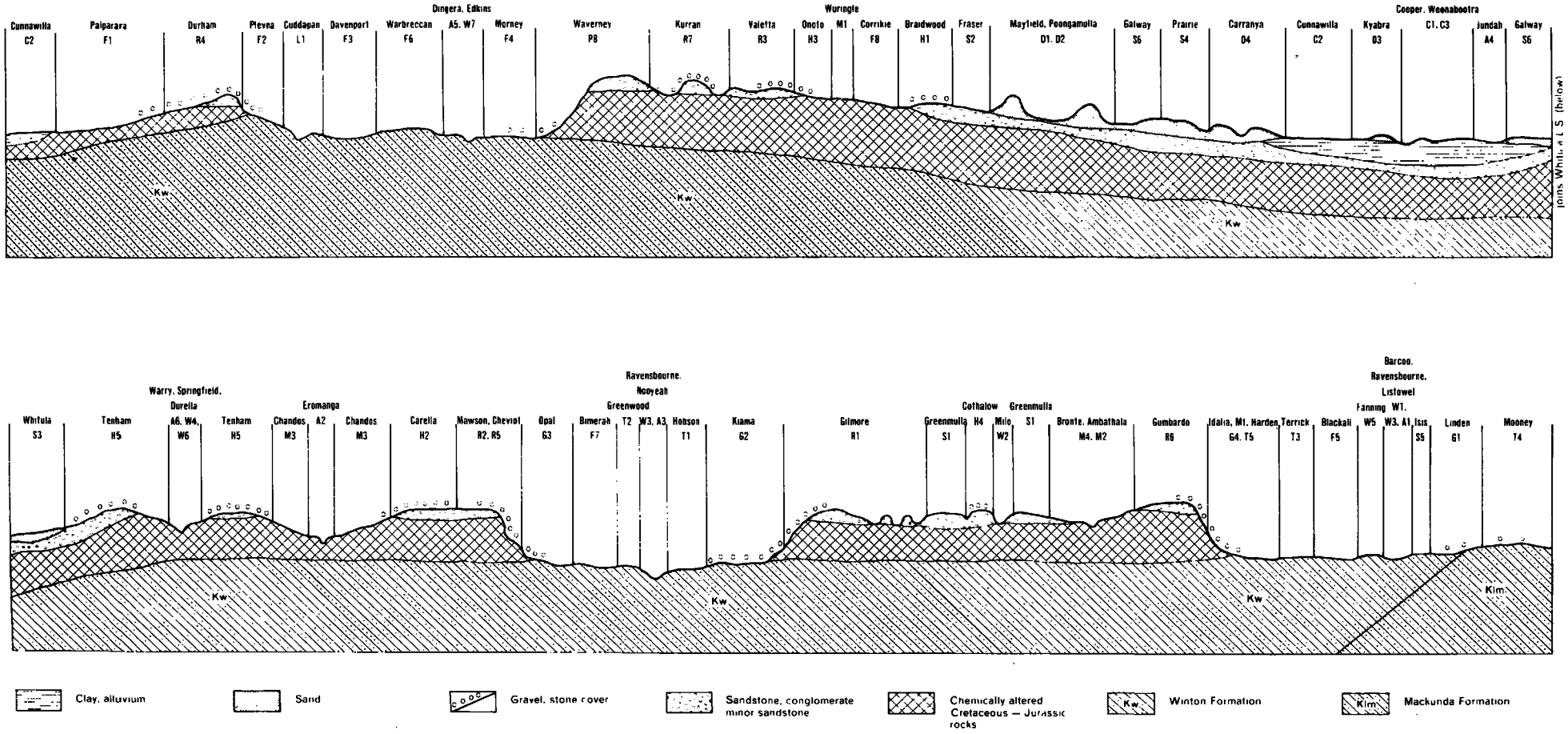


Figure 6.1 Diagrammatic cross section illustrating idealized relationship between land systems and geology.

sites recorded on land units regarded as having significant land use potential. Some units which were considered of minor importance were not sampled in detail, and descriptions were prepared from reconnaissance sites previously recorded for these units. Data were collected at detailed sample sites using standardised descriptions and recording sheets. Data were coded directly onto these recording sheets in the field. Site locations were marked on the aerial photographs and co-ordinates were recorded on the data sheets.

The information recorded at these sites on landform, geology, vegetation, land use factors, soil profile information and analytical data for the soils, are shown in Microfiche I. These data are also stored on computer tape forming a data bank for the area. These data can be sorted and processed by computer and all recorded information is available on computer tapes for analyses by other workers.

Dyeline prints of the land system map at a scale of 1:250 000 are available for use by other interested persons working in the area.

LAND SYSTEMS

A total of 61 land systems is described. A land systems map at a scale of 1:500 000 is presented, showing the distribution of the land systems throughout the survey area. Detailed land system descriptions and diagrams are presented in Appendix IV. The relationship between land systems and their position in the landscape is shown in Figure 6.1.

Land systems have been named after localities, properties or other features where typical developments of the particular land system occur. They are not intended to indicate any single geographic area to which the land system is confined in occurrence.

For purposes of description, the 61 land systems have been grouped into 12 land zones on the basis of vegetation, soils, topography and geomorphic development.

DUNEFIELDS LAND ZONE

Four land systems have been recognized in this land zone based on differences in structural form of the dunes. The longitudinal dunefields consist of sand ridges up to 10 m high, tending north-west or west-north-west, parallel to the dominant winds (Gregory and Vine, 1969). Other dune types occur where drainage lines enter areas thereby giving rise to numerous claypans with reticulate dunes, and where aeolian sands have recently encroached across the alluvial plains.

The dunefields are composed largely of quartzose sands derived mainly from the *Glendower Formation*, while most of the clay fraction is derived from altered *Winton Formation*. Heavy mineral analyses of sand samples indicate that the quartzose sands originated in the Mt. Isa or Charters Towers regions and were eventually transported to their present positions by a complex process of alluvial and aeolian action (Gregory, Senior and Galloway, 1967).

Many dunes have a partly consolidated core with a higher percentage of clay than the outer dune surface. Reworking of this outer surface zone occurs, but it is apparent that little mass movement of sand occurs between dunes. However, there may be some minor local longitudinal movement of sand along dunes.

Mayfield land system (1 010 km^2) comprises longitudinal dunes with continuous mobile crests. These dunes are approximately parallel and are generally oriented in a north-westerly direction, although this may be modified by the effect of local topographic features, for example the Little Hills anticline. Soils are red siliceous sands and earthy sands with scattered spinifex stabilizing the lower flanks. The interdune areas comprise red earthy sands with scattered shrubs and spinifex open hummock grassland.

Poongamulla land system (1 000 km^2) comprises longitudinal dunes with continuous mobile crests, similar to Mayfield, but differs in that the interdune areas contain claypans. The dunes characteristically display a hook-shaped tail on the southern end. Inter-dune areas support spinifex open hummock grassland on the red earthy sands, with mulga communities on the texture contrast soils surrounding the claypans and scattered coolibahs fringing the claypans.

Kyabra land system (950 km^2) comprises small dunes which occur singly or in groups, mainly on the outer alluvial plains of Cooper Creek and the lower reaches of the Barcoo River, Farrars Creek and Kyabra Creek. Mobile crests are developed on the larger dunes. Cemented aprons occur around the base. The red siliceous sands and earthy sands support spinifex communities and scattered trees.

Carranya land system (500 km^2) consists of networks of reticulate dunes of Quaternary sand with salinas, claypans and seasonal swamps in the inter-dune areas. The red siliceous sands and earthy sands support spinifex open hummock grassland on the dunes and coolibah/bluebush communities on the claypans.

SANDPLAINS LAND ZONE

Six sandplain land systems have been delineated. Greenmulla, Fraser and Whitula land systems are mulga dominant, while the remaining three are predominantly spinifex grasslands. These sandplains have been formed by the same geological process as the dunefields with sand and finer grained material being deposited over the Tertiary land surfaces and Quaternary alluvium. All of the sandplains are vegetated, stabilised sand surfaces with varying amounts of finer grained material intermixed. Textures range from sands and loamy sands to sandy loams on the spinifex sandplains. The mulga sandplains generally have sandy loam to sandy clay loam textures between 0-60 cm.

Greenmulla land system (2 010 km^2) occurs in the south-east where the surfaces of the Powell and Gumbardo plateaux have been covered by Quaternary sands and finer grained material. This land system is relatively flat with few defined drainage lines. Deep, sandy red earths and red earths with diffusely groved, mulga open shrublands predominate. Stony red earths and lithosols occur occasionally, particularly around the margins of the plateaux where the underlying land surface is thinly covered.

Fraser land system (1 740 km^2) comprises a flat to slightly undulating sandplain occurring west of the Thomson River where Quaternary sands of aeolian, alluvial and sedentary origin have covered the *Glendower Formation*. Deep, sandy red earths support groved mulga communities. The characteristics of this land system change slightly in the north, where some coarse-grained sandstone outcrops, and topography is more undulating with slopes up to 2%.

Whitula land system (1 400 km^2) is essentially a flat to gently sloping sandplain of Quaternary sand and clay which occurs over Tertiary land surfaces and alluvium in the south-west. Mulga open shrublands generally showing a characteristic groving pattern predominate on deep, acid, sandy red earths. Small areas of bloodwood open woodlands occur, mainly on texture contrast soils and red clays in run-on areas where deposits of Cainozoic limestone occur.

Prairie land system (820 km^2) is essentially a flat, wooded spinifex sandplain formed where Quaternary sands have covered alluvial plains. Scattered claypans occur where the underlying alluvium is exposed. Areas of Whitula land system occur where this land system grades into the hard mulga land zone. The red earthy sands and siliceous sands support spinifex open hummock grassland with scattered trees and shrubs.

Isis land system (1 420 km^2) consists of Quaternary sands which form flat sand sheets and small sand ridges along the margins of extensive alluvial plains, mainly on the upper Barcoo River. The deep, sandy surfaced, texture contrast soils support gidgee and dead finish communities. Limited areas of poplar box woodlands occur on the sandy levees in the east.

Galway land system (3 080 km^2) is the major area of sandplain supporting spinifex vegetation. It occurs mainly west of Cooper Creek. Quaternary sands cover the older Quaternary alluvial plains and in some cases the Tertiary land surface. This has resulted in flat to very gently undulating plains of red earthy sands and red siliceous sands. Tree cover is variable. Occasional sand dunes occur on this land system, but where larger dunes are developed they have been mapped as Mayfield land system.

SOFT MULGA LAND ZONE

Four land systems have been delineated in the soft mulga land zone, three on the basis of vegetation (reflecting climatic changes from east to west), and one on surface microrelief. Weathering and erosion of the Tertiary land surface have resulted in the formation of gently undulating plains supporting mulga shrublands. Redistributed erosion materials form a red earth soil cover of variable depth and texture. These comprise flat to gently undulating plains of loamy red earth soils deeper than 50 cm. Soil depth usually increases down the slope. Alluvial land zones and sometimes sandplains grade into the lower slopes of the soft mulga land zone. The upper slopes usually grade into the hard mulga or dissected residual land zones.

Wuringle land system (460 km^2) is confined to areas west of the Thomson River. Gilgai microrelief occurs in the grove areas. Long gentle slopes are characteristic. Areas of the hard mulga and residual land zones occur at the top of the slopes. Red earths predominate in the intergrove. The vegetated groves have red clays and texture contrast soils and support mulga tall open shrublands with kangaroo grass conspicuous in the gilgais.

Ambathala land system (640 km^2) is confined to the Ambathala Plateau in the south east. A large basin with gently sloping plains running down to extensive central run-on areas has been formed on this plateau. Re-distribution of erosion material derived from *Glendower Formation* and altered *Winton Formation* has led to the development of deep, red earths and red texture contrast soils, with minor occurrences of brown and grey clays in the run-on areas. Mulga, poplar box woodlands occur on the slopes, grading into gidgee, sandalwood shrubby woodlands in the run-on areas.

Chandos land system (2 570 km^2) extends through the south from the Bulloo River to Cooper Creek. West of Cooper Creek, the Chandos land system grades into the more arid Onoto land system. In the east Chandos land system grades into the Bronte and Ambathala land systems. Chandos occurs on the lower slopes of hard mulga land zones, where redistribution of erosion material has formed red earths with scattered gravel cover and occasionally texture contrast soils in the run-on areas. Groved, mulga tall shrublands predominate with scattered western bloodwoods. Sink holes sometimes occur in the grove areas.

Bronte land system (1 410 km^2) occurs in the south-east on the Ambathala Plateau. Limited areas of the Bronte land system occur west of the Bulloo River, where it grades into the Greenmulla and Chandos land systems. Deep, red earths with ironstone shot on the surface and texture contrast soils occur on gently undulating to flat plains. Diffusely groved mulga, poplar box tall open shrublands predominate.

HARD MULGA LAND ZONE

Five land systems have been delineated in this land zone, mainly on the basis of landform characteristics. The hard mulga land zone occurs where a thin cover of the redistributed material derived from the erosion of the former land surface is present over *Glendower Formation* or altered *Winton Formation*. Gently undulating to undulating plains with stone and gravel cover are characteristic. Shallow red earths predominate, supporting groved mulga open shrublands. Small areas of bastard mulga open shrubland occur on stony lithosols on crests.

Braidwood land system (230 km^2) comprises gently undulating to undulating plains which occur along the west bank of the Thomson River. A complex of soils occurs. Red hardpan soils with gravel cover predominate, with minor areas of red and brown clays in the drainage lines. The presence of clay beds with the *Glendower Formation* may explain the presence of these clay soils. Sparse, mulga low open shrublands occur on the red hardpan soils with gidgee tall open shrublands on the clay soils. This land system grades into the Valetta land system on the upper slopes.

Carella land system (1 380 km^2) comprises the flat to gently undulating tops of dissected tablelands in the central parts of the survey area. Very shallow red earths and lithosols are formed on the *Glendower Formation* sediments which have been silicified and eroded in some areas. This has resulted in variable silcrete cover and areas of exposed rock on the Mawson land system which occurs around the edges of these plateaux. Mulga tall open shrubland to sparse tall open shrubland with limited areas of bastard mulga/mulga low open shrubland predominates. Carella land system is generally associated with the Cheviot land system which is part of the residual land zone.

Onoto land system (1 980 km^2) comprises long gently sloping plains of thin Quaternary deposits overlying altered *Winton Formation*. Shallow to moderately deep red earths support groved mulga, and western dead finish tall open shrublands. Texture contrast soils occur in the groves. Sink holes are characteristic in these areas. This land system represents a more arid development of the Chandos and Wuringle land systems. It occurs in the north, west of the Thomson River.

Cothalow land system (890 km^2) comprises rounded, gently undulating, convex plains of Quaternary detritus overlying the Tertiary *Glendower Formation*. The *Glendower Formation* has been eroded in places giving rise to variable silcrete cover. Rock grass is associated with small areas of silcrete stones and cobbles, on the crests of the hills. Shallow red earths support mulga sparse tall open shrublands. This land system is associated with the Cothalow dissected tract which occurs north of Adavale.

Tenham land system (2 070 km^2) comprises gently undulating to undulating plains of thin Quaternary cover overlying the *Glendower Formation*. It occurs throughout the centre and south-west, on slopes leading up to areas of the dissected residual land zone, for example the Mawson land system. Shallow, stony red earths support bastard mulga, mulga low open shrublands. This land system is particularly subject to erosion and degradation if subjected to adverse combinations of overgrazing, drought and fire.

DISSECTED RESIDUALS LAND ZONE

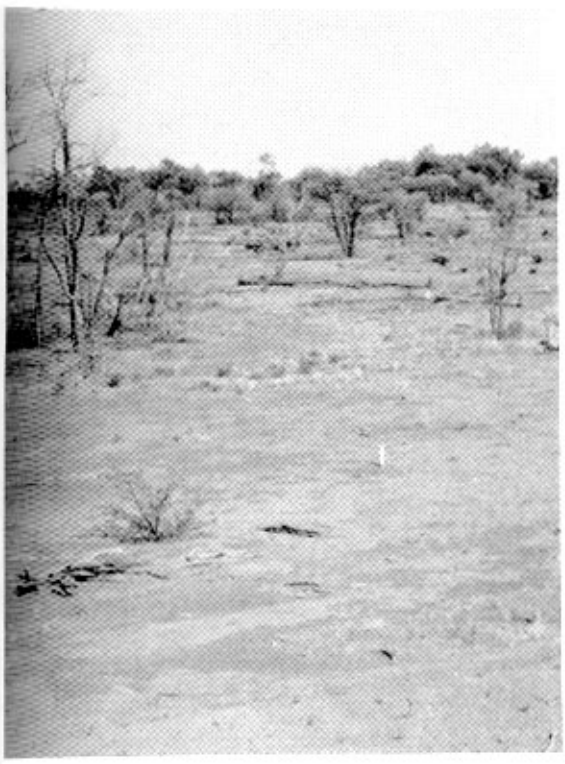
This land zone represents the present day remnants of the Tertiary land surface which has been modified by erosion and now remains as either a thinly covered silcrete surface forming tablelands, or as stripped silcrete surfaces with groups of mesas, buttes and rounded hills. The dissected residuals are typically altered *Winton Formation* with a capping of silicified *Glendower Formation* in some areas.

The dissected residual land zone has been subdivided into eight land systems on the basis of landform and vegetation. These residual land systems often form watersheds and divides, and hence exert a strong controlling influence over drainage patterns. Surrounding land systems are commonly strewn with stone and gravel derived as a result of erosion of the residual land zone.

Gilmore land system (4 710 km^2) comprises the scarps and tops of old tablelands, mesas and buttes of the Filmore dissected tract, which fringes the Powell Plateau west of Blackwater Creek. Silicified *Glendower Formation* overlies altered sediments of the *Winton Formation*, with fresh *Winton Formation* sediments of gravel and detrital cover at the foot of the scarps. In the south, the Gilmore land system grades into the Greenmulla land system. Soils are very shallow, stony lithosols supporting mulga, bendee and lancewood shrublands.

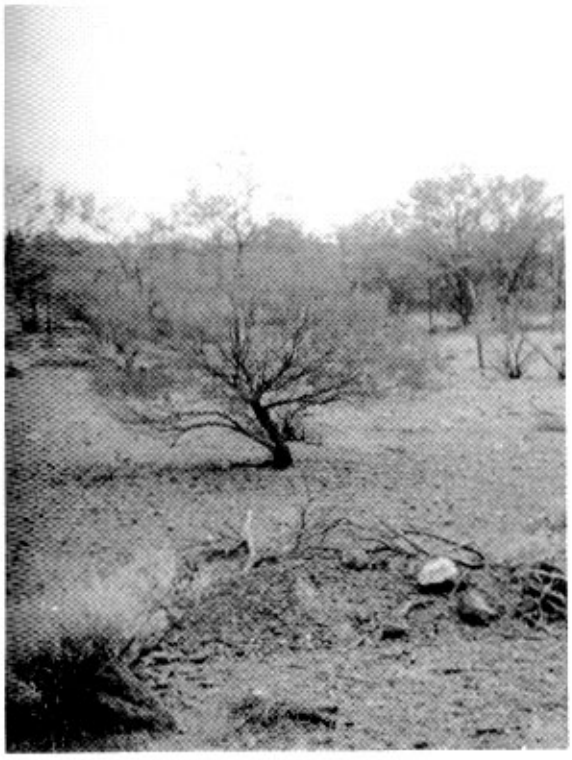
Mawson land system (3 590 km^2) comprises slightly undulating to flat rocky plains, usually occurring at the top of scarp retreat zones. These areas are remnants of the Tertiary land surface and are formed on altered *Winton Formation* and smaller areas of silicified *Glendower Formation*. Soils are very shallow, gravelly lithosols. Areas of exposed rock are common. Bastard mulga low open shrublands predominate with significant areas being devoid of vegetation.

Valetta land system (1 020 km^2) occurs as undulating plains and dissected low hills and scarps which border the eastern edge of the Warbreccan plain. Scarps are altered *Winton Formation* with a capping of silicified *Glendower Formation* in some areas. Fresh *Winton Formation* sediments with stone, gravel and detrital cover occur at the base of the scarps. Soils are shallow lithosols usually with gravel and stone cover, supporting hard spinifex, bastard mulga and mulga low open shrublands. Gidgee open shrublands are associated with small areas of desert loams which occur at the foot of the scarps.

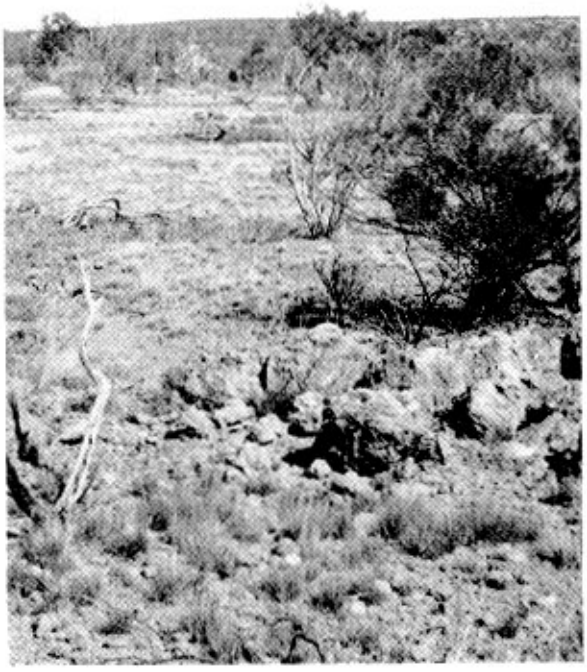


Mulga lands of Chandos L.S. are prone to degradation if overutilisation of the topfeed reserve reduces mulga densities too far.

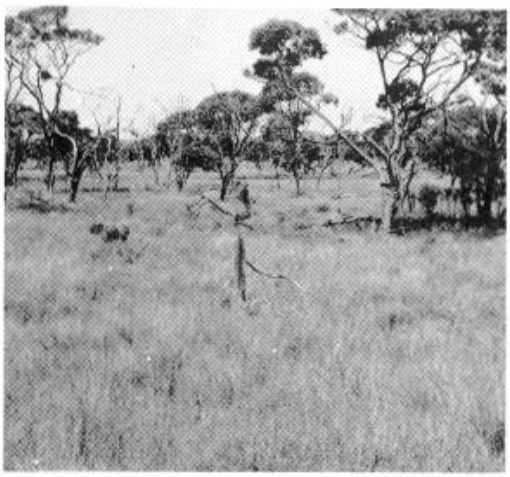
In the west shallow red earths of Onoto L.S. support sparse mulga shrublands with a ground layer of ephemeral grasses.



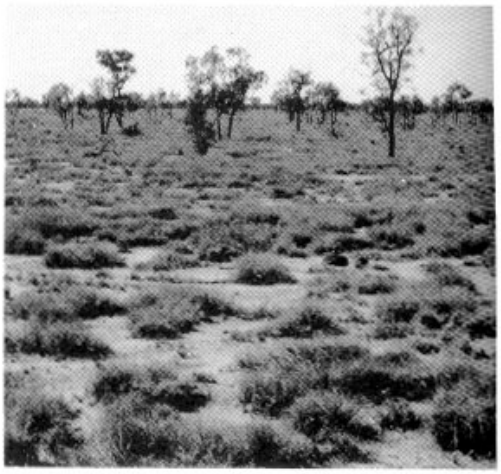
Stone cover on the shallow stony red earths of Tenham L.S. provides some protection from erosion for these soils.



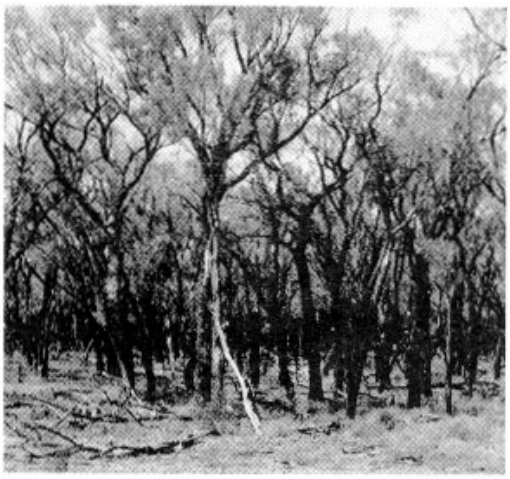
Pastures on the shallow rocky soils of Mawson L.S. are of limited value for grazing.



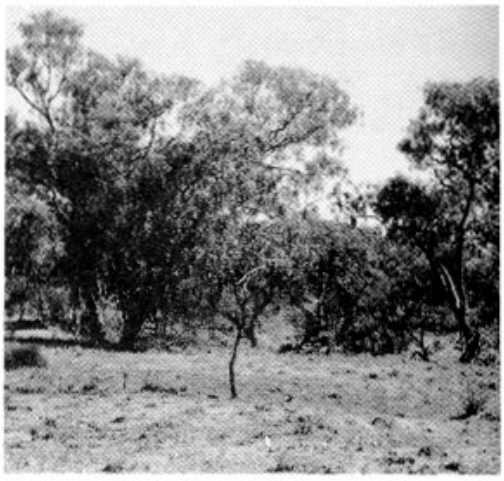
Greenwood L.S. comprises Mitchell grass tussock grasslands lightly timbered with boree. Areas of wooded downs provide valuable shade for stock.



Extensive areas of red earthy sands occur in the spinifex sand plain land systems. These areas are relatively stable as long as the spinifex cover is maintained.



Linden L.S. is of low productivity in the natural state, but can safely carry high stocking rates when cleared and sown to buffel grass.



Alluvial plains of Ravensbourne L.S. are productive following flooding, but are subject to overgrazing when the pasture supply becomes exhausted.

Soft self-mulching surfaces are common on Mitchell grass downs land systems. Mitchell grass densities are frequently higher than shown here.

Extensive areas of widely cracking brown clays occur in the Downs, Wooded Downs and Gidgee Land Zones.

Durham land system (850 km^2) occurs as low dissected tablelands, mesas and buttes in the south-west. These formations represent remnants of the silicified Tertiary land surface which has been eroded in surrounding areas to form a dense silcrete cover over fresh *Winton Formation* sediments (Plevna land system). Soils are shallow lithosols and red earths with silcrete cover, supporting mulga, bastard mulga open shrublands. Limited areas of red clays and desert loams occur.

Cheviot land system (3 000 km^2) comprises dissected tablelands, mesas, buttes and low hills of the Swanvale Block and the Cheviot Range. These cover extensive tracts of country in the centre of the area. A capping of *Glendower Formation* (silicified in places) has been eroded in some areas exposing altered *Winton Formation* sediments. Gravel-strewn fresh *Winton Formation* sediments occur at the bottom of the scarps (Opal land system). Mulga, bastard mulga open shrublands occur on the ridge tops, with mulga lancewood low open woodlands on the scarps. Soils are stony lithosols and shallow red earths with exposed rock common along the top of the scarps.

Gumbardo land system (1 150 km^2) consists of scarps and rims of dissected tablelands and mesas which occur along the edge of the Ambathala and Gumbardo Plateaux in the south-east. Altered *Winton Formation* with a thin veneer of stone and detritus occurs on the scarps. The *Glendower Formation* occurs as a capping on the top of the scarps in some areas, while gravel strewn fresh *Winton Formation* sediments are exposed at the bottom of the scarps. Bendee, lancewood shrublands occur on the scarps with mulga, bastard mulga open shrublands on the ridge tops. Soils are very shallow, acid, stony lithosols. This land system grades into the soft mulga land zone (Bronte land system) further down the backslope.

Kurran land system (2 530 km^2) occurs throughout the north-west and comprises mesas, buttes and dissected tablelands. A well developed duricrust of altered *Winton Formation* forms a capping on most remnants. A pallid zone is often exposed below the duricrust. Bastard mulga, mulga, lancewood, hard spinifex open shrublands occur on shallow, stony, lithosols on the scarps and tops of these remnants. Exposed rock is common. On the valley floors gidgee tall open shrublands occur on shallow brown clays. Areas of desert loams with a characteristic black surface pavement of ironstone shot also occur in the valleys. A small area of the Tertiary *Moses Sandstone Formation* is also included in this land system.

Waverney land system (1 640 km^2) comprises dissected tablelands, mesas, buttes and undulating plains in the west, grading into Kurran land system in the north. Large areas of dissected altered *Winton Formation* occur with small areas capped by *Glendower Formation*. Shallow, stony lithosols and exposed rock predominate, supporting bastard mulga, mulga open shrublands on the ridge tops, and lancewood open shrublands on the scarps.

GIDGEE LAND ZONE

Four land systems have been delineated based on differences in land form and vegetation. Limited areas of gidgee shrublands also occur in the Alluvial Plains, Woodlands land zone.

The gidgee lands occur in areas where fresh sediments of the *Winton Formation*have been covered by a thin veneer of stone and detritus. This occurs in scarp retreat zones where undulating pediment plains are formed by stone and detritus from higher up in the landscape, spreading over fresh *Winton Formation* sediments. Extensive areas of gidgee also occur away from scarp retreat zones on

flat to gently undulating plains formed on fresh *Winton Formation* sediments in the Blackall district. These stony areas are thought to be the remains of old drainage systems formed during erosion of the previous land surface, as they generally include gravel cover and reddish-brown cracking clays.

Linden land system (3 560 km^2) occurs mainly in the Blackall to Isisford area as flat to gently undulating plains of gidgee tall shrubland to low open woodland. Areas of this land system have been cleared and sown to introduced pastures with variable results. This is one of the few land systems in the survey area on which development of this nature may be an economic proposition. Soils are brown, reddish-brown and grey cracking clays with weak to moderate gilgai microrelief with variable stone and gravel cover.

Kiama land system (3 930 km^2) comprises undulating plains which occur in scarp retreat zones in the east. Transported material from further up the slopes has been spread over fresh *Winton Formation* sediments. This results in a characteristic dense stone cover over brown and reddish brown cracking clays. This stone cover is partly responsible for the relative stability of the steeper slopes (1 - 3%) found in this land system. Moderate to strongly developed gilgai microrelief occurs throughout much of this land system. Gidgee tall open shrublands to low open woodlands predominate. Development of this land system by clearing and pasture introduction has occurred in a number of areas.

Opal land system (2 210 km^2) occurs in similar situations to Kiama land system but is restricted to the drier areas in the west. As a result the gidgee tall open shrublands which occur are less dense and more stunted than those in the Kiama land system. Soils are stony, brown cracking clays.

Idalia land system (610 km^2) comprises limited areas of undulating to gently undulating plains in the scarp retreat zones around the northern edge of the Gowan Range. Incised valleys running back into the residual land mass are also included in this land system. Red cracking clays and desert loams occur on the plains and support brigalow low open woodlands. Brigalow, poplar box, Dawson gum and mountain yapunyah occur in the incised valleys, mainly on texture contrast soils and small areas of red and brown clays. This land system has been included in the gidgee land zone because of the limited area involved and its similarity in land use to the gidgee land systems. Clearing of the brigalow areas and the introduction of buffel grass has been successful in some places, but regrowth and erosion may present serious problems.

WOODED DOWNS LAND ZONE

Five land systems have been delineated mainly on the basis of vegetation and geology. This land zone is developed on the fresh Cretaceous sediments known as the *'Rolling Downs Group'*.

Main occurrence is from the Thomson River east. The term 'wooded downs' has been used to describe lands which have sufficient tree density to distinguish them from the open or treeless downs, but do not have consistently dense tree cover comparable with the open shrublands and open woodlands of the gidgee land zone. Tree densities (1 - 25 trees/hectare) range from scattered trees on open tussock grassland to small clumps of open woodland. Tree cover appears to be sufficiently sparse over most of the land zone not to interfere with pasture growth. Densities are sufficient however to provide some shade for the stock. Most of the noted merino studs in the survey area have significant areas of this land type which appears well suited to sheep breeding.

Hobson land system (1 580 km^2) comprises flat to gently undulating plains of Mitchell grass open tussock grassland with scattered boree and gidgee trees. Small clumps of gidgee are characteristic. It occurs in the area west of Emmet and down the Barcoo River and Powell Creek to Hobson's Gap. These areas represent the most westerly occurrence of the Wooded Downs land zone,and have a significantly lower rainfall than the other wooded downs land systems. Soils are moderately deep to deep, brown cracking clay formed on *Winton Formation* sediments. They appear similar to the soils of the Downs land zone occurring in these areas.

Greenwood land system (2 250 km^2) occurs as flat to very gently undulating plains of Mitchell grass open tussock grassland similar to Hobson land system, but are timbered with boree only, ranging in density from scattered trees to low open woodlands and open woodlands. This land system is mainly associated with the open downs, often fringing minor alluvia and drainage lines of the Blackall and Bimerah land systems in the Downs land zone. It also occurs as fringing areas of the Gidgee land zone, and sometimes as small patches of open woodland in the eastern gidgee lands.

Terrick land system (1 160 km^2) is the most important and productive land system in the Wooded Downs land zone. It occurs throughout the eastern higher rainfall region, mainly in the Blackall and Listowel Valley districts. It is associated with the Blackall land system, and comprises large areas of Mitchell grass tussock grasslands with scattered trees. The trees are often most noticeable on the tops of ridges or fringing local alluvia. Main tree species are whitewood, vinetree, boree, gidgee and myall, ranging in density from scattered trees to open woodlands. Soils are moderately deep to deep, brown and grey cracking clays with self-mulching surfaces. They are formed on *Winton Formation* sediments. This land type should remain stable under present management systems. The scattered trees afford sufficient shade and protection for stock to make this ideal sheep breeding country.

Mooney land system (500 km^2) comprises gently undulating plains formed on the sediments of the *Mackunda Formation.* Occurrence is limited to small areas in the north-east. Mitchell grass open tussock grasslands predominate, with scattered vinetree, eastern dead finish, whitewood and bauhinia forming low open woodlands in places. Soils are shallow to moderately deep, grey cracking clays containing more sand than those formed on *Winton Formation* sediments. Shallow to very shallow brown and red clays and texture contrast soils occur on the tops of the ridges, where there are occasional sandstone outcrops.

Mt. Harden land system (160 km^2) comprises flat to gently undulating plains formed on *Winton Formation* sediments. It occurs in limited areas adjacent to the northern edges of the Grey Range. Mitchell grass tussock grasslands predominate, with brigalow trees occurring in clumps 1 to 3 metres in diameter and spaced 5 to 20 metres apart. Stone and gravel cover the surface in areas between the clumps. Soils are moderately deep to deep, reddish-brown cracking clays.

DOWNS LAND ZONE

Six land systems have been identified in the Downs Land Zone mainly on the basis of climatic changes from east to west across the area and its subsequent effects on vegetation characteristics. Two of the land systems were delineated on the presence of surface stone cover. This land zone occupies approximately 18% of the area. Because of its large area and potential productivity, this land zone is of major importance.

All land systems in this land zone with the exception of Palparara and Corrikie have soils developed on the gently undulating sediments of the *Winton Formation*. Erosion of the previous land surface has resulted in variable stone cover in some areas. Slopes are typically very low (less than 1%) and trees are usually absent from these lands. High available soil water capacities and generally adequate nutrient levels make these soils highly productive when sufficient rainfall is received. Droughts however can be particularly severe due to the lack of alternate fodder sources, for example topfeed.

Palparara land system (1 260 km^2) comprises long fan slopes of material derived from erosion of the Tertiary land surface. It occurs mainly adjacent to the lower reaches of Farrar's Creek. Vegetation is dependent on seasonal conditions, ranging from Mitchell grass and other short grasses to sparse saltbush and Bassia herbfields. Soils are deep to very deep, red desert loams, with a surface pavement of ironstone shot and gravel and slight gilgai microrelief. Soils on the upper slopes are shallower with occasional areas of shallow red earths underlain by ferruginous hardpans. On the lower slopes of these fan plains, the desert loams grade into red and brown clays on broad alluvial plains.

Plevna land system (2 010 km^2) occurs to a limited extent in the south-west. It comprises gently undulating to undulating plains, characteristically with a dense cover of silcrete stone and cobble. Gilgai microrelief is prominent. The silcrete cover was derived by erosion of a Tertiary silcrete surface which once covered these areas, and has now been broken up, exposing fresh *Winton Formation* sediments. Vegetation is seasonally dependent, ranging from Mitchell grass and other short grasses to saltbush and Bassia herbfields. Shallow to moderately deep, brown cracking clays predominate. Mitchell grass tends to concentrate in the shallow gilgai depressions where moisture levels are more favourable.

Davenport land system (3 390 km^2) comprises large areas of flat to gently undulating plains of soft downs in the far west. Brown cracking clays with soft self-mulching surfaces have developed on sediments of the *Winton Formation*. Ironstone gravel cover is present in some areas. Vegetation is again dependent on seasonal conditions, ranging from Mitchell grass and other short grasses to saltbush and Bassia herbfields. In good seasons, excellent Mitchell grass pastures grow on this land system. On the more undulating parts, where slopes of 1 to 3% occur, some examples of minor gully erosion have been noted following heavy rains.

Morney land system (1 200 km^2) occurs in association with Davenport and Plevna land systems in the west. It forms gently sloping pediment plains between the dissected Residual Land Zone and Davenport Land System. Dense silcrete gravel cover is characteristic, though smaller in size than that occurring on Plevna land system. Morney land system also differs from Plevna in being topographically lower in the landscape, and having no gilgai development. Soils are brown cracking clays, while vegetation is similar to the other western downs land systems with seasonal pastures of Mitchell grass, other short grasses and saltbush and Bassia herbfields.

Blackall land system (3 320 km^2) comprises large areas of the rolling downs in the Blackall, Listowel Valley and Isisford - Yaraka districts. It is the most productive and important of the Downs land systems. Mitchell grass tussock grasslands predominate with saltbush and Bassia 'herbage; occurring between the tussocks in season. In many areas scattered trees and shrubs in clumps are present on this land system. Large areas have been mapped either as Blackall/Terrick land systems (F5/T3) as there is no clearcut division between the two land systems. Soils are moderately deep, brown and grey cracking clays with self-mulching surfaces, becoming slightly shallower and lighter textured on the tops of some of the rises. Scattered pebble

occurs on the surface in the Portland Downs area. Small drainage lines are usually fringed by scattered mimosa bushes.

Warbreccan land system (2 710 km^2) comprises flat to gently undulating downs on the Warbreccan Plain, west of the Thomson River. Mitchell grass open tussock grasslands predominate, with Bassias, saltbushes and short grasses between the tussocks in season. Shallow to moderately deep, brown cracking clays with self-mulching surfaces occur, with surface gravel cover in some of the more undulating areas. Where slopes approach 2%, as at the southern end of the Warbreccan Plain, minor sheet and rill soil erosion have been noted after heavy rains.

Bimerah land system (3 230 km^2) comprises flat to gently undulating plains. It occurs in the north, between the Thomson River and Isisford. This land system is similar to the Blackall land system but is usually not wooded to the same extent. Rainfall is lower than for most of the Blackall land system. Bimerah land system exhibits pronounced striped patterns on aerial photos which are reflected in vegetation and minor soil differences on the ground. These striped patterns result from the exposure of different geological beds in the *Winton Formation* to surface weathering. Mitchell grass open tussock grassland predominates with seasonal occurrence of saltbushes, Bassias and other short grasses between the tussocks. Patches of boree and gidgee are associated with the local alluvia on this land system.

Corrikie land system (530 km^2) comprises flat to gently sloping, treeless plains of red cracking clays with incipient gilgai microrelief. These are presumed to be formed on Tertiary clay beds, and usually have well defined drainage lines fringed by mimosa bush. This land system is relatively small in area, occurring along the upper reaches of Farrar's Creek and is associated with Vergemont Creek in the north-west. Due to the lower nutritional status of the soils in this land system, sparse short grasses, Mitchell grass and forblands predominate.

ALLUVIAL PLAINS, WOODLANDS ZONE

This land zone has been distinguished from other alluvial land zones by the greater density of tree and tall shrub vegetation. It has been divided into seven land systems based on flood plain characteristics, type of channels, and frequency of flooding. The concentration of run-off water on the deep clay soils which predominate in this land zone means that the potential for pasture growth following light to moderate falls of rain is higher than for non-alluvial lands types. This leads to increased grazing pressure on the alluvial land systems, which if applied for continuing periods after useful feed has been exhausted can lead to decreased production from these areas. The overall productive capacity of the whole of the surrounding area will be affected if degradation of the alluvial plains occurs, thus putting more grazing pressure on other land zones. The degradation of small sacrifice areas around waterholes appears unavoidable under present conditions. So long as these degraded areas remain relatively insignificant they may not become a serious threat. However, continued overgrazing of vegetation around waterholes can lead to the enlargement of these areas and increased land degradation and gullying.

Barcoo land system (1 150 km^2) comprises the channels and portions of the associated flood plain of the Barcoo River which forms the major drainage system in the north-east. The Barcoo River joins with the Thomson River north of Windorah to form Cooper Creek. Along the upper reaches of the Barcoo River one or more main channels and some braided channels are present. Extensive areas of flat alluvial plains are associated with these channels. Many of these plains

are of sufficient size to be mapped as separate land systems for example Listowel. Along the lower reaches of the Barcoo a single well defined main channel is typical with very few braided channels and extensive areas of seasonally scalded alluvial plains. Channels are lined by coolibah and river red gum woodlands with herbfields on the associated alluvial plains. Soils are very deep, grey and brown alluvial clays. This land system appears susceptible to scalding, particularly below the point where Powell Creek joins the Barcoo River where extensive areas of scalded alluvial plains were observed. Early explorers also commented on scalding along the Barcoo, indicating this may be an inherent feature of the land system.

Milo land system (440 km^2) comprises the channels and associated floodplain of the upper reaches of the Bulloo River which drains the Tertiary Adavale Plateau in the south-east. One or more main channels are present on a flat, relatively narrow alluvial plain. Channels are fringed by coolibah and river red gum woodlands. Yapunyah woodlands, occasionally with scattered sandalwood and patches of gidgee woodland occur on the alluvial plains, with some open herbfield areas. Seasonal scalding is common. Soils are mainly deep, grey and brown alluvial clays with crusts of silt and sand and some smaller areas of texture contrast soils.

Ravensbourne land system (1 910 km2) comprises flat alluvial plains with braided channels which form drainage lines on the *Winton Formation* sediments. It occurs mainly in the east, draining the Downs, Wooded Downs and Gidgee Land Zones. Channels are typically 1 to 2 metres deep and may be up to 10 metres wide. Coolibah and some river red gum woodlands are associated with the channels. On the alluvial plains and interchannel areas, Mitchell grass tussock grasslands predominate. Where these areas are sufficiently large they are mapped as a separate land system, for example, Listowel land system. Soils are deep, grey and brown alluvial clays with sand and silt intermixed. Seasonal scalding becomes more prevalent towards the western limits of this land system.

Springfield land system (1 050 km^2) comprises braided channels which tend to merge into a single main channel in the lower reaches of the stream. Broad flat alluvial plains are associated with the channels often with sand cover encroaching on the margins. It occurs mainly in the Kyabra Creek drainage system which rises in the Hard Mulga Land Zone east of Windorah. Gidgee woodlands occur on the braided channels and in some areas sand cover has encroached over the alluvia. Coolibah and river red gum are associated with the major channel, while yapunyah and gidgee woodlands occur on scalded alluvial plains associated with the lower reaches of the stream. Grey alluvial clays predominate. Hardpans are commonly present where sand encroaches over these clays. They may be exposed around the base of low sand mounds, which occur in some parts of the alluvial plain. Large areas of this land system are subject to seasonal scalding.

Fanning land system (180 km^2) comprises areas of boree woodlands which occur on the outer fringes of alluvial plains formed on *Winton Formation* sediments. This land system is small in area and occurs mainly along the Barcoo River and its major tributaries. These areas are subject to infrequent flooding. Mitchell grass open tussock grasslands wooded with boree predominate. Soils are deep, brown cracking clays with soft surfaces and incipient gilgai microrelief in most areas. In the east on the Barcoo River floodplain small areas of coolibah woodlands have been included in with this land system as they display a similar photopattern.

Durella land system (840 km^2) comprises gidgee woodlands formed on flat alluvial plains. These plains are drained by channels which are fringed by gidgee or coolibah river red gum woodlands depending on location. Some minor braided channels are included in this land system. Soils are deep, brown and grey cracking clays with occasional areas of gilgai microrelief, and minor occurrences of alluvial texture contrast soils. Seasonal scalding is not widespread on this land

system although the adjacent treeless alluvial plains are often scalded.

Edkins land system (2 050 km^2) comprises alluvial plains with numerous braided channels, usually rising in areas of altered *Winton Formation*. It occurs mainly in the north-west. Gidgee tall open shrublands predominate along the channels, with occasional coolibahs along the larger channels. Mineritchie *(Acacia cyperophylla)* occurs in the upper reaches of some smaller channels with sandy bottoms. Inter-channel areas are subject to seasonal scalding, particularly where stocking pressure is concentrated around watering points.

CHANNEL COUNTRY LAND ZONE

This land zone has been subdivided into three land systems, mainly on the basis of differing flooding frequencies and the subsequent effect on vegetation of each of the land systems.

The Channel Country land zone is characterised by low gradients of less than one in 5 000 (Skerman *et al.* 1947). The Channel Country proper begins where the Thomson and Barcoo Rivers join above Windorah to produce the broad flood plain of Cooper Creek. Above this junction the Thomson River exhibits fairly typical channel country characteristics, but on a much smaller floodplain than exists below Windorah. Depths of up to 150 metres of alluvium have been recorded on the Cooper Creek floodplain. A system of minor anastomosing channels has developed on the present floodplain. This forms a natural irrigation system which spreads floodwaters over the Cooper and Woonabootra land systems. The Channel Country is extremely productive following floods and is renowned for the fattening of cattle. It occupies almost 9% of the survey area. Nutrient status (notably phosphorus) of all soils in this land zone is relatively good, particularly in the more frequently flooded areas.

Cooper land system (3 180 km^2) comprises flat alluvial plains with numerous shallow anastomosing channels. It is estimated from available data this land system is flooded on average once every two to three years. Where the channels become broad and shallow, they grade into the swamps of Woonabootra land system which are more frequently flooded. A discontinuous main channel forms a line of billabongs or waterholes down the western side of the Cooper floodplain. Major channels are fringed by river red gum and coolibah low open woodlands. Coolibah and lignum occur on the smaller channels. On the interchannel areas herbfield and bluebush predominate with smaller areas sparsely wooded with coolibah. The remainder of the interchannel pasture comprises winter or summer growing annuals depending on the time of flooding. Winter growing pasture species (for example cooper clover) are regarded as the most valuable fattening plants. Summer growing species such as channel millet produce a greater bulk of lower quality pasture which will stand over into the winter (Skerman *et al.* 1947). Soils are very deep, widely cracking grey clays, with buried silt and sand bands.

Cunnawilla land system (2 870 km^2) comprises flat alluvial plains which are slightly above (1 to 3 metres) those of Cooper land system. They occur mainly along the outer margins of the Cooper Creek floodplain, but small areas form low rises on the floodplain proper, particularly along the Thomson River. Flooding on this land system is less common, with a frequency on average once every five to ten years. Where flooding occurs on the western edges of Cooper Creek around Tanbar Station, areas of old man saltbush and some seasonally scalded areas are present. Wind-blown sands commonly encroach on this land system, ranging from small sand mounds to larger areas with longitudinal dunes beginning to form. Soils are brown and grey alluvial clays, usually supporting open herbfields.

Woonabootra land system (2 850 km^2) comprises the lignum and blue-bush swamps which occur where the channels of Cooper land system spread out to form shallow channelled areas and swamps. It is estimated that innundation of these swamps occurs in six years out of ten, making them the most reliable fattening areas on Cooper Creek. Productivity varies according to the density of lignum cover. Bluebush, nardoo and channel millet are the most important pasture species. Soils are very deep, widely cracking grey clays, with high waterholding capacities. These soils are capable of supplying moisture for plant growth for extended periods after flooding.

OTHER ALLUVIA LAND ZONE

This relatively small land zone has been subdivided into six land systems, based on rainfall, flooding frequency, vegetation and soils. Productivity of this land zone is strongly influenced by the frequency of flooding and soil nutrient levels.

Listowel land system (1 400 km^2) comprises seasonally flooded, flat alluvial plains. These occur as interchannel areas on alluvia draining the Cretaceous sediments in the east. Some ridge and swale microrelief occur near the channels. Small areas of braided channels, bluebush swamps and scalds have been included in this land system. Vegetation is Mitchell grass open tussock grassland with occasional coolibahs on the channels and drainage lines. Boree woodlands usually fringe the outer margins of this land type. Soils are deep to very deep, brown and grey cracking clays with weakly self-mulching surfaces. These plains are highly productive areas, but because of their position adjacent to waterholes, high stocking pressure may be unavoidable. Seasonal scalding occurs on this land system in some areas and significant loss of production is likely if these areas become permanently degraded.

Eromanga land system (1 170 km^2) comprises occasionally flooded broad, flat alluvial plains with occasional areas of braided channels. It occupies minor areas along Bulgroo and Tampoon Creeks and extends south into the Part I Study Area (Dawson 1974) where it is better developed. Saltbush, Bassia and short grass herbfields predominate on the deep, brown, reddish brown and grey clays. Large areas are subject to seasonal scalding, but these scalded areas may revegetate in good seasons.

Nooyeah land system (530 km^2) comprises flat, scalded alluvial plains which have been mapped out from other alluvial land systems where possible. In some areas the scalding is seasonal and vegetation will re-establish in good seasons. Characteristics of the scalded areas are a strong platy or vesicular crust with fine cracks, under which are strongly structured clay subsoils. Such vegetation as occurs ranges from sparse Bassia and saltbush herbfields. Recognition of long term trends in these seasonally scalded areas is essential to prevent further degradation.

Jundah land system (250 km^2) comprises rarely flooded alluvial plains which occur in areas along the outer edges of the Thomson River at levels slightly above those of the present day flood plain. These older alluvia support open herbfields and occasional areas of Mitchell grass on red and brown cracking clays. Scalding is widespread on this land type. Areas of texture contrast soils occur where a thin sand cover is present over the alluvial clays. Gidgee tall shrublands occur in these areas. Productivity of this land system is much lower than that of the more recent alluvia, due to the reduced flooding frequency and lower soil fertility in these areas.

Dingera land system (1 570 km^2) comprises flat alluvial plains with single or braided channels. This land system occurs mainly on the fresh *Winton Formation* sediments west of the Thomson River. It forms minor drainage lines on the open downs, which join to produce wider alluvial plains with shallow braided channels. Coolibah and river red gum occur on the larger channels, with mimosa bush along smaller drainage lines. Mineritchie occurs on minor channels in the stony downs area. Ground cover is dependent on seasonal conditions, ranging from sparse Bassia and saltbush forblands to Mitchell grass grasslands. Soils are mainly brown alluvial clays with minor areas of red and grey clays. Channels usually have sandy surfaces and small areas of sandy surfaced alluvial texture contrast soils are associated with the channels. Seasonal scalding is evident on much of this land system.

Warry land system (1 470 km^2) consists of alluvial plains with a well-defined main channel and occasionally associated minor channels. These form local alluvia draining land zones occurring on the altered *Winton* and *Glendower Formations*. Larger channels are lined by coolibah plains and some minor channels. *Cassia phyllodinea* occurs on the run-on areas at the head of this land system. Ground cover on the alluvial plains is dependent on seasonal conditions, ranging from sparse Bassia, saltbush and short grass herbfields to Mitchell grass. Soils are mainly red and brown texture contrast soils. Red, brown and grey clays become increasingly dominant as the alluvial plain increases in size, eventually grading into Eromanga land system. Larger areas of Warry land system are subject to scalding. As these streams drain the easily degraded hard mulga lands, increased runoff from these areas can result in severe erosion of these alluvial plains. Careful management of the adjacent mulga land zones is the first step in preventing degradation of this system.

MISCELLANEOUS LAND ZONE

Cuddapan land system (70 km^2) comprises a small area of seasonally inundated shallow lakes which usually occur between the Dunefields and Stony Downs Land Zones. Grey and brown alluvial cracking clays occur in the Lake with low sand mounds and scalded areas around the margins. Vegetation in the lake is entirely dependent on flooding. Canegrass is present in the centre of the lake with some areas of lignum/bluebush swamps. The outer margins of the lake are regarded as the most productive areas with bluebush and saltbush Bassia herbfields ('channel country' type feed) present after flooding. Extended periods of inundation restrict these species from the central parts of the lake.

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CURRENT LAND USE

by J.R. Mills, D. Hunter #, and W.F.Y. Mawson **

SOCIAL ORGANISATION AND COMMUNICATIONS

The 1976 census figures show a population of 3 248 in the Shires of Blackall, Isisford and Barcoo. These three Shires, together with a small portion of the Quilpie Shire, account for the bulk of the population of this area, although the Shire boundaries do not coincide exactly with those of the study area. These figures show a decline of almost 40% in the population since the 1961 census.

TABLE 7.1 Population Census Figures [1]

Shire	1911	1921	1933	1947	1954	1961	1966	1971	1976
Blackall	-	-	-	1085	1780	3291	3067	2325	2160
Isisford	-	616	345	273	817	867	747	453	431
Barcoo	-	872	345	269	1110	1037	909	734	657
Total				1627	3707	5195	4723	3512	3248
Towns									
Adavale	294	213	132	82	79	7	-	-	-
Blackall	1102	1426	1780	1747	1885	2217	2004	1755	-
Isisford	356	388	323	294	323	293	270	169	143
Jundah	217	284	167	122	183	137	153	121	118
Stonehenge	118	124	107	38	58	53	-	-	-
Windorah	72	103	74	48	70	99	127	-	-
Yaraka	-	107	84	27	66	87	-	-	-

Source: Australian Bureau of Statistics.

The movement of people out of the area has occurred as a result of a combination of reduced rural incomes and the higher cost of labour. This has restricted employment opportunities both on properties and in the towns.

1. Figures before 1971 did not include aboriginals.

* Development Planning Branch, Queensland Department of Primary Industries.

Queensland Department of Lands.

Depressed wool prices in the early seventies and the current (1978) depressed price of beef, combined with steadily rising costs of production have raised an air of uncertainty about the future of the pastoral industries. This has caused many people, particularly the young, to move elsewhere in search of more stable employment, better facilities and improved living conditions.

It is significant that while the living standard expectations of urban dwellers have risen substantially over the last fifteen years, improvements in the living standards of the majority of the rural population have been minimal. The main exception being the provision of rural power to the more closely settled north-eastern part of the area.

The amenities and wages which mining companies are obliged to provide to attract labour to projects in remote areas is indicative of the current free market price of labour in isolated areas. While some differential in wages and conditions between the pastoral and mining industries may be inherent due to the nature of the work involved, the inability of the pastoral industry to pay comparable wages and provide equivalent conditions has resulted in a shortage of suitable rural labour in some areas. Where the traditional 'family farm' unit has broken up and younger family members have moved to the city, the loss of their relatively cheap but skilled labour poses a serious management problem.

The towns of Blackall, Isisford and Jundah are the administrative headquarters of their respective shires, and in the case of Jundah (Barcoo Shire) and Isisford (Isisford Shire), shire employees form a substantial proportion of the town population. These three towns all have hospital facilities, but the Blackall hospital is the only one with a resident Medical Superintendent. The more remote parts of the area are serviced by the Royal Flying Doctor Network, which operates from bases at Charleville and Mt. Isa. Dental treatment is available at Blackall, Charleville and Longreach.

Primary Schools are located at Blackall, Isisford, Windorah, Jundah, Stonehenge and Yaraka. The School of the Air operating from Charleville and the Primary Correspondence School provide lessons for pupils on properties unable to attend schools in the various centres. Secondary schooling to year 12 standard is available in Blackall. The Longreach Pastoral College at Longreach caters for people educated to Junior standard, with courses in animal husbandry, farm management and machinery maintenance. The courses cater for those who intend to work on Queensland pastoral properties.

Because of the limited access to Secondary School facilities, and the isolation of children on properties and in small centres from current events, cultural activities and sporting facilities, many parents in the past have elected to send their children to secondary schools in the major population centres. In recent times the decline in real rural incomes and increases in costs associated with this type of education, have put it beyond the reach of many families. Unless rural incomes rise, or generous government assistance is given, this will remain one of the major incentives for the family unit to move out of the more remote areas.

Commercial radio stations operate from Longreach and Charleville. The A.B.C. operates a radio station from Longreach and television transmitters of limited range at Blackall, Barcaldine and Longreach.

The majority of properties east of the Thomson River and Cooper Creek have telephone services. In the western part of the area the Flying Doctor radio network provides the main means of communication.

All towns in the area, and most of the larger properties in the west have airstrips suitable for light aircraft.

TRANSPORT

A railway line runs from Yaraka to Blackall and then north to Jericho, connecting with the central line to Rockhampton. The Diamantina Development Highway provides a bitumen road from near Morney to Windorah and thence down to the railhead at Quilpie. Much of the south western part of the area depends on this road and railhead for movement of stock and goods in and out of the area. Blackall is the main centre in the east and is connected by bitumen roads to Charleville and Barcaldine. A bitumen road connects Isisford to the Landsborough Highway at Ilfracombe. Formed dirt roads connect other centres in the area. These roads frequently become untrafficable in the wet season and rapidly degenerate when used by heavy vehicles. Most stock and wool movement in this area are carried out by road transport to the railhead, and by rail from there to the coastal abbattoirs and wool stores. This system makes efficient use of the lower cost of rail transport over long distances.

Regular air services run from Brisbane to Blackall three times a week, to Isisford twice a week and Windorah once a week. A daily bus service connects Brisbane, Blackall and Longreach.

LAND TENURE

The majority of the area was first taken up as pastoral runs. The Act of 1869 provided for leases over runs for up to 21 years; areas had to be rectangular in shape and could not be less than 25 square miles nor more than 100 square miles - unavailable areas up to half the size of the run could be included in addition by the Land Commissioner. There was provision for resumption of the runs - up to 4 square miles immediately and the whole on 6 months notice with the permission of Parliament.

The first attempts at more permanent settlement were made by opening small areas for sale as Agricultural Selections or Conditional Purchases. The first Agricultural Selection was made available at Blackall in 1879 and in 1880 the Land Commissioner reported having 9 selections with a total area of 2240 acres (the maximum area for the selections being limited to 640 acres). The following year he reported that the general lack of water was restricting cultivation and in 1882 he said that in his opinion the securing of settlement based on cultivation had been defeated and the only use of the selections was to graze a few cattle, horses or goats and that the settlers indicated that they needed at least 2560 acres. The Commissioner indicated that irrigation was needed for cultivation 'which considering the very high price of wages and the uncertainty of the rainfall would be too expensive'.

The Land Act of 1884 provided the framework for the present land tenures in the area and in many respects the Land Acts have not been changed greatly since in relation to Pastoral lands. The 1884 Act provided for the consolidation of the existing pastoral runs, the issue of a new 15 year lease (later extended to 21 years) over part and the resumption of the balance (up to one half) for selection. The Selection tenure of Grazing Farm with 30 year lease and a maximum area of 20 000 acres was introduced - these leases had to be surveyed and the boundaries fenced and the condition of occupation was introduced; the lessee or his appointed bailiff had to reside on (or later near) the selection.

The first Grazing Farm was taken up at Blackall in 1886 (only two (2) years after the passing of the Act). It comprised 2458 acres and was portion IV Northampton Downs Resumption. Larger areas followed - G.F. 5 an area of 18 655 acres being portion 7V Malvern Hills Resumption was opened shortly afterwards. The first Grazing Farm at Windorah was taken up to 1895. The tenure was generally well accepted and in ten (10) years there were over 100 Grazing Farms in the Blackall District alone.

The tenure of Grazing Homestead was introduced later with a personal residence condition requiring the successful applicant to reside on the area for an initial period of 10 years - later amended to 7 years. This was done to assist the bona fide settler to obtain land - there were over 7 000 applicants for one selection in the Longreach District and obviously a more selective approach was required.

The freeholding of large areas of land was always viewed with suspicion based on the fear that the wealthy would acquire huge aggregations and prevent the genuine landseeker from obtaining land. In the subject areas there are odd, fairly extensive areas of freehold apart from the small blocks around towns. These freehold areas include 38 342 ha worked with Terrick Terrick Stud and Thalia Pastoral Holding; 27 173 ha worked with Isis Downs Stud Holding; 55 075 ha worked with Portland Downs Stud Holding; 12 027 ha worked with Bimerah Pastoral Holding. Although these areas are individually large, the total of all freehold land in the Study Area is only about 1½ per cent of the total area.

A check of the Deeds of the larger freehold areas mentioned above indicates that the lands were sold in two (2) periods, 1892-94 and 1902-07. The purchasing price in all cases was $1 per acre and it appears that the lands were sold after the passing of a Special Land Sales Act in 1891 and a similar Act in 1901 which made provision for the sale of larger areas of rural lands to retire Treasury Bills which had been issued and the Acts were to cease as soon as the Bills and interest had been discharged. Offering of land under freeholding titles ceased in 1916 and it was not until 1964 that it was revived in respect of larger rural areas.

PRESENT LAND TENURES:

The attached Tables 7.2 to 7.5 indicate land tenures, property sizes by area for both cattle and sheep and property sizes based on carrying capacities. There would be a slight overlap as the tenures on which figures are assessed would not fit into the precise geographical boundaries of the area. It will be noted that of the 9.9 million ha occupied by all tenures, about 20 per cent of the area and 47 per cent of the leases are Grazing Selections (Grazing Farms and Grazing Homesteads) and over 70 per cent of the area and 25 per cent of the tenures are Pastoral Leases. A brief outline of the various tenures involved in the area with condition attaching to each is as follows:-

TABLE 7.2 Types of Tenure and Estimated Carrying Capacity

Tenure No.	No.	Area in Hectares	Estimated Carrying Capacity	
			(Sheep)	(Cattle)
Agricultural Farm	3	9 814	7 402	
Perpetual Lease Selection	11	10 762	7 449	
Grazing Farm	96	625 846	236 437	315
Grazing Homestead	144	1 345 749	745 349	
Grazing Homestead Freehold lease	57	323 827	193 254	
Stud Holding	5	136 641	99 370	
Pastoral Development Holding	6	553 304	121 802	
Pastoral Holding	71	5 389 662	481 753	60 855
Preferential Pastoral Holding	49	1 396 515	211 007	13 338
Freehold Land (Portions)	73	145 923	86 806	
Total	515	9 933 128	2 190 629	74 508

(1) AGRICULTURAL FARM AND PERPETUAL LEASE SELECTION:

These give permanent tenure over the land with the Agricultural Farm being a freeholding tenure with purchase price extending over up to 40 years and perpetual lease being a lease in perpetuity attracting an annual rent which is reassessed every ten (10) years. Both were designed as Agricultural Selections with a normal maximum area of 1 024 hectares. The leases cannot be held by Companies.

TABLE 7.3 Property Size Ranges and Estimated Carrying Capacity (Cattle)

Property Size Range (hectares)	No. of Aggregates	Estimated Carrying Capacity Range (Cattle)	Total Estimated Carrying Capacity (Cattle)
5 000 - 20 000	5	200 - 800	1 753
20 000 - 60 000	7	397 - 1 536	6 342
60 000 - 100 000	5	600 - 2 560	7 467
100 000 - 200 000	3	2 976 - 4 300	11 365
200 000 - 500 000	3	5 000 - 6 450	18 039
500 000 and over	2	7 760 - 20 728	29 542
	25		74 508

(2) GRAZING SELECTIONS, GRAZING FARM AND GRAZING HOMESTEAD:

These are now 30 year leases with the lessee having a statutory right of a new lease over a living area at the expiration of the lease. They are the predominant tenure of our sheep lands. There are few, if any, Grazing Selections which would be sufficiently large to consider subdividing at the expiration of the lease so that the existing tenures are quite secure. Lessees have the right of conversion to the freeholding or perpetual lease tenure (see 3 below) if the area is not substantially more than a living area - in effect practically every Grazing Selection could be converted to one of these tenures. The leases cannot be held by Companies and the maximum area is 18 000 hectares which can be extended in cases of very poor lands to an absolute maximum of 24 000 hectares . The tenures are subject to the condition of occupation (residence by the owner or registered bailiff on the selection or rural land within 48 kilometers; Grazing Homesteads when first opened are subject also to personal residence for an initial period.

TABLE 7.4 Property Size Ranges and Estimated Carrying Capacity (Sheep)

Property Size Range (hectares)	No. of Aggregates	Estimated Carrying Capacity Range (Sheep)	Total Estimated Carrying Capacity (Sheep)
500 - 5 000	6	640 - 3 000	9 113
5 000 - 15 000	71	1 786 - 10 522	418 496
15 000 - 20 000	37	4 544 - 15 239	320 185
20 000 - 30 000	33	3 320 - 19 850	367 744
30 000 - 40 000	23	3 400 - 27 550	301 743
40 000 - 50 000	5	9 970 - 20 580	77 904
50 000 - 60 000	8	4 200 - 25 130	131 012
60 000 - 70 000	4	11 600 - 16 727	58 951
70 000 - 80 000	6	6 604 - 56 200	162 485
80 000 - 100 000	2	24 280 - 57 095	81 375
100 000 - 140 000	2	15 580 - 34 340	49 920
140 000 - 180 000	4	18 455 - 40 380	118 283
180 000 and over	2	42 615 - 55 480	98 095
	203		2 190 629

(3) GRAZING HOMESTEAD FREEHOLDING LEASE:

Grazing Selections can be converted to this tenure with freeholding over 40 years and an annual payment to the Crown of one-fortieth of the unimproved value as fixed at the date of the application to convert. During the freeholding period all the conditions which attach to the original grazing selection continue to apply and when the land eventually becomes freehold the deed of grant cannot be held by a corporation and there are also area limitations applying.

These restrictions and area limitations may only be waived with the consent of the Governor in Council.

Grazing Homestead Perpetual Lease is a new tenure to which a Grazing Selection may be converted and given a lease in perpetuity with similar conditions and rent to the Grazing Selection; areas in excess of a living area may not be converted but in practice this would now have negligible application.

(4) PASTORAL LEASES:

The various Pastoral Lease Tenures cover most of the cattle lands in the area. Pastoral Holdings except for Preferential Pastoral Holdings may be held by Companies and there are not area limitations. Leases are normally for 30 years; at the expiration of the lease if the land is subdivided, the former lessee is entitled to a living area as a retention block provided the lessees are competent in law to hold the subdivided tenure.

The Crown has the right of resuming one-third of the area of a Pastoral Holding after 15 years without payment of compensation. The following special conditions attach to other Pastoral Holdings -

TABLE 7.5 Distribution of Estimated Carrying Capacity and Number of Properties

Stock Numbers (Sheep)	No. of Properties	Stock Numbers (Cattle)	No. of Properties
640 - 1 000	3	200 - 1 000	9
1 000 - 3 000	7	1 000 - 2 000	6
3 000 - 4 000	9	2 000 - 4 000	3
4 000 - 5 000	18	4 000 - 5 000	2
5 000 - 6 000	21	5 000 - 7 000	3
6 000 - 7 000	25	7 000 and over	2
7 000 - 8 000	16		
8 000 - 9 000	11		
9 000 - 10 000	14		
10 000 - 11 000	15		
11 000 - 12 000	11		
12 000 - 13 000	7		
13 000 - 14 000	3		
14 000 - 15 000	2		
15 000 - 16 000	8		
16 000 - 17 000	6		
17 000 - 18 000	2		
18 000 - 19 000	2		
19 000 - 20 000	3		
20 000 - 25 000	8		
25 000 - 30 000	4		
30 000 - 40 000	3		
40 000 and over	5		
	203		25

(a) PASTORAL DEVELOPMENT HOLDINGS:

This may be issued over areas more difficult than normal to develop and the term may be up to 50 years with possible variation of resumption rights.

(b) PREFERENTIAL PASTORAL HOLDINGS:

This is a restrictive Pastoral Lease and in many respects is similar to a Grazing Selection in that the lease cannot be held by corporations, may be subject to personal residence in the initial period and the area which may be held is restricted by the opening notification. The tenure allows for larger areas to be held than does the Grazing Selection and also survey is not necessary. The Crown has no statutory resumption rights.

(c) STUD HOLDINGS:

There are only five of these in the area and the tenure was designed to foster the development and maintenance of stud flocks and herds. The lease provides for areas of up to three normal living areas to be held provided a specified number of stud stock are sold annually.

GENERAL LAND ADMINISTRATION:

Estimates by the Lands Department indicate the area carries over 2 million sheep and only some 75 000 cattle. Most of the sheep are carried on Grazing Selection tenures.

Rents on Grazing Selections (apart from those being freeholded) and Pastoral Leases are reassessed every ten (10) years and are fixed by the Land Court on the basis of land quality with a rent per sheep or beast having regard also to the costs of provision of necessary improvements for grazing such as water and timber treatment. Once established, the general level of rents per sheep/beast (known as net rates) is carried on until there has been an appreciable change in the economics of the industry and land values, when a fresh level may be approved by the Court.

In this respect rents per sheep were increased above former levels in 1958 and reduced by up to half after the slump in wool prices in the 1970-71 period. These reduced levels are still being applied. Similarly, rents per beast were increased above previous levels in 1960 and the general net rate per beast level is at present the subject of a State wide inquiry following the 1974 collapse of the beef market. As rents are based on carrying capacity in average seasons, over the years there has been ample opportunity for lessees and others experienced in the areas to present evidence of long term carrying capacity, and in the areas concerned there is now fairly widespread agreement on carrying capacities of the major land types. In this respect the best of the land in the Blackall District is now rated at 1 sheep to 1.2 hectares (3 acres); it is noted that prior to the 1900-1902 drought the opinion was fairly widely held that the downs country would safely carry 1 sheep to 2 acres.

Subdivision and opening of new areas for settlement has ceased in the last twenty years. In latter years with the general decline in profitability of rural industries, the accent has been on making any lands which revert to the Crown available for additional areas to smaller landholders in the locality. Granting of land as additional areas has been possible since 1927 but until recent years new settlement took precedence over additional areas.

Records indicate some twelve such additional areas have been made available in the survey area in the last ten (10) years.

Also, with the setting up of the national Rural Reconstruction Scheme providing funds at concessional interest rates for farm build-up, the Department has relaxed somewhat, previous policy in respect of private subdivision of leases. This has allowed a reallocation of land among existing enterprises by the addition and closing down of the smaller uneconomic properties, with the remaining landholders buying part or all of these smaller properties.

Unfortunately, subdivision for settlement in the early days was a somewhat haphazard affair largely left in the hands of Local Land Commissioners or Surveyors who were subjected to the demands and pressures of local opinion. As mentioned previously the capabilities of the land were also overrated. There was little, if any, attempt to classify lands according to carrying capacity, with subdivisions being largely on an area basis, and it was not until 1927 that definite living area

TABLE 7.6 Stock Populations 1897-1977

Year	Beef Cattle ('000 head)	Sheep ('000 head)	Year	Beef Cattle ('000 head)	Sheep ('000 head)
1897	226.7	1 865.7	1938	73.1	1 251.2
1898	199.3	1 712.9	1939	73.2	1 679.3
1899	169.3	1 500.0	1940	-	-
1900	39.8	607.1	1941	-	-
1901	28.0	881.0	1942	-	-
1902	26.7	786.4	1943	-	-
1903	17.7	846.4	1944	-	-
1904	33.8	1 073.4	1945	86.1	1 409.1
1905	30.0	1 096.4	1946	91.6	1 301.6
1906	37.2	1 390.2	1947	90.7	1 007.1
1907	46.5	686.3	1948	91.5	1 114.9
1908	53.5	1 996.4	1949	87.1	1 012.7
1909	71.0	2 182.2	1950	105.8	1 114.0
1910	74.3	2 245.8	1951	123.3	1 161.3
1911	59.8	2 238.3	1952	120.7	1 060.6
1912	70.7	2 246.7	1953	124.9	1 088.8
1913	80.1	2 267.1	1954	144.3	1 101.1
1914	100.2	2 261.5	1955	157.4	1 268.6
1915	67.4	1 760.1	1956	154.1	1 479.4
1916	71.6	1 726.7	1957	169.7	1 548.9
1917	92.0	1 963.2	1958	159.3	1 468.6
1918	109.3	2 169.7	1959	120.9	1 350.7
1919	123.3	1 959.7	1960	88.7	1 462.6
1920	135.2	1 874.5	1961	100.1	1 543.3
1921	147.3	1 945.7	1962	110.4	1 507.0
1922	133.6	1 726.0	1963	111.1	1 430.8
1923	146.5	1 781.4	1964	125.1	1 668.8
1924	151.1	1 920.0	1965	121.4	1 637.3
1925	132.8	1 916.0	1966	82.7	1 172.3
1926	117.3	1 345.6	1967	76.5	1 230.4
1927	84.6	973.4	1968	80.3	1 205.7
1928	59.5	1 333.5	1969	93.6	1 262.5
1929	49.2	1 473.7	1970	98.9	1 086.2
1930	41.4	1 895.9	1971	89.6	873.5
1931	44.6	2 051.5	1972	125.4	995.3
1932	62.1	2 164.9	1973	146.3	991.7
1933	80.4	1 510.5	1974	175.8	1 033.1
1934	89.8	1 683.4	1975	205.8	1 136.5
1935	81.1	1 012.2	1976	217.7	1 118.2
1936	86.6	1 504.5	1977	248.2	1 126.8
1937	77.2	1 619.7			

standards were laid down for the various sheep areas of the State.

The Land Advisory Board of 1927 recommended that in determining living areas (which incidentally was a new concept introduced into the Land Act at that time) 'in the best of the western grazing districts such as Barcaldine, Longreach, Blackall, Charleville, Cunnamulla, the area for good average breeding country within a radius of say 40 miles from rail should be such as will carry about 6 000 sheep. A capacity of 5 000 sheep must be regarded as an absolute minimum. In our opinion a grazier should have such an area as will permit him to carry about 4 000 breeding ewes'. Present living area standards vary with land type and generally are higher than these first estimates.

After 1927, settlement policies were thus much more soundly based and amalgamation of smaller leases has been encouraged particularly in later years.

Apart from statutory conditions regarding area limitations and eligibility of the lessee, many leases and particularly the larger pastoral leases also have specific development conditions which vary with the individual lease and are aimed at achieving a realistic level of development with ability to control stock numbers on the holding by provision of subdivisional fences etc.

In the study area good progress was made in the provision of water facilities, subdivisional fencing and structural improvements until the drought and the slump in wool prices in the late sixties and the recent collapse of the cattle market. Since these recessions, graziers have not had the finance for development programmes and the Lands Department is sympathetic towards the lessees during difficult periods.

Station improvements throughout the sheep area chiefly consist of station buildings, yards, fencing and water improvements. Most of the original netting fences were erected early in the present century and the Dingo Barrier Fence, utilising much of the existing fencing, was completed across the area about twenty (20) years ago. Subdivisional fences in the sheep areas consist of 6 wire and ringlock netting and as the dingo is now largely controlled by poisoning operations, the need for high netting fences has declined. Artesian bores still provide water over much of the sheep areas.

The cattle area was for many years only lightly improved with grazing use limited by proximity to available natural waterholes. As Pastoral Leases expired and were renewed, development conditions were imposed and now most stations are reasonably improved with station buildings and outstations where warranted, holding paddocks, bronco yards and water improvements where the country is suitable for grazing and storage of water. Water improvements in the western part of the area are mainly large dams.

THE PASTORAL INDUSTRIES

Precise stock population figures for the area are not available. However, official statistics based on Petty Sessions districts are available for the period 1897 to 1939 inclusive and on a Local Authority (Shire) basis from 1940 to 1975 inclusive, with the exception of some gaps due to war conditions. Some adjustments and apportionments have been necessary to obtain area figures due to;

(a) changes in boundaries of the Petty Sessions # districts over the relevant period

(b) Petty Sessions districts in the Local Authority boundaries do not coincide exactly with the surveyed area and

(c) the Local Authority boundaries themselves have not remained constant.

For purposes of historical record the apportionments made in arriving at stock population from 1897 to 1974 are detailed below.

(a) Stock population by Petty Sessions districts 1897 - 1939.

Period (inclusive)	Petty Sessions district included
1897 - 1903	Windorah, Isisford, Blackall (two-thirds), Adavale (one-half).
1904-1931	Jundah, Windorah, Isisford, Blackall (two-thirds), Adavale (one-half).
1932-1939	Jundah, Windorah, Isisford, Blackall (two-thirds), Adavale (four-fifths).

(b) Shires 1940 - 1975 Barcoo, Isisford, Blackall (two-thirds of both cattle and sheep population), Quilpie (one-third of cattle population).

Cattle numbers in the region have varied widely over time with numbers only exceeding 200 000 in 1897 and the years 1975, 1976 and 1977.

The high figure recorded at the turn of the century was soon followed by a record low as the infamous drought at the beginning of the 20th century took its toll. Numbers plummetted from 169 000 head in 1899 to 39 000 head in 1900 and continued to fall until 1903 when the lowest ever figure of less than 18 000 head was recorded. Following the 1903 disaster, 11 years elapsed before numbers reached 100 000 when drought again struck. Numbers fell to 67 000 in 1915 but then began a steady rise to reach a peak of 151 000 in 1924. Then followed a decline with a low of 41 000 in 1930, again as a result of drought (see Table 7.6).

It was to be another 20 years, namely 1950, before cattle numbers again exceeded 100 000 and they have generally remained in excess of that figure until the effects of the 1964-66 drought resulted in a fall to 76 000 early in 1967. With the exception of a minor setback from the 1970 drought there has been a very substantial rise to the 1977 figure of 248 000. This reflects the run of good seasons from 1971 onwards with some evidence of a deliberate change from sheep to cattle as a result of very low wool prices in 1970 and 1971.

Sheep numbers have also been severely affected by drought. However, sheep numbers tend to fall more rapidly and recover faster.

There is evidence of a deliberate movement into sheep production from 1908 when the numbers of sheep had exceeded the level of the 1900 - 1902 pre-drought era. By 1913 sheep numbers exceeded 2.3 million and fluctuated between that figure and 1.7 million until 1927 when drought forced a temporary depression to 970 000. By 1932 the figure of 2.1 million was again reached but this is well in advance of any recorded since that date. Records are not available for the period 1940 to 1944 inclusive.

We are indebted to officers of the Justice Department for details of changes to Petty Sessions district boundaries 1897 to 1939.

The drought of 1964-66 did not affect this region as severely as that immediately to the south and east but sheep numbers fell from 1.6 million to 1.1 million. Numbers then remained static until 1971 when drought, combined with low wool prices, caused a drop in sheep numbers to 870 000 which is the lowest recorded figure since 1903 and the fourth lowest on record. With an improvement in wool prices, numbers recovered to 1.1 million in 1975 and have been steady at that level to 1978.

BREEDS

The commercial wool growing industry in this area is based on medium to strong (21-23 micron) Peppin merino sheep. In the north-east there are several nationally known studs which supply sires and breeding ewes to wool growers throughout the State.

Sheep producing medium to strong wool are favoured because of their large frames, heavy wool cuts and ability to survive and reproduce under harsh conditions with a minimum of attention.

Beef cattle herds are predominantly Shorthorn in the western areas with Santa Gertrudis and Hereford based herds becoming more common east of the Thomson River and Cooper Creek.

PROPERTY IMPROVEMENTS

Pastoral lease provisions in the drier western cattle country usually require the erection of boundary fencing, holding paddocks and bonco yards, as well as the provision of adequate station buildings. Extra water facilities and outstations have been required where these have been considered necessary to encourage the usage of more remote areas of suitable country.

There is general compliance with these lease conditions. Almost all country suitable for grazing can be utilized, with some exceptions during dry years when surface water is not available. Under present technology and cost-price relationships development of this country is unlikely to occur. Current trends (1976-77) are towards containing costs by reductions in paid labour and minimal expenditure on improvements.

In the area to the east of the cattle country, both sheep and cattle are run at present, but traditionally wool production has been the main source of income. Holdings generally have boundary and subdivision fencing, yards and station buildings for successful operation. Again cost pressures are forcing managers to prune labour costs and expenditure on maintenance and replacement of fencing, other fixed improvements and plant. Management systems based on a minimum of well-designed, efficient improvements aimed at improving labour productivity, and concentrating only on essential stock work are being adopted.

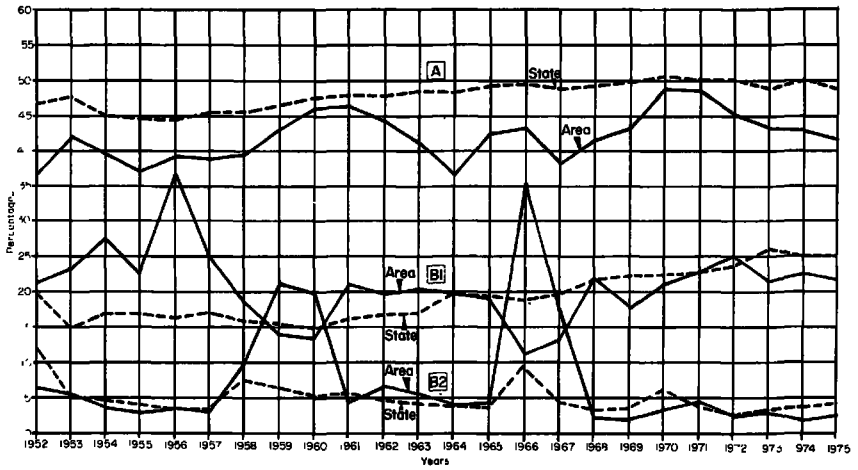
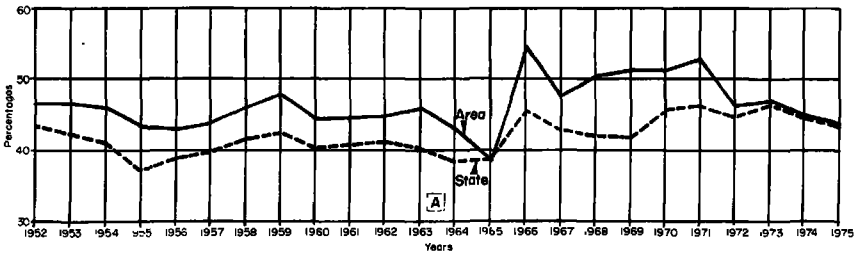


Fig. 7.1 *A%* *breeding cattle to total cattle.*
B *Comparative efficiency factors based on total cattle numbers,*
1. breedings
2. mortalities

The area carries nearly 2% of the total state beef cattle herd. Parameters of herd composition and performance are presented in Figure 7.1. The ratio of breeders (cows and heifers over 1 year) to total cattle is consistently below the State average with much greater seasonal variation in numbers. An increase in the ratio in the early 1970's is thought to be due to the retention of breeding cattle during drought years and a possible build up in breeder numbers on sheep properties as many graziers turned to cattle during a period of very low wool prices. For the period 1952 to 1975 figures show that the number of stock bred exceeded mortalities by approximately 15% of total cattle numbers. Branding and mortality figures approximate those for the whole State, again showing more pronounced seasonal fluctuations, particularly in regard to mortalities, which probably reflect climatic extremes, particularly drought.

FLOCK COMPOSITION AND PERFORMANCE

The area contains approximately 8% of total state sheep numbers, indicating the relative importance of the sheep industry. The ratio of breeding ewes to total sheep was slightly above state figures for the period 1952 - 1975 (Figure 7.2A). As pointed out by Mawson *et al.* (1974) the peaks in this ratio during the period 1966 to 1970/71 appear to indicate the retention of breeding ewes during drought periods at the expense of other sheep.



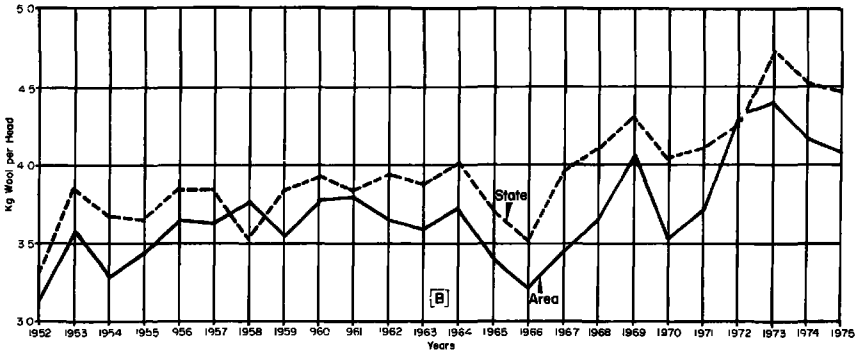


Fig. 7.2 *Comparative data.*
A% of breeding ewes to total sheep.
B kg. of wool per head.

Greasy wool cuts (Figure 7.2B) are below the State average for most of the period examined. However it should be pointed out that amount of greasy wool cut is not the sole determinant of the value of production per animal, which must be considered in the light of various factors affecting fleece quality. Wool from the Downs, Wooded Downs and Gidgee land zones in the east is usually relatively free from dust and vegetable fault and generally enjoys an excellent reputation for quality.

Lamb marking percentages and mortalities are roughly similar to State averages (Figure 7.3). Lambs marked are expressed as a percentage of total breeding ewes rather than ewes actually joined and so may give an erroneous impression of reproductive performance of the animals in poor seasons when some ewes may not be joined. Over the period 1952-75 numbers of lambs marked have exceeded mortalities by approximately 12% of total sheep numbers.

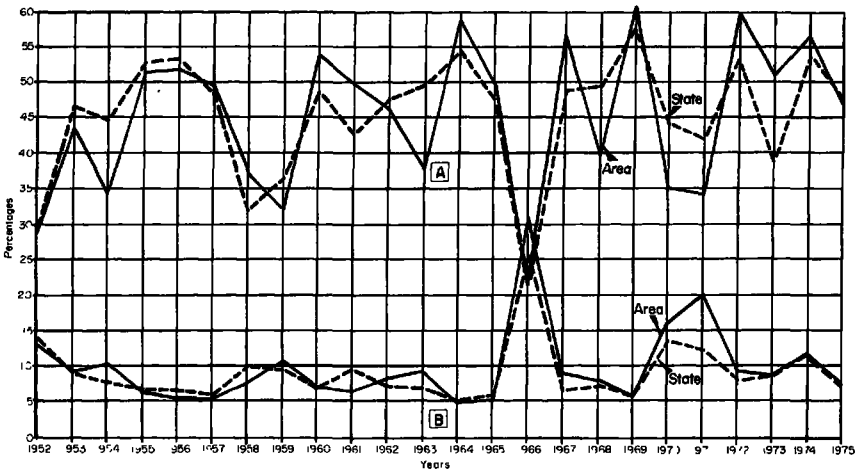


Fig. 7.3 *A% lambs marked to breeding ewes.*
B% sheep mortalities to total sheep.

HUSBANDRY AND DROUGHT MANAGEMENT

Detailed discussion of husbandry practices is not described in this section. These aspects have been covered by Moule (1952), Anson (1959), Howard (1961), Anson *et al.* (1969), Weller (1969), Gibb (1961, 1966), Bell and Young (1967), Anson and Mawson (1969) and Burns (1971).

Management problems posed by the unpredictable duration and severity of drought in the arid zone are considerable. Rainfall has a prounounced summer maximum i.e. the 'wet' season occurs from January to March when general rain is expected to cover all districts. The use of rainfall probabilities (Mawson and Robinson 1975) to determine the chances of receiving useful rains at various times throughout the year provides some objective basis on which to formulate drought strategies.

Most landholders recognise the types of country on their properties which provide useful feed well into drought periods. Similarly, types of country which respond to lighter falls of rain are fairly widely recognised. From the aspect of land management it would be desirable to manage each land type or land unit according to its individual characteristics, but fencing and water considerations make this impracticable in many cases. However the recognition that different stocking and management strategies are required for different land units, and that more sensitive land units in a paddock may be severely damaged while others remain relatively unaffected by the same grazing pressure is a step towards more flexible and efficient land management under drought conditions.

A brief outline of some forms of drought strategy which managers adopt during drought conditions follows:-

(a) On-property strategies

1. Stock are not joined.
2. Feeding supplements.
3. Feeding topfeed (usually mulga).

(b) Destocking or off-property strategies

1. Sell off stock.
2. Move stock to agistment.
3. Destock to other properties under the same ownership.

The decision on whether to join stock or not is more relevant in the case of sheep as the shorter gestation period of five months allows managers to predict to some extent pasture conditions both before and after lambing takes place. Their decisions can then be guided by these predictions. The longer 9½ month gestation period of cattle makes prediction of pasture conditions at and after calving uncertain. In some areas different classes of cattle are not segregated and controlled mating is not possible.

Breeder losses during calving or lambing and up to weaning can be heavy if adequate feed is not available. Lambing and calving percentages are often severely reduced under drought conditions. Sheep born in times of drought receive a setback which results in inferior production from the animal throughout its entire life (Schinckel and Short 1960). Animals of this nature make unsuitable replacements, particularly when the risk of losing female breeding stock and the reduction of wool cut and quality from them is considered.

Feeding of mineral protein and energy supplements to stock has been practised at various times on a number of properties. Main disadvantages are high costs, the fact that stock may die anyway if the drought is unduly prolonged, and pastures may be severely damaged by consumption of plant material which is not normally eaten (Weller 1969). The benefits of providing breeding animals and weaners with mineral supplements are not clear and vary from one area to another. The feeding of bought fodder is generally restricted to horses and stud stock because of the expense involved.

The feeding of mulga by lopping with axes, saws or pushing or breaking with tractors is the traditional form of drought feeding on mulga properties. Significant areas of mulga have been cut out during past drought periods. These areas have often degenerated as a result of the continued grazing during drought conditions. Fortunately, considerable regeneration of mulga has occurred during the recent good seasons. Maintenance of a minimum density of mulga trees (175/ha) and a certain amount of ground cover appears necessary to prevent serious degradation of the mulga lands. Mulga provides a suitable maintenance ration for dry stock and will sustain them for considerable periods, providing stock will eat the mulga which is cut, sufficient mulga can be cut, and the condition of the stock is not allowed to decline too far before feeding is commenced.

Selling-off stock is the most straight forward method of destocking. It is apt to be regarded as unsatisfactory by managers in some instances because of low prices realized when whole areas are affected by drought and large numbers of stock are brought on the market. However Miller, Alexander and Mawson (1973) found that reduction of stock numbers by selling was a sound policy in the 1964 to 1966 drought, providing stock were sold while still in reasonable condition, and some demand existed in the market. An early decision on whether to sell or not is essential to gain greatest benefit from this strategy. Transport costs from this area to the big markets such as Cannon Hill are considerable and act as a disincentive to managers to destock by selling in these markets.

The use of agistment so stock can be moved from drought-affected areas is again expensive in terms of transport costs and agistment fees. This is particularly so where drought conditions are widespread, demand for agistment is high and stock have to be moved considerable distances. Government rail freight and road transport concessions at a rate of 50% apply to movement of stock, fodder and water to or from holdings within a declared drought area or to or from an individual drought stricken property (at July 1978).

Where large chains of properties are run under the same management it is often possible to move stock from drought affected properties to other properties in the same chain. The fact that each individual property in the chain does not have to turn in a profit each year also means that drought stricken properties are not so likely to be damaged by high grazing pressures if management is aware of the dangers of overstocking sensitive land types during drought. More information on the comparative efficiencies of large aggregations of land and the single property unit is needed, particularly under drought conditions.

A general policy of matching stocking rates to the capabilities of the pasture available, forms a sound basis for implementation of any of the foregoing drought strategies. Stock and pasture are kept in better condition under this policy, and if early steps are taken to reduce grazing pressure at the onset of drought, the effects of drought conditions will not be as severe on both animal production and pasture.

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RESOURCE USE

By J.R. Mills and D.E. Boyland #*

PASTURES

For the most part, the grazing industry depends on native pastures. Limited areas, mainly associated with the gidgee lands in the north-east, have been cleared or partly cleared and sown to buffel grass (*Cenchrus ciliaris*). In this area, the tall shrub layers composed of edible trees and shrubs also make a major contribution to the pasture particularly in long drought periods.

The composition of the pasture depends to a large degree on the amount and incidence of rainfall which is extremely variable and unreliable. Most of the grasses germinate and grow in the summer period and require adequate rainfall for growth during this time. Many forbs especially some saltbushes, bassias and related species grow during the autumn/winter period and so require winter rains.

The type, incidence, time and duration of flooding is also critical to pasture composition. Early winter floods result in winter growing herbage such as Cooper clover, billy buttons and *Senecio lautus* whereas summer flooding results in grasses such as pepper grass and channel millet. Cooper clover usually only occurs after general flooding.

Fire also has had an influence on the composition of the pasture but it is difficult to estimate its real effect as this has not been well documented. The effect of the fire depends on its intensity, the time of day, and the season. In the spinifex lands, fires are not a regular feature of the environment due to the paucity of dry matter and its poor ability to carry a fire. When fire does occur on these lands it appears to have a deleterious effect and frequent burning may cause the temporary destruction of spinifex resulting in a loss of stability in the system.

Mulga associations are greatly affected by fire (Everist *et al*, 1958). Fire damage in sandplain mulga associations, frequently leads to deterioration and rapid colonization of denuded areas of species such as hopbush and desert poplar. Also mulga seeds may germinate in large quantities following a fire (Everist, 1969). This can result in a thicket almost impenetrable to stock if the young plants are not grazed. Pedley (1974), observed that adjacent paddocks may vary widely in the amount of mulga carried, not because of the difference in stocking rate but because of the difference in the timing of grazing in relation to fires.

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\# Botany Branch, Queensland Department of Primary Industries.

Mitchell grass pastures are frequently subjected to fire as burning has been used to destroy excess dry herbage at the end of dry seasons. Orr (1975) states that the burning of Mitchell grass pastures is unnecessary and undesirable in most years but adds that during excessively wet years Mitchell grasses grow so vigorously as to exclude ephemerals from between the tussocks. This is not desirable from a nutritional viewpoint and fires may be justified. Everist's observations (pers. comm.) of Mitchell grass pastures subjected to fire indicate no apparent difference in botanical composition or vigour of these pastures compared to those in unburnt areas although fire plowing to prevent the spread of fire can lead to soil erosion.

The type of grazing animal also influences the composition of pastures. Sheep generally prefer short soft grasses and forbs with a proportion of browse plants; cattle eat coarse grasses and some browse; horses rarely eat shrubs or trees if grasses are available.

Usually the plants within the pastures exist in a delicate equilibrium competing for nutrients and water. Overgrazing may upset this balance leading to a gradual change in the composition of the pastures. However the effect of grazing is minimal in most pasture types compared to the over-riding influence of climate. Due to this climatic effect and other management variables such as paddock size, watering points and financial and labour resources it is difficult to devise a set formula to calculate optimum carrying capacity figures.

PASTURE LANDS

Pasture lands cover approximately 80% of the area. The remainder of the land is occupied by extensive areas of rugged, naturally unstable country relatively inaccessible to stock and supporting pastures of poor quality.

The land systems have been grouped into pasture lands based on the composition and density of the major plant associations within each land system (Table 8.1). Where possible smaller more homogenous pasture groups have been recognized within each pasture land. Carrying capacity figures are not given but estimates are provided in Table 8.1.

MITCHELL GRASS PASTURE LANDS

These are widely distributed throughout the area, associated mainly with the gently undulating to undulating clay plains. They are also found on the alluvial plains of some rivers and local alluvia draining these plains.

Mitchell grass pastures may occur as grasslands with few or no trees and shrubs, as wooded grasslands with scattered trees of boree, gidgee and whitewood conspicuous, or as the ground layer in various low open woodlands or tall open shrublands. The stony downs in the west may also support Mitchell grass pastures following a series of above average rainfall seasons. Generally herbfields are found on the stony downs land systems, with either Mitchell grass or other short grasses or forbs predominating, depending on seasonal conditions.

CURLEY MITCHELL GRASS PASTURES

This pasture is characterized by an even, sparsely distributed stand of Mitchell grasses with curley Mitchell grass predominant. The other Mitchell grasses, barley, bull and hoop may be present. Tussocks are usually over a metre apart resulting in a low basal cover in the order of 3 to 6%. The spaces between the tussocks may be bare or occupied by a number of different plants depending largely on cover and the incidence and amount of rainfall received.

TABLE 8.1 LAND SYSTEM CONDITION AND GRAZING CHARACTERISTICS

LAND SYSTEM	EROSION CLASS (TYPE)[1]	NATURAL STABILITY	CONDITION[2]	ESTIMATED AVERAGE GRAZING CAPACITY[3]	DROUGHT GRAZING CAPACITY AND REACTION TO OVERSTOCKING	COMMENTS
DUNEFIELDS						
D1 MAYFIELD	6	Stable	Fair to mediocre	1.5 beasts / km^2 (3.8 beasts / sq. mile) 0.15 sheep / ha (1 sheep to 16 ac.)	Useful low grazing capacity, drought reserve. Not readily damaged except around watering points.	Responds quickly to light falls of rain. Moderate stocking rates beneficial as spinifex is thinned allowing greater herbage production. Research on fire as a management tool is needed.
D2 POONGAMULLA	6, 10	Stable	Fair to mediocre	1.5 beasts / km^2 (3.8 beasts / sq. mile)	Low grazing capacity, drought reserve. Not readily damaged except around watering points.	" "
D3 KYABRA	10	Unstable	Poor to mediocre	0.75 beasts / km^2 (2 beasts / sq. mile)	Some value as a drought reserve; sparse topfeed. Subject to over-grazing and subsequent erosion.	Easily overstocked and damaged. Responds to light falls of rain. Scalding may occur around the base.
D4 CARRANYA	10	Stable	Fair to mediocre	1.5 beasts / km^2 (3.8 beasts / sq. mile)	Very low grazing capacity, drought reserve. Not readily damaged.	Usually benefits from run-on water flooding claypans after general rains. The sandhill component of this land system responds quickly to light rains.
SANDPLAINS						
S1 GREENMULLA	1, 4	Stable	Fair	0.2 sheep / ha (1 sheep to 13 ac.)	Valuable drought reserve with abundant topfeed. Desirable grass species may decrease if overstocked.	Not subject to degradation providing adequate topfeed and vegetation cover is maintained. High infiltration rates restrict runoff. Some thinning of mulga may increase production. Woody weeds and wire grass may be a problem after fire or excessive thinning of mulga.
S2 FRASER	1	Stable	Fair to good	0.15 sheep / ha (1 sheep to 16 ac.)	Valuable drought reserve with abundant topfeed.	Sandy red earth soils with distinctly groved mulga produce most pasture in the grove areas. Mulga densities should be maintained at 175 shrubs / ha even though there is little evidence of degradation. In the north, this land system bears similarities to the eastern "desert" country.
S3 WHITULA	5	Stable	Fair to mediocre	1.5 beasts / km (3.8 beasts / sq. mile) 0.17 sheep / ha (1 sheep to 15 ac.)	Mulga provides valuable drought reserve, but usually only occurs in limited areas. Maintain ground and shrub cover.	Receives run-off water from residual and hard mulga zones; responds well to light falls of rain.
S4 PRARIE	1, 10	Stable	Fair	1.5 beasts / km (3.8 beasts / sq. mile) 0.15 sheep / ha (1 sheep to 16 ac.)	Limited value as drought reserve of very low grazing capacity. Not readily damaged.	Responds well to light falls of rain and provides some shade. Small areas of better quality pasture grow around the edges of the claypans.
S5 ISIS	1	Stable	Fair (Seasonal)	0.4 sheep / ha (1 sheep to 6 ac.)	Limited topfeed available; provides valuable drought reserve when surrounding heavier country has no useful feed available.	Responds to light falls of rain. Good mixture of perennial and annual species with plenty of shade available.
S6 GALWAY	1	Stable	Fair	1.2 beasts / km (3 beasts / sq. mile) 0.15 sheep / ha (1 sheep to 16 ac.)	Limited value as a drought reserve can degrade and erode if overgrazed for extended periods.	Responds to light falls of rain; moderate grazing pressure results in greater herbage production.
SOFT MULGA LANDS						
M1 WURINGLE	2, 7	Slightly unstable	Fair to mediocre	0.2 sheep / ha (1 sheep to 13 ac.)	Good drought reserve. The intergrove areas degrade if adequate ground cover is not maintained.	Well developed groving leads to efficient water use. Mulga densities of 175 shrubs / ha should be maintained.
M2 AMBATHALA	1,7	Stable to slightly unstable	Fair	0.3 sheep / ha (1 sheep to 9 ac.)	Good drought reserve with abundant topfeed; upper slopes degrade if overgrazed; adequate ground cover must be maintained on the slopes.	Woody weeds and sodicity problems on lower slopes which benefit from run-on water. Thinning of mulga to densities not less than 175 shrubs / ha increases productivity.
M3 CHANDOS	2, 7	Slightly unstable	Mediocre to fair	0.25 sheep / ha (1 sheep to 10 ac.)	Good low grazing capacity drought reserve; moderately dense topfeed; susceptible to degradation if adequate ground cover is not maintained in the form of trees and shrubs.	Well developed groving leads to efficient water use. Frequent areas suffering from degradation. Thinning of mulga to densities not less than 175 shrubs / ha may increase production.
M4 BRONTE	1, 7	Slightly unstable	Fair to good	0.3 sheep / ha (1 sheep to 9 ac.)	Good drought reserve with abundant topfeed; upper slopes subject to degradation; run-off is excessive if adequate vegetative cover is not maintained.	Thinning of dense stands of mulga to densities of not less than 175 shrubs / ha may increase production.
HARD MULGA LANDS						
H1 BRAIDWOOD	4, 7	Slightly unstable	Poor	0.12 sheep / ha (1 sheep to 20 ac.)	Limited value as a drought reserve as topfeed is now very sparse. Ground cover must be maintained to prevent erosion.	Subject to overgrazing because of proximity to Channel Country land systems.
H2 CARELLA	4, 7	Slightly unstable	Fair to mediocre	0.12 sheep / ha (1 sheep to 20 ac.)	Very low grazing capacity drought reserve with some topfeed. Natural erosion around the margins.	Limited productivity. Access and availability of water may be limiting.
H3 ONOTO	4, 7	Slightly unstable	Mediocre to fair	1.5 beasts / km (3.8 beasts / sq. mile)	Useful drought reserve with some topfeed; adequate vegetative cover must be maintained to prevent degradation.	Groving makes efficient use of low and unreliable rainfall; best pasture grown on heavier soils in the grove areas.
H4 COTHALOW	4, 7	Slightly unstable	Fair to mediocre	0.17 sheep / ha (1 sheep to 15 ac.)	Little value as drought reserve as topfeed is sparse and the pastures mainly ephemeral; susceptible to erosion and excessive run-off if ground cover not maintained.	Limited productivity, but acts as a watershed for softer mulga land systems and local alluvium on the lower slopes.
H5 TENHAM	4, 7	Slightly unstable	Poor to mediocre	0.2 sheep / ha (1 sheep to 13 ac.)	Frequently of limited drought grazing capacity because of sparse topfeed; valuable drought reserve when in good condition. High stocking pressure during drought periods must be avoided where possible.	Extensive areas have been degraded as a result of drought feeding, careful management needed to revegetate areas where loss of surface soil has occurred; restoration of adequate mulga densities (175 trees / ha) is essential.

1 Condon and Stannard (1957)
2 Condon, Newman and Cunningham (1969)
3 Estimated average grazing capacity figures are presented for use as regional guide only. These figures were arrived at by assessing data held by the Department of Lands, officers of the Department of Primary Industries and discussions with station managers. Grazing capacity is expressed in terms of adult bovines (a steer of 450 kg liveweight) per km^2 and dry sheep / ha. Eight dry sheep are taken as equivalent to one dry bovine.

F7 BIMERAH	1	Stable	Good	0.6 sheep / ha (1 sheep to 4 ac.)	Mitchell grass provides useful stand-over feed; topfeed very sparse. Drought grazing capacity low.	Productive, stable Mitchell grass pastures, shade available in eastern areas. Light falls of rain produce little pasture growth.
F8 CORRIKIE	1	Stable	Poor to Mediocre	0.25 sheep / ha (1 sheep to 10 ac.)	Little stand over feed. Drought grazing capacity extremely low.	Low grazing capacity, seasonal ephemeral pastures.
ALLUVIAL PLAINS, WOODLANDS						
W1 BARCOO	7, 8	Stable to slightly unstable	Fair (seasonal)	0.6 sheep / ha (1 sheep to 4 ac.) in eastern areas; to 0.35 sheep / ha (1 sheep to 7 ac.) in western areas.	Limited value during drought; topfeed absent; subject to severe overgrazing, particularly around watering points.	Seasonally flooded, producing useful high carrying capacity pastures. Scalding is widespread below the junction with Powell Creek. Seasonal scalding occurs on the upper reaches. Adequate shade and water for stock.
W2 MILO	7, 8	Slightly unstable	Seasonal	0.35 sheep / ha (1 sheep to 7 ac.)	Limited value during drought; topfeed absent; subject to overgrazing, particularly round watering points.	Seasonal ephemeral pastures only. Headwaters are in the residual land zone and benefits from high run-off in this country. Seasonal scalding occurs throughout.
W3 RAVENSBOURNE	1, 8	Stable to slightly unstable	Good (seasonal)	0.6 sheep / ha (1 sheep to 4 ac.)	Useful drought pasture available in Mitchell grass which stands over well; however subject to overgrazing; sparse topfeed.	Seasonally flooded, producing durable high carrying capacity pastures. Subject to seasonal scalding if overgrazed, particularly around watering points.
W4 SPRINGFIELD	7, 8	Slightly unstable	Seasonal	0.35 sheep / ha (1 sheep to 7 ac.) in eastern areas: 4 beasts / km^2 (10 beasts / sq. mile) in western areas.	Limited value during drought; sparse topfeed on sandhills; subject to overgrazing.	Seasonally flooded, producing useful ephemeral pastures only; receives run-off from hard mulga lands; thus lighter storm rains will produce feed on the sandhills and the runoff produces feed on the heavier clay soils along the channels.
W5 FANNING	1	Stable	Seasonal	0.7 sheep / ha (1 sheep to 3.5 ac.)	Useful drought pastures available, Mitchell grass stands over well, though subject to overgrazing; some topfeed present.	Infrequently flooded "frontage country" producing durable high carrying capacity pastures; useful shade near water; good herbage production in season.
W6 DURELLA	1, 8	Slightly unstable	Seasonal	0.25 sheep / ha (1 sheep to 10 ac.)	Very low drought grazing capacity, topfeed very sparse; standover feed very limited.	Seasonally flooded, producing useful ephemeral pastures; during runs of good seasons perennial grasses become a significant pasture component. Receives runoff from hard mulga lands and so can respond to lighter storm rains. Subject to seasonal scalding.
W7 EDKINS	1, 8	Slightly unstable	Seasonal	1 - 3 beasts / km^2 (2.5 - 8 beasts / sq. mile)	Very low drought grazing capacity, topfeed absent; standover feed very limited.	Occasionally flooded, but rainfall is low and erratic. Useful ephemeral pastures produced following rains or flooding; subject to overgrazing and scalding. Useful shade.
CHANNEL COUNTRY						
C1 COOPER	1	Stable	Good (seasonal flooding)	3.0 + beasts / km^2 (8 + beasts / sq. mile): higher rates are possible following flooding.	Very low drought grazing capacity.	Swamps and channels flooded one year in two; general inundation one year in four. Fertile soils produce excellent ephemeral pastures of high grazing capacity following flooding. Excellent cattle fattening country.
C2 CUNNAWILLA	1	Stable	Seasonal	2.0 - 3.0 beasts / km^2 (5 - 8 beasts / sq. mile): higher rates are possible following flooding.	Low drought grazing capacity; standover feed is limited; topfeed absent except on sandhills.	General inundation one year in four on average. Good quality ephemeral pastures of high grazing capacity produced following flooding. Local runoff can also produce useful feed in years when general inundation does not occur. Subject to scalding in overgrazed situations such as around watering points. Good cattle fattening country in season.
C3 WOONABOOTRA	1	Stable	Good (seasonal flooding)	3.0 + beasts / km^2 (8 + beasts / sq. mile): higher rates are possible following flooding.	Limited standover feed; low drought grazing capacity.	General inundation estimated one year in two on average. Fertile soils produce excellent quality ephemeral pastures. These areas are readily flooded and can benefit from flooding caused by local storm rains. Adequate shade. Excellent cattle fattening country.
OTHER ALLUVIA						
A1 LISTOWEL	1	Stable	Fair (seasonal)	0.7 sheep / ha (1 sheep to 3.5 ac.)	Moderate drought grazing capacity; Mitchell grass stands over well if not overgrazed.	Seasonally flooded, producing durable high carrying capacity pastures. Subject to overgrazing and some seasonal scalding, particularly around watering points.
A2 EROMANGA	1, 7	Stable	Poor (seasonal)	0.25 sheep / ha (1 sheep to 10 ac.)	Very low drought grazing capacity; topfeed absent. Subject to severe overgrazing.	Seasonally flooded. Capable of producing useful ephemeral pastures in good seasons, but overstocking during drought periods results in severe scalding and low quality ephemeral pastures.
A3 NOOYEAH	5, 7	Unstable	Very poor (seasonal)	nil	nil	Severely scalded alluvial plains subject to occasional flooding. Scalding may be seasonal or permanent. Seasonal scalds disappear during a run of good seasons if not overstocked and are a natural feature of the area; permanent scalding is often due to a combination of inherent soil or climate factors plus overgrazing and is difficult to reclaim successfully.
A4 JUNDAH	1, 3, 7	Slightly	Poor	0.2 sheep / ha	Very low drought grazing capacity. Subject to extensive seasonal scalding. Topfeed absent.	Produces ephemeral pastures of low carrying capacity.
A4 DINGERA	1, 8	Stable	Mediocre (seasonal)	3.0 beasts / km^2 (8 beasts / sq. mile) in western areas: 0.35 sheep / ha (1 sheep to 7 ac.) in eastern areas.	Low drought grazing capacity; subject to extensive seasonal scalding. Topfeed virtually absent.	Seasonally flooded, producing ephemeral pastures of moderate carrying capacity; good herbage country; following a run of good seasons Mitchell grass may form a significant component of the pasture.
A6 WARRY	7, 8	Unstable	Mediocre (seasonal)	3.0 beasts / km^2 (8 beasts / sq. mile) in western areas: 0.25 sheep / ha (1 sheep to 10 ac.) in eastern areas.	Low drought grazing capacity; subject to overgrazing; extensive areas are seasonally scalded, particularly around watering points.	Seasonally flooded, producing mainly ephemeral pastures of moderate carrying capacity; receives runoff from mulga lands and residual land zones, and so responds to light storm rains. Shade adequate. Gully erosion in the upper reaches of these streams can destroy productive flats. Adequate vegetative cover must be maintained in the catchments.
MISCELLANEOUS						
L1 CUDDAPAN	1	Stable	Seasonal	1 + beasts / km^2 1 + beasts / km^2 (2.5 + beasts / sq. mile): higher rates are possible following flooding.	Very low drought grazing capacity; extensive areas are seasonally scalded.	Low and erratic rainfall results in infrequent inundation for extended periods; certain areas produce good "channel country" type feed; much of the pasture produced on the remaining area is of limited value.

DISSECTED RESIDUALS						
R1 GILMORE	9	Unstable	Poor	-	Little value as a drought reserve as trees and shrubs mainly inedible; minor areas of mulga in the valleys provide limited topfeed.	Very low productivity, mostly from run-on areas in the dissected tracts; excessive run-off causes some erosion problems but results in useful pasture further down on the alluvial plains; dingoes a problem.
R2 MAWSON	9	Unstable	Poor to	-	Nil	Extremely low productivity; high run-off.
R3 VALETTA	9	Unstable	Poor to mediocre	-	Sparse topfeed provides a limited drought reserve at very low stocking rates.	Low productivity, mainly from ephemeral pastures; use limited by access and availability of water.
R4 DURHAM	8	Moderately unstable	Poor to mediocre	-	Little value as a drought reserve.	Ephemeral pastures on lower slopes receive run-off and provide limited grazing following rain.
R5 CHEVIOT	9	Unstable	Poor to mediocre	-	Pastures are of little value as a drought reserve; however sparse mulga topfeed is available in most areas.	Very low productivity from ephemeral pastures; excessive run-off.
R6 GUMBARDO	9	Unstable	Poor	-	Little value as drought reserve.	Very low productivity; ephemeral pastures benefit from run-off higher up the slope; excessive run-off leads to gully erosion at the bottom of the drop-offs and on adjacent land systems, but results in useful feed on the alluvial plains.
R7 KURRAN	9	Unstable	Poor to very poor	-	Little value as a drought reserve. Sparse mulga topfeed available in some areas. Stock water limiting.	Very low productivity except for run-on areas between the remnants which produce useful ephemeral pastures in season suitable for cattle fattening.
R8 WAVERNEY	9	Unstable	Poor	-	Little value as a drought reserve; very sparse mulga topfeed available in some areas. Stock water limiting.	Very low productivity mainly on lower slopes which benefit from run-off water, producing useful ephemeral pastures in season
GIDGEE LANDS						
G1 LINDEN	1	Stable	Fair to good	0.25 sheep / ha (1 sheep to 10 ac.) when uncleared; 0.8 + sheep / ha (1 + sheep to 3 ac.) when developed to buffel grass.	Drought grazing capacity very low unless perennial species are present. Improved pastures (buffel grass) stand over well.	Suitable for development by clearing and introduction of buffel grass; woody weeds and pasture establishment problems require careful management.
G2 KIAMA	1	Stable	Fair	0.25 sheep / ha (1 sheep to 10 ac.) when uncleared; 0.6 sheep / ha (1 sheep to 4 ac.) when developed to buffel grass.	" "	Eastern areas suitable for development and introduction of buffel grass. Dense stone cover limits susceptibility to erosion in most areas.
G3 OPAL	1, 8	Stable	Fair	0.2 sheep / ha (1 sheep to 13 ac.) 2.0 beasts / km^2 (5 beasts / sq. mile)	Drought grazing capacity very low unless perennial species are present.	Low carrying capacity, receives run-off from nearby scarps. Stone cover limits susceptibility to erosion.
G4 IDALIA	1, 9	Stable (incised valleys are unstable).	Mediocre	0.2 sheep / ha (1 sheep to 13 ac.)	Little value as a drought reserve.	Low carrying capacity; usually receives run-off from nearby scarps. Development not recommended due to woody weed and pasture establishment problems. Severe erosion of valley floors has occurred.
WOODED DOWNS						
T1 HOBSON	1	Stable	Fair	0.6 sheep / ha (1 sheep to 4 ac.)	Mitchell grass stands over well; sparse topfeed.	Productive, well-shaded land system capable of high levels of production in good seasons. Good breeding country. Light falls of rain generally produce little pasture growth.
T2 GREENWOOD	1	Stable	Fair to good	0.6 sheep / ha (1 sheep to 4 ac.)	Mitchell grass stands over well; sparse topfeed.	Productive, well-shaded land system capable of high levels of production in good seasons. Good breeding country. Light falls of rain generally produce little pasture growth.
T3 TERRICK	1	Stable	Fair to good	0.8 sheep / ha (1 sheep to 3 ac.)	Mitchell grass stands over well; limited topfeed available.	Stable well-shaded pastures capable of high levels of production in good seasons. Limited areas respond to light falls of rain. Excellent breeding country.
T4 MOONEY	1	Stable	Fair	0.7 sheep / ha (1 sheep to 3.5 ac.)	Mitchell grass stands over well; limited topfeed available.	Stable well-shaded pastures capable of high levels of production in good seasons. Pasture on areas of shallower and lighter soils will respond to light falls of rain.
T5 MT. HARDEN	1	Stable	Fair	0.7 sheep / ha (1 sheep to 3.5 ac.)	Mitchell grass stands over well; topfeed absent.	Stable well-shaded pastures capable of high levels of production in good seasons. Pasture does not respond to light falls of rain.
DOWNS						
F1 PALPARARA	1, 7	Stable	Poor	0.5 - 2.0 beasts / km (1 - 5 beasts / sq. mile)	Little value as drought reserve.	Low and unreliable rainfall; seasonal ephemeral pastures only.
F2 PLEVNA	1, 7	Stable	Fair to poor	1.0 - 2.5 beasts / km (2.5 - 6 beasts / sq. mile)	Little value as drought reserve.	Low and unreliable rainfall; usually seasonal ephemeral pastures only; following good seasons Mitchell grass may become a significant component of the pasture.
F3 DAVENPORT	1, 7	Stable	Poor to good	1.0 - 2.5 beasts / km (2.5 - 6 beasts / sq. mile)	Little value as drought reserve.	Low and unreliable rainfall; usually seasonal ephemeral pastures only; following good seasons Mitchell grass may become a significant component of the pasture.
F4 MORNEY	1, 7	Stable	Fair to poor	1.0 - 2.5 beasts / km^2 (2.5 - 6 beasts / sq. mile)	Little value as a drought reserve.	Low and unreliable rainfall usually seasonal ephemeral pastures only; following good seasons Mitchell grass may become a significant component of the pasture. Receives some run-on water.
F5 BLACKALL	1	Stable	Good to very good	0.8 sheep / ha (1 sheep to 3 ac.)	Mitchell grass stands over well. Sparse topfeed present on associated wooded downs land systems. Moderate drought grazing capacity.	Highly productive, stable Mitchell grass pastures. Adequate shade on associated wooded downs and gidgee areas. Moderate grazing pressure increases herbage production. Light falls of rain produce little pasture growth and may spoil the quality of standing dry feed.
F6 WARBRECCAN	1, 8	Stable	Good	0.5 - 0.25 sheep / ha (1 sheep to 5 - 10 ac.)	Mitchell grass provides useful stand-over feed. Topfeed absent. Drought grazing capacity low.	Stable Mitchell grass pastures; production dependant on rainfall; little shade; light falls of rain produce little pasture growth.

Summer rains produce both perennial and annual grasses such as button grass, Flinders grass, blue grass, native panics and forbs such as *Abutilon* spp. and *Sida* spp. Winter rains result in a higher forb component with saltbushes, burrs (*Bassia* spp.) and members of the daisy family conspicuous.

The pasture is composed of drought evading or drought resisting species which respond rapidly following sufficient rain for plant growth. The growth is palatable and nutritious. Carrying capacity is in the order of one sheep to one and a half hectares. As the pasture dries off, the Mitchell grasses become coarse, unpalatable and nutritionally poor and the animals tend to selectively graze the ephemerals which although dry, retain both their palatability and nutritive value. Eventually the animals are forced back on to the Mitchell grasses which provide only a maintenance diet.

Generally this pasture is resistant to grazing. Light to medium grazing appears to have little effect and even under heavy grazing little permanent damage appears to occur. Feather top grass is increasing in some situations. General opinion is that this is a result of overgrazing but it is morelikely a combination of seasonal conditions and grazing. Davidson (1954) and Everist (pers. comm.) also observed that it was difficult to separate the effects of climate and grazing. Orr (1975) in his review of Mitchell grass pastures discusses the effect of grazing in more detail.

In moist situations, bull Mitchell, a very coarse grass becomes the predominant species forming a distinctive pasture up to 1.3m high. This pasture is less acceptable to stock than the curly Mitchell grass pasture.

BARLEY MITCHELL GRASS $\pm$ OTHER SHORT GRASSES $\pm$ FORBS PASTURES

These occur in the west associated with the stony downs. Structurally these pastures are similar to the curley Mitchell grass pasturebut the tussocks are more scattered. The composition of the pasture is dependant on seasonal conditions and in drought years barley Mitchell grass is confined to gilgais or drainage channels. Even in good seasons Mitchell grasses rarely contribute more than 50% to the biomass of the pasture. Other perennial grasses occur infrequently but annual grasses such as button grass and Flinders grass are more prevelant. Forbs are usually present and may predominate depending on seasonal conditions.

Carrying capacity is high during above average seasons but drought grazing capacity is low. Heavy grazing leads to changes in pasture composition with the more palatable species being replaced. However, this pasture is very resistant to overgrazing and recovers rapidly during a sequence of above average seasons.

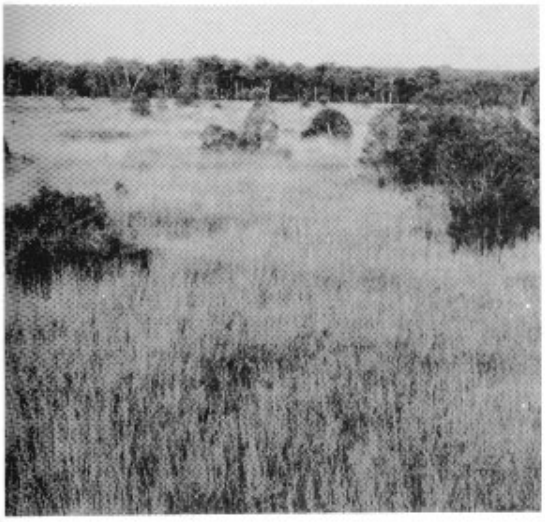
GIDGEE PASTURE LANDS

These pasture lands comprise short grass and/or forb pastures under gidgee the density of which varies greatly from 50 - 2000 trees/ha. They occur throughout the area in three different situations; on gently undulating plains, on alluvial plains and on mantled pediments in the scarp retreat zones. They are best developed in the north-east and to a lesser degree in the central north on gently undulating plains.

In their natural state these pasture lands have a low grazing capacity. Ringbarking to increase the herbage yield of native pastures or clearing and sowing to introduced pastures greatly increases the carrying capacity. Development of the gidgee lands has been discussed in detail by Purcell (1964). Woody weeds, particularly sandalwood, can be a major problem after disturbance, reducing productivity.

Sheep grazing wooded Mitchell grass downs. Adequate shade and water contribute to high lambing percentages.

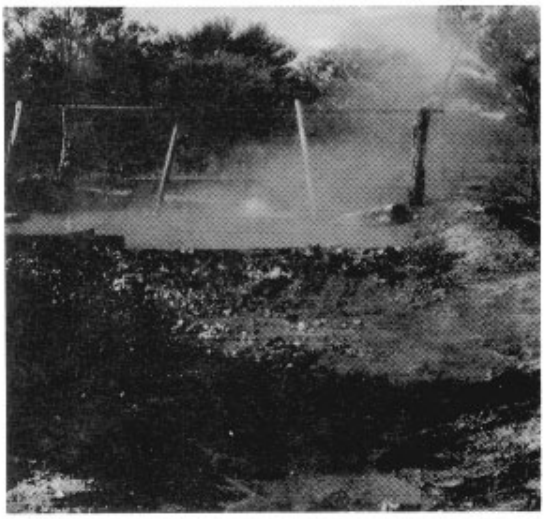
Freshly pulled gidgee scrub. Once a body of dry matter builds up, this area would normally be burnt and seeded with buffel species.



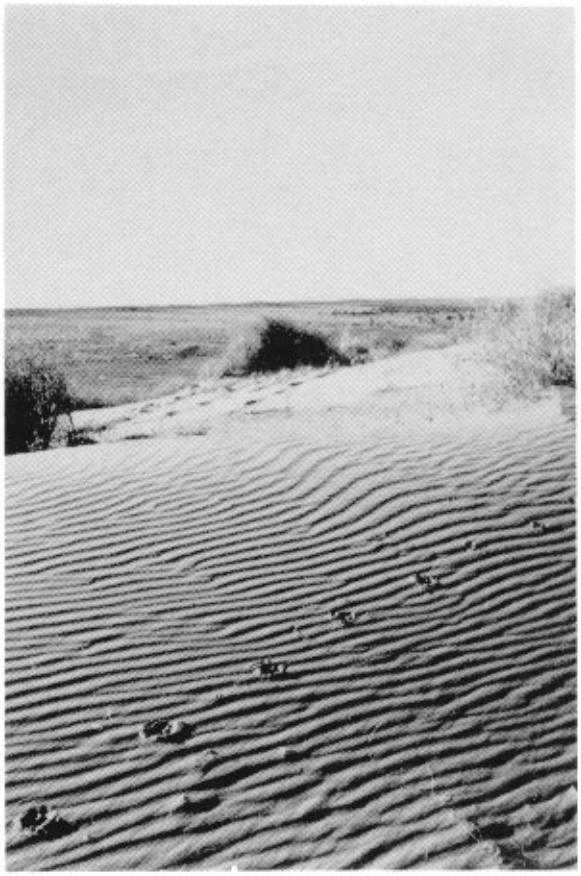
Buffel grass pasture in an area where gidgee scrub has been pulled and burnt. Woody weeds can present a serious problem in these areas.

Grove area carrying a heavy body of pasture in Bronte land system.

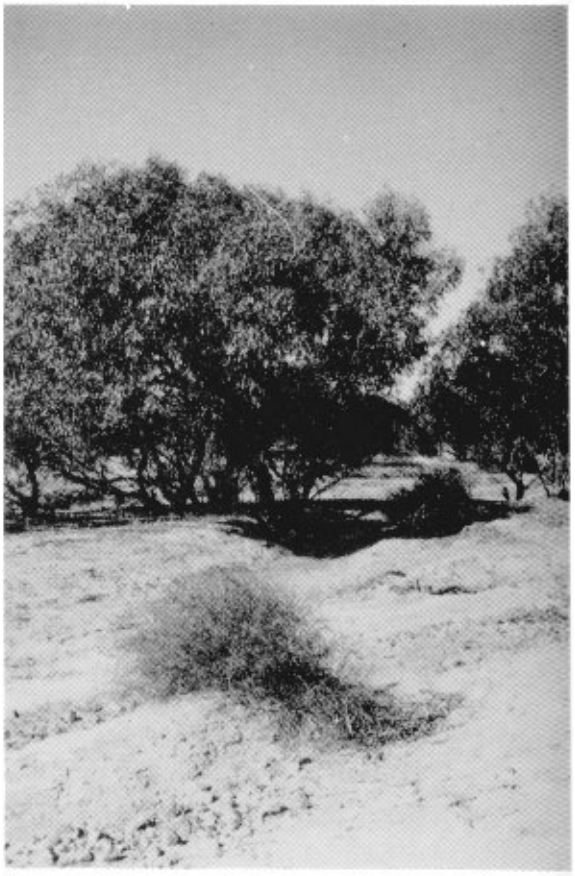
On the Western Downs Land Systems Mitchell grass forms a significant percentage of the pastures only in good years. Note the distance between tussocks.



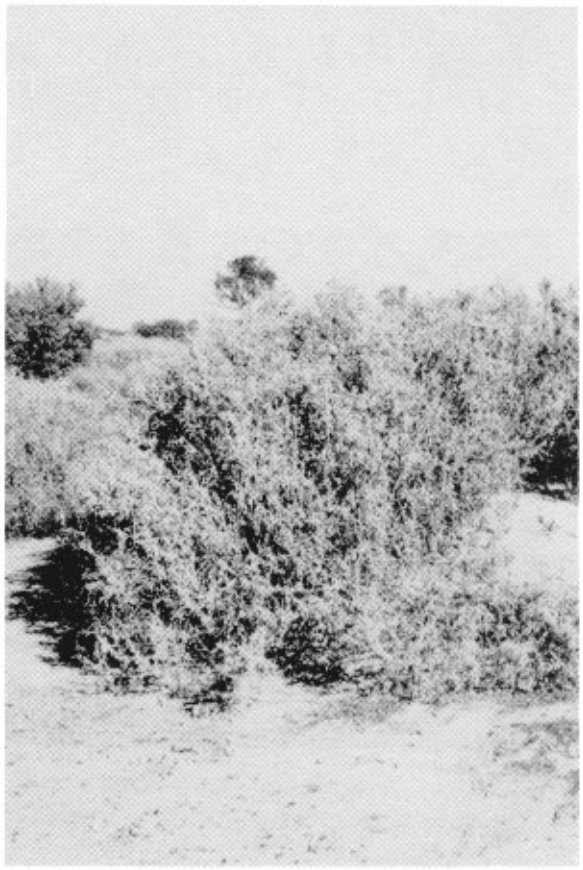
Artesian and sub-artesian bores provide reliable water supplies in many areas.



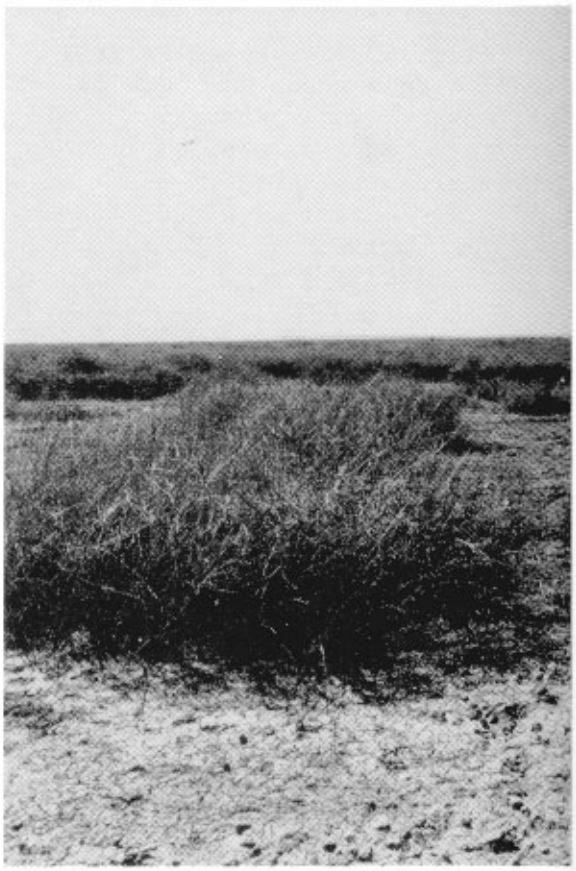
Dunefields with sandhill canegrass.



Coolibahs lining channels
in Barcoo land system.



Oldman saltbush on alluvia.



Canegrass on channel country.

SHORT GRASS AND/OR FORB PASTURES

This pasture is characterized by short grasses and/or forbs the abundance and composition of which is governed by seasonal conditions. The ground cover is extremely variable and is influenced by shrub or tree density as well as seasonal conditions. Where the upper strata of trees and shrubs are dense the ground cover is low.

Grasses include curly windmill grass, Katoora, button grass and bottlewasher grasses. Saltbushes, burrs (*Bassia* spp.), tar-vine, red spinach and *Sida* spp. are frequently occurring forbs. Stocking rates are low and because most of the species are annuals it is doubtful if pastures can be used for long periods without stock having access to other pastures. Grasses usually contribute little bulk to the pasture on the mantled pediments. In its natural state the pasture has some standover value.

Buffel Grass (*Cenchrus ciliaris*) Pasture

Various cultivars of buffel grass can be sown into cleared gidgee areas. Gayndah and American buffel are the most widespread of the cultivars used. Gayndah appears to be the more aggressive of the two, but it is reported to be less palatable than American.

Buffel grass forms perennial tussock grasslands up to 1 m high. The carrying capacity is relatively high and is far greater than the native pastures.

In places establishment may be a problem. Woody weeds may also be a major problem in this pasture.

THE CHANNEL COUNTRY PASTURE LANDS

The channel country pastures are associated with the channelled flooded alluvia of the Diamantina River, Farrar's Creek, Cooper Creek and to a lesser degree the Barcoo River.

These alluvia support a mosaic of various pastures comprising herbfields with grasses or forbs predominating and low open shrublands. The composition of these pastures is dependant on the type of flood, length of inundation and the time of the year. Following summer flooding, grasses dominate the pastures on the alluvial plains whilst forbs are more prevalent following winter floods. Once the soil moisture is exhausted plant growth ceases and material dries off. The standover value varies with the type of pasture, with forbs retaining their nutritive value, whereas the nutritive level of grasses declines rapidly.

The carrying capacity of these pastures varies greatly being extremely high following floods to nil when the ground is practically bare. The permanent carrying capacity depends on the adjacent pastures. The efficient use of these lands depends on being able to move stock onto the channel country when pastures are abundant.

The following are pasture types commonly found in the channel country. They are not all restricted to the channel country and some may occur on alluvia in other areas.

Channel Millet (*Echinochloa turnerana)* Pasture

This pasture occupies areas which are periodically flooded. Limited areas also occur on other alluvia away from the channel country but the areas must be subjected to periodic flooding.

Channel millet is an annual grass up to 2 m high, highly palatable and very nutritious. The area between the clumps supports short grasses such as pepper grass and forbs after favourable summer floods. It is reported that mass germination of channel millet only occurs after general summer flooding. Carrying capacity is high and the pasture will stand over for sometime.

Pepper grass forms open tussock grasslands on less frequently flooded alluvia following summer rains. General flooding is not necessary for establishment. Summer growing forbs are usually present. Carrying capacity is high for limited periods.

Cooper Clover (*Trigonella suavissima*) Pasture

This annual pasture occurs on areas subject to periodic flooding. It occupies the same habitat as the channel millet pastures as well as some less frequently flooded areas.

Cooper clover forms dense stands up to 0.4 m high interspersed with other forbs such as yellowtop and other members of the daisy family. The pasture provides lush, highly nutritious fodder, has a high carrying capacity and some standover value. It follows general flooding in late summer, autumn, or winter. Local flooding does not appear to induce mass germination of this species. Inundation caused by local flooding is generally of a shorter duration than that associated with general flooding. It appears that the period of inundation is critical for mass germination of this species.

PERENNIAL PASTURES

Oldman Saltbush (*Atriplex nummularia*) Pasture

This pasture is limited in extent and occurs in areas which are seasonally flooded for short periods.

This perennial shrub grows to about 1.6m and density varies considerably. When the shrubs are relatively close the area between the individuals is bare. However in sparse stands ephemeral grasses and forbs may occur in favourable seasons.

Oldman saltbush is palatable and nutritious and can withstand heavy continuous grazing provided it is given sufficient time to re-establish. It appears to be more palatable as it is drying off.

Queensland Bluebush (*Chenopodium auricomum*) Pasture

This pasture occurs in clay depressions on seasonally flooded alluvia. Queensland bluebush forms a shrubland up to 1 m high, with the density of shrubs varying greatly. The areas between the shrubs support both annual forbs and grasses.

This pasture responds quickly to flooding. Queensland bluebush has a high protein and phosphorus content and is palatable and nutritious. It has the ability to regenerate when heavily grazed but continuous overgrazing will cause death of the plant.

Although limited in extent these pastures are important because of their high carrying capacity both in good seasons and during drought.

Swamp Canegrass *(Eragrostis australasica)* Pasture

Small areas of this pasture occur on heavy clays periodically subjected to flooding.

The shrub-like swamp canegrass, up to 1.75 m high, forms a sparse ground cover. Frequently the areas between the clumps are devoid of vegetation but scattered ephemeral forbs may occur under favourable conditions. Grasses are infrequent components and contribute little to the pasture.

Swamp canegrass is coarse, not readily accepted by stock and is low in nutritive value. Stock will eat young regenerating shoots but the carrying capacity is very low even under the most favourable conditions.

Eucalyptus Woodlands and Associated Herbfields on Alluvial Plains

These pasture lands are associated with alluvia throughout the area. They vary greatly in floristic composition and structural formations range from low shrublands to open herbfields. These pasture lands may form associations in their own right or occur as a ground or low shrub layer or low open woodlands dominated by eucalypts.

ANNUAL PASTURES

Short Grasses $\pm$ Forbs Pasture

The pasture is characterized by numerous short (0.5m) ephemeral grasses and forbs. The floristic composition and abundance of the species vary greatly with seasonal conditions. There is a tendancy for short grasses such as button grass, Flinders grasses, kerosene grass, love grasses and bottlewasher grasses to be predominant after summer rains. Forbs such as saltbushes, burrs *(Bassia* spp.) and members of the daisy family are usually conspicuous after winter rains. The basal cover varies greatly and in adverse seasons extensive areas devoid of vegetation occur.

Short grasses and forbs provide lush but temporary pastures which are nutritious and palatable. With the onset of moisture stress the pastures die back rapidly and fragment. Prolonged heavy stocking in drought times may lead to erosion, and the development of scalds both of which will render the area unproductive, at least in the short term. Re-establishment of pastures under these conditions is slow. Pastures cannot be used continuously without stock having access to other pasture types.

Saltbush $\pm$ Burr *(Bassia* spp.) Pasture

These pastures are associated mainly with salinas and playas but also found as the ground layer in some gidgee associations.

It is similar to the short grass, forb pastures in appearance and structure but grasses occur infrequently. The compositions of species and their abundance is dependent on seasonal conditions. The pasture is readily acceptable to stock, nutritious and will stand over for some time into a drought. This is because unlike grasses, forbs tend to retain their nutritive level as they are drying off. Overall the grazing capacity is low.

MID-HEIGHT PERENNIAL TUSSOCK GRASSES PASTURE

Limited areas of this pasture occur mainly associated with eucalypt woodlands in alluvial situations. The pasture is characterized by a dense growth of perennial grasses up to 1.3m high. Common grasses may include kangaroo grass, native oats grass, golden-beard grass, desert bluegrass, silky browntop, Queensland blue grass, windmill grasses and early spring grasses. The spaces between the tussocks are bare or have a sparse cover of ephemeral species. These perennial grasses are all drought resistant species, their foliage drying off but standing over for extended periods. The resulting dry forage gives a sub-maintenance diet during drought after the more palatable and nutritious short grasses and forbs have been selectively grazed.

Where these pastures are situated close to water, they are usually overgrazed. Heavy uncontrolled grazing tends to reduce the perennial species component of the pasture which is not desirable for long term productivity and stability.

Neverfail Grass *(Eragrostis setifolia)* Pasture

This pasture is limited in extent and is restricted mainly to alluvial situations associated with eucalypts woodlands.

This perennial tussock grass, up to 0.4 m high, forms an open tussock grassland with other grass species such as rat's tail, couch and chloris. Forbs occur under favourable conditions. Neverfail grass is a moderately acceptable, nutritious species, but does not produce much bulk. Because of the presence of other grasses this pasture provides good, high-carrying capacity pasture during favourable periods but has a relatively low value as a drought reserve.

Lignum *(Muehlenbeckia cunninghamii)* Pasture

This pasture occupies areas which are frequently flooded and usually is associated with eucalypt woodlands. The pastures consist of bushes, up to 3 m high, forming almost impenetrable clumps in places. The ground flora is usually sparse, composed of ephemeral forbs but grasses may also occur.

Lignum stems are heavily lignified and unpalatable but stock relish the young shoots. Overall the grazing capacity is low.

Mulga *(Acacia aneura)* Pasture Lands

These occur throughout the area over a wide climatic and edaphic range. They comprise a tall shrub layer or less frequently a low tree layer of mulga, the density of which ranges from 50 - 1500 shrubs or trees/ha. The associated ground layer vegetation varies greatly ranging from spinifex open hummock grassland to mid-height perennial tussock grassland. The type of ground vegetation is mainly governed by edaphic and climatic factors but the composition within each type is influenced by shrub density and the amount of moisture available.

Mulga is a valuable top-feed species and serves as a useful drought reserve. Careful management is required when utilizing these pastures in order to prevent excessive damage to the ground layer. Unfortunately because of the presence of topfeed, stock are often kept in paddocks long after they should be removed, resulting in degradation and lowered carrying capacity.

In the east where mulga densities are high and regeneration not a problem, the clearing of mulga to increase herbage is a common practice (Beale, 1973). Whilst there is an increase in herbage the

quality of the resulting pasture and the possibility of a woody weed problem must be considered before extensive clearing is undertaken. In the drier western areas where densities are low and conditions for regeneration less favourable, the excessive clearing of mulga should not be practised. Clearing lessens the stability of the rather fragile system and depletes the drought reserve. Woody weeds, especially Charleville turkey bush, silver turkey bush and to a lesser degree Cassias may be troublesome following disturbance.

Carrying capacity varies greatly depending on the associated ground vegetation. The following ground layer associations are the only ones of any real significance in the area. Everist (1949) discussed the mulga lands of Queensland in more detail.

Wire Grasses *(Aristida* spp.) Pastures

These occur mainly as the ground layer vegetation of mulga, poplar box associations but are found in mulga associations that have been cleared. The pasture is characterized by mid-height perennial tussock grasses up to 0.75 m high. Various species of wire grasses predominate. In good seasons, provided the pasture has not been overgrazed, mulga oats and mulga Mitchell occur. Forbs are usually present. Wire grasses grow rapidly after adequate summer rains and their nutritive value is moderate to low when they are green. However the pastures usually consist of coarse, standing fibrous material.

Mulga Mitchell *(Thyridolepis mitchelliana)* and/or mulga oats *(Monachather paradoxa)* Pasture

This pasture occurs mainly in the east and is frequently associated with run-on mulga. It is characterized by perennial tussock grasses with mulga Mitchell and or mulga oats predominating. Other grasses and forbs are present. Carrying capacity is high. The pasture is highly palatable and nutritious, but as in other grasslands nutritional levels decrease as the pasture dries off. Standover feed will last into a drought but the pasture is susceptible to overgrazing. Species such as the less palatable and less nutritious wire grasses will invade and reduce the value of the pasture to the grazing animal if overgrazed.

Kerosene Grass *(Aristida contorta)* Pasture

This is widespread occurring on sandy red earths and loamy red earths. Kerosene grass is an annual up to 0.35 m high. Other annual and perennial grasses may occur. Forbs are also present under favourable conditions. The pasture responds quickly to summer rains providing palatable forage. With maturity the palatability and the nutritional quality of the pasture decreases rapidly and it has little standover value.

Grazing capacity is variable depending on seasonal conditions.

Woollybutt Grass *(Eragrostis eriopoda)* Pasture

This pasture is best developed on the mulga sandplains. Woollybutt grass forms tight erect tussocks less than 0.4 m high with a low basal cover. Wanderrie grasses and other perennial grasses occur between the tussocks. In favourable seasons ephemeral grasses and forbs are present. These pastures are moderately palatable and provide fodder well into a drought.

SPINIFEX PASTURE LANDS

These pastures are associated with the dunefields and sandplains in the west. Scattered shrubs and trees, mainly *Acacia* spp., *Eucalyptus* spp. and *Hakea* spp. occur, some of which provide a limited amount of browse for stock.

Spinifex forms hummocks up to 1.5 m high (including the seed head) and up to 1 m in diameter. The hummocks frequently form rings several metres in diameter. Basal cover is low and the spaces between the hummocks are usually bare but may support various perennial tussock grasses, such as woollybutt grass and *Eriachne* spp., annual grasses and forbs. The species which grow in the interspaces between the hummocks of spinifex are important to the grazing animal and govern the carrying capacity of the pasture. With continued grazing and/or fire and suitable rainfall the ephemeral component of the pasture increases at the expense of the spinifex. Continued heavy stocking leads to a breakdown of the spinifex hummocks, a loss of stability and renders the system susceptible to erosion.

Spinifex grows quickly after rains and then remains inactive for most of the year. The foliage provides coarse, unpalatable and nutritionally poor material of little use. It is reported that stock will accept it more readily once it has blackened off and commences to break down. The seed heads are both palatable and nutritious.

Overall the carrying capacity is low. These pastures are best used shortly after rains when the species between the tussocks are most productive. Spinifex is not readily accepted by stock, and the pastures are of limited value after long dry periods. Light falls of rain do however result in a quick response by the ephemeral species.

TOPFEED

The use of edible trees and shrubs is an essential part of the grazing industry in western Queensland. Frequently these trees and shrubs are a major component of the vegetation, and excessive depletion and removal of topfeed is likely to result in degradation in these areas. Even when there is adequate herbage and grasses available topfeed is browsed by stock, and acts as a source of protein to supplement the fibre and energy obtained from grasses. In areas such as the mulga lands, topfeed becomes the main fodder source during drought.

Important factors governing the acceptability of species include the kind of animal, the composition of the pasture, and the season of use. Chippendale (1963) and Everist (1969, 1972) discuss the requirements of topfeed species. Species must be palatable, digestible, plentiful and accessible to stock either through the action of the animal or that of man. The degree to which a species is eaten depends on its abundance, accessibility and also on the presence and abundance of other more palatable shrubs. Chippendale's investigations suggest that a flat soft leaf is more acceptable to the grazing animal. Spines on stems tend to act as a deterrent, and a viscid covering on a leaf makes it unattractive to cattle.

Undoubtedly the most important topfeed species is mulga, not because of any exceptional nutritional value but because it is widespread, accessible and usually palatable. However mulga is a variable species (Pedley 1973) and observations suggest that acceptability varies with different types.

Skilful management is required to utilise the topfeed resource without over - utilisation and virtual elimination of the more acceptable ground layer species. The damage to more palatable species is often so severe that regeneration is doubtful, and palatable species are either replaced by less palatable species such as *Aristida* spp. or the ground remains bare. Subsequent erosion of the topsoil makes re-establishment of vegetation almost impossible. However if mulga densities are high, prudent clearing will increase ground layer production (Beale, 1973).

Some of the most palatable species such as boonaree, whitewood are known to be toxic under certain conditions, and this must be considered in management strategies.

Topfeed species can be killed by excessive grazing but areas where species have been totally destroyed by grazing resulting in deterioration of the site are not common. However in heavily stocked areas edible trees and shrubs are being reduced in numbers and replacement seedlings are not as abundant as in unstocked areas. This was also observed by Chippendale (1963 b) in Central Australia and Beadle (1948) in western New South Wales.

The following are the principal topfeed species occurring in the area. Everist (1969) gives a brief description, distribution and usually photographs of most of these species. The acceptability to animals of all species recorded is given in Appendix III.

Bauhinia *(Lysiphyllum gilvum)*. Eaten by cattle but is of little use in droughts due to shedding of leaves during late winter.

Beefwood *(Grevillea striata)*. Appears to be more acceptable to sheep than cattle but is still a useful species.

Bendee *(Acacia catenulata)*. Frequently confused with *A. aneura* and is referred to in some areas as black mulga. There is no evidence of this species being grazed in the region. At times animals will eat the leaves resulting from windfall. It is not considered a useful fodder plant.

Berrigan or emu bush *(Eremophila longifolia)*. Regarded as useful fodder and is eaten in the field in large quantities without ill-effect. However, feeding tests have shown it to be poisonous to sheep.

Bitter bark *(Alstonia constricta)*. Usually eaten in the field by cattle and sheep without harmful effects but the leaves can cause stock losses.

Black fuchsia *(Eremophila glabra)*. Lignum fuchsia *(E. polyclada)*. Both are eaten to some extent by stock.

Boobiala *(Myoporum acuminatum)*. Toxic if eaten in excess but sheep eat small quantities apparently without any harmful effects.

Boonaree *(Heterodendrum oleifolium)*. It is eaten with relish by sheep and cattle. Young leaves have been shown to be cyanogenetic.

Bootlace Oak *(Hakea chordophylla)*. Eaten to a limited extent by sheep and cattle.

Boree *(Acacia cana)*. It is eaten fairly readily by sheep. It has been reported to cause impaction after about 6 weeks' continuous grazing.

Bowyakka (*Acacia microsperma*). Occurs only in isolated pockets but appears to be eaten readily by both sheep and cattle.

Broom bush (*Apophyllum anomalum*). The cylindrical green branchlets are eagerly eaten by sheep and cattle.

Bumble or wild orange (*Capparis mitchellii*). The leaves are eaten readily and are usually considered excellent fodder. It is not extensive in this area. Narrow-leaved bumble (*Capparis loranthifolia*) occurs more commonly but appears to be less acceptable.

Charleville turkey bush (*Eremophila gilesii*). It is rarely eaten except for the flowers which sheep eat freely.

Coolibah (*Eucalyptus microtheca*). Eaten to a limited extent. *Eucalyptus* spp. are not usually sought after by stock for fodder.

Current bush (*Carissa ovata*). In central Queensland areas it is regarded as a pest but it is eaten and considered useful by some graziers in the east of the area.

Dead finish (*Acacia tetragonophylla*). Eaten at times but does not provide much bulk. It drops its leaves under drought conditions and is of little use as a drought reserve.

Desert gum (*Eucalyptus papuana*). Eaten to a limited extent but is not highly regarded as topfeed.

Doolan (*Acacia salicina*). The leaves are eaten readily by stock but it sheds its leaves in a dry season and is useless for drought fodder.

Ellangowan poison bush (*Myoporum deserti*). Both sheep and cattle eat it readily in the field but it has caused large stock losses in hungry travelling animals.

Emu apple (*Owenia acidula*). Eaten readily by sheep and cattle.

Fuchsia bush (*Eremophila maculata*). Frequently eaten in the field apparently without harmful effect and is considered a useful fodder. It yields large quantities of prussic acid and is definitely a danger to hungry or travelling stock. However, when trucking of animals replaced tradition methods of moving stock losses from this plant were greatly reduced.

Gidgee (*Acacia cambagei*). Not regarded as a useful fodder plant but is included here because of its abundance. However, at times animals will eat the leaves blown down by wind and in places sheep eat the leaves if the trees are burnt down.

Gooramurra (*Eremophila bignoniiflora*). Eaten freely by all classes of stock.

Gundabluey (*Acacia victoriae*). Eaten readily but does not produce any bulk of forage.

Ironwood (*Acacia excelsa*). Both sheep and cattle eat this species freely.

Leopardwood (*Flindersia maculosa*). Leaves are eaten readily by both sheep and cattle and are regarded as excellent fodder. It usually does not occur in extensive stands.

Lignum *(Muehlenbeckia cunninghamii)*. Young shoots are eaten readily by cattle and is a useful feed in dry times.

Mineritchie *(Acacia cyperophylla)*. Confined to the area west of Cooper Creek and although not abundant, cattle appear to eat this species readily.

Mulga *(Acacia aneura)*. The most important topfeed species, not because of any exceptional nutritional value but because it is palatable, widespread and abundant.

Needlewood *(Hakea leucoptera)*. Eaten to a limited extent.

Nelia *(Acacia oswaldii)*. Where other fodder trees are scarse it is eaten to a limited degree.

Nipan or split jack *(Capparis lasiantha)*. Eaten with relish by stock but does not occur in any great abundance.

Old man saltbush *(Atriplex nummularia)*. A valuable supplement in the dry season.

Plumwood or true sandalwood *(Santalum lanceolatum)*. It is one of the most palatable of all native species and is regarded as excellent fodder. It usually does not occur in extensive stands.

Turpentine mulga *(Acacia brachystachya)*. Eaten at times but usually ignored.

Vinetree *(Ventilago viminalis)*. Generally regarded as one of the best native fodder trees. Although it has been shown a pure diet of this plant can be toxic, no field losses have been reported.

Whitewood *(Atalaya hemiglauca)*. Readily eaten by sheep, cattle and horses and is one of the most sought after fodder plants.

Yarran *(Acacia omalophylla)*. Eaten readily but is not abundant in the area.

POISONOUS PLANTS

Poisonous plants include grasses, forbs, trees and vines and may occur in any land zone. Not only are poisonous plants responsible for large stock losses but as in the case of Birdsville indigo *(Indigofera linnaei)* they hinder the management of properties by rendering extensive areas of grazing land useless for all or part of the year.

In general, poisoning of some type may be suspected when a number of animals simultaneously become ill or are found dead particularly if many are affected and the animals have not been subjected to any treatment such as shearing or dipping from which death may occur.

A large proportion of animals graze pastures which contain plants known to be toxic. Many poisonous plants can be eaten with impunity if they form only a small fraction of the total feed. Usually local stock seem to learn to avoid the harmful species but this is not always so with stock introduced from another area.

TABLE 8.2 KNOWN POISONOUS PLANTS

COMMON NAME	BOTANICAL NAME	TOXINS							
		Oxalates	Nitrates	Essential Oils	Glycosides: Cyanogenetic	Glycosides: Others	Alkaloids	Other Known Toxins	Toxins Uncertain or Unknown
Berrigan or Emu bush	*Eremophila longifolia*								*
Bitter bark	*Alstonia constricta*						*		
Birdsville indigo	*Indigofera linnaei*								*
Blackberry nightshade	*Solanum nigrum*						*		
Blue flax lily	*Dianella* sp. aff. *D. laevis*								*
Bluebush pea	*Crotalaria eremaea*						*		
Blue parsnip	*Trachymene glaucifolia*								*
Boggabri	*Amaranthus mitchellii*	*	*						
Boobialla	*Myoporum acuminatum*			*					
Boonaree	*Heterodendrum oleifolium*				*				
Burr, Bathurst	*Xanthium spinosum*					*			*
Burr, Noogoora	*Xanthium pungens*				*		*		*
Burr, red	*Bassia calcarata*		*						
Burr, yellow	*Bassia anisacanthoides*		*						
Button grass	*Dactyloctenium radulans*								*
Caltrop	*Tribulus terrestris*		*					*	
Caustic creeper	*Euphorbia drummondii*								*
Caustic vine	*Sarcostemma australe*								*
Calocynth	*Citrullus colocynthis*					*			
Common verbena	*Verbena officinalis*					*			
Conker berry	*Carissa lanceolata*						*		
Creeping oxalis or yellow wood sorrel	*Oxalis corniculata*	*							
Crumbweed, black	*Chenopodium melanocarpum*				*				
Crumbweed, green	*Chenopodium rhadinostachyum*				?				
Crumbwood, red	*Dysphania microcephala*				*				
Doolan	*Acacia salicina*							*	
Ellangowan poison bush	*Myoporum deserti*			*					
Fishweed	*Chenopodium hubbardii*	*							
Flaxweed	*Pimelea trichostachya*					*			*
Flaxweed	*Pimelea continua*					*			*
Flaxweed	*Pimelea* sp. aff. *P. trichostachya*					*			*
Fuchsia, limestone	*Eremophila freelingii*								*
Fuchsia, native	*Eremophila maculosa*								*
Gascoyne spurge	*Euphorbia boophthana*								*
Golden billy buttons	*Craspedia chrysantha*								*
Gomphrena	*Gomphrena celosioides*								*
Goosefoot, crested	*Chenopodium cristatum*				*				
Goosefoot, keeled	*Chenopodium carinatum*				*				
Lancewood	*Acacia sparsiflora*								*
Malvastrum	*Malvastrum americanum*							*	
Mexican poppy	*Argemone ochroleuca*						*		
Mintweed	*Salvia reflexa*		*						
Morgan flower	*Morgania floribunda*							*	
Mulga fern or rock fern	*Cheilanthes sieberi*							*	
Munyeroo	*Portulaca* sp. aff. *P. oleracea*	*	*						
Nardoo	*Marsilea* spp.								*
Native couch grass	*Brachyachne convergens*				*				
Native leek	*Bulbinopsis bulbosa*								*
Native leek	*Bulbinopsis semibarbata*								*
A native tobacco	*Nicotiana exigua*						*		
A native tobacco	*Nicotiana megalosiphon*						*		
A native tobacco	*Nicotiana velutina*						*		
Nelia	*Acacia oswaldii*				*				
New Zealand spinach	*Tetragonia tetragonioides*	*			*	*			
Parakeelya	*Calandrinia balonensis*	*							
Parakeelya	*Calandrinia ptychosperma*	*							
Parakeelya	*Calandrinia pumila*	*							
Pigweed, giant	*Trianthema portulacastrum*	*				*	*		
Poranthera, small-leaf	*Poranthera microphylla*				*				
Potato bush	*Solanum ellipticum*							*	
Prickly paddy melon	*Cucumis myriocarpus*					*		*	*
Purple plum grass	*Triraphis mollis*				*				
Red-flowered birdsfoot trefoil	*Lotus cruentus*				*				
Red spinach	*Trianthema triquetra*	*	*						
Roly poly, black	*Bassia quinquecuspis*	*							
Roly poly, soft	*Salsola kali*	*	*						
Saltbush, annual	*Atriplex muelleri*	*	*						
Saltbush, oldman	*Atriplex nummularia*	*							
Saltbush, ruby	*Enchylaena tomentosa*	*							
Sand twin-leaf	*Zygophyllum ammophilum*								*
Soda bush	*Threlkeldia proceriflora*	*							
Thornapple, long-spined	*Datura ferox*						*		
Thornapple, native	*Datura leichhardtii*						*		
Vine tree	*Ventilago viminalis*							*	
Whitewood	*Atalaya hemiglauca*								*
Wild parsnip	*Trachymene cyanantha*								*
Wild parsnip	*Trachymene ochracea*								*
	Crotalaria trifoliastrum						*		
	Eremophila latrobei								*
	Phyllanthus fuernrohrii								*
	Senecio magnificus						*		

* Indicates that no field cases are reported or that syndromes described are not consistent with known action of the reported toxic substance.

TABLE 8.3 Conditions leading to toxicity of specified toxins.

Toxin or Specific Disease	Conditions leading to toxicity
Prussic acid	Field losses occur most commonly when - (a) animals are hungry or under stress (e.g. being driven) - (b) prussic acid yielding plants are young and luscious or with dew or light rain. Symptoms usually appear shortly after grazing but may be delayed until after watering if plant material is dry.
Nitrate	Hungry animals under stress and nitrate containing plants abundant. Poisoning is rapid.
Oxalates	Hungry animals (without food for 24 hours or more) given access to restricted areas with oxalate containing plants abundant. Poisoning is quick but not as rapid as the two mentioned above.
Alkaloids	Most losses occur in travelling stock but limited losses occur in house paddocks. Availability of feed may be an important factor.
Saponions	Most losses occur in travelling stock or when stock is concentrated on young regrowth when feed is limited.
Essential oils	Losses occur mostly in travelling stock, rarely are animals grazing in a paddock affected. Usually there is a delay of 1 to 3 days between eating the plant and the onset of symptoms. Ellangowan poison bush is usually responsible, boobialla and *Eremophila latrobei* are rarely involved.
Noogoora burr poisoning	Most losses occur when there is an early germination following spring rains and stock consume large quantities of the very young seedlings in the absence of other food. Most cases occur closer to the coast. There is doubt that glycosides are totally responsible, other toxins are probably involved.
Birdsville disease	Only affects horses. Most cases occur in winter, spring or early winter when Birdsville indigo is abundant around the base of dunes and other feed is limited.
St. George disease	Only affects cattle. Most cases occur when there is a shortage of feed and animals are forced to graze among the flax weeds. The disease is due to the inhalation and ingestion of minute amounts of flaxweed (Clark, 1971). Flaxweed also causes gastro-enteritis in travelling sheep.

Many factors combine to produce a situation where stock losses may occur. More important of these are the stage of growth of the plant, the condition and composition of the pasture, the kind and condition of the grazing animals and environmental conditions. Usually most losses occur either during drought periods when local stock may eat shrubs and trees they ordinarily would not touch or when animals being driven long distances becoming hungry and stressed.

The opportunities and usefulness of treatment for poisonous plant cases are limited by many factors. Death may occur before any remedy is available. Many plants cause such extensive damage to tissues that no remedy can offer any hope after symptoms appear. Manpower to handle the number of affected animals may also limit treatment.

With poisonous plant cases prevention is better than cure. It is best to recognize a potential situation when losses may occur and devise management systems to minimize losses. A knowledge of toxic plants present in a district, the situation or conditions under which losses may occur and the kind of animal affected is essential for efficient management of an area.

Within the area most losses occur through oxalate poisoning.

It is indicated in the species list (Appendix III) of plants observed in this area if a species is known to contain toxins, shown to be toxic by feeding tests or suspected of being toxic on strong field evidence. There is no indication given if a plant has been suspected on weak or vague field evidence. Table 8.2 lists known toxic plants in the area together with the chemical classification of the toxin. Generalized conditions leading to possible losses by various toxins or diseases are given in Table 8.3. Everist (1974) has compiled all known data on poisonous plants in Australia.

Detailed descriptions of plants as well as symptoms and treatments are given.

WOODY WEEDS

Woody weeds or unwanted trees and shrubs frequently invade as a result of modifications imposed on the woodlands and shrublands for improving productivity. Natural factors such as seasonal conditions and fire also influence shrub and tree densities (Dawson and Boyland 1974).

Initially clearing and thinning of the woodlands and shrublands was to provide timber for shelter, fencing and fuel. While trees and shrubs within the area are not suitable for the establishment of a forestry industry they provide timber to meet immediate local needs. The overall effect of this disturbance was minimal in generating woody weed problems. It was only when man commenced manipulating tree and shrub densities to supply drought fodder and to increase pasture production that major problems arose. These actions coupled with stocking pressure and the kind of grazing animal have been the major contributing factors to the present woody weed problem.

Woody weeds present most problems in the mulga lands, gidyea lands and brigalow lands. Various species of *Eremophila* and *Cassia* are the most troublesome plants although hopbush can be a problem on dune fields. A woody weed does not always have to be a useless plant because where mulga forms dense stands limiting pasture production then mulga is a woody weed.

Tree and shrub densities were originally reduced by ring barking. In more recent times the use of heavy machinery for clearing is most common. Grazing management and biological control are the best techniques for controlling woody weeds in arid areas. Herbicides are of limited use because of the costs involved. Fire has been advocated (Moore, 1973) but existing knowledge on fire as a management tool, is very limited. In the east in the gidyea and brigalow lands mechanical methods such as stick raking are useful for controlling weeds in spite of costs involved.

The following are trees or shrubs which may cause problems if disturbed or are known to be woody weeds. Those marked with an asterisk are species of major significance.

Belalie *(Acacia stenophylla)*. In places this species forms dense stands along water courses restricting stock movement.

Bendee *(Acacia catenulata)*. In this region these communities should not be disturbed. Suppressed seedlings are a problem following disturbance.

Bitter bark *(Alstonia constricta)*. This is limited in extent but root suckers and suppressed seedlings may be a problem. Chemical control methods are available.

Blackbutt or Dawson gum *(Eucalyptus cambageana)*. Very limited in extent but this tree can be a problem following disturbance. Back (1972) discusses control of this plant.

Bowyakka *(Acacia microsperma)*. Limited in extent but suckers and suppressed seedlings can be troublesome if the plant association in disturbed.

Brigalow *(Acacia harpophylla)**. Troublesome if disturbed mainly due to sucker regrowth. Development of brigalow has been discussed by many workers (Johnson 1964, 1966; Everist, 1966).

Budda bush *(Eremophila sturtii)**. It can cause problems on sandplains and margins of dunefields adjacent to alluvia.

Butterbush *(Cassia nemophila)**. *Cassia* spp. are a serious problem in some situations especially on water spreading developments (Batianoff and Burrows, 1973) and in some gidgee development areas (Purcell, 1966).

Charleville turkey bush *(Eremophila gilesii)**. It is troublesome in mulga lands. It is increasing in density where it occurs under high stock numbers and areas where stock are excluded (Burrows, 1973). The plant is periodically attacked by a wingless grasshopper *(Monistria pustulifera)* and large areas are killed. Because of the cost factor, mechanical and chemical control is limited. (Burrows, 1973).

Coolibah *(Eucalyptus microtheca)*. Usually not a problem but suppressed seedlings can be troublesome if the association is disturbed. Mass germination also occurs following flooding.

Currant bush or woodvine *(Carissa ovata)*. It is limited in extent but does form dense thickets in some gidgee lands.

Desert poplar *(Codonocarpus cotinifolius)*. Found on dunefields and sand plains and can be a problem especially after fire.

Ellangowan poison bush *(Myoporum deserti)*. Because of its poisonous properties it is sometimes considered a pest and should be eliminated from holding yards and stock routes. It is also troublesome in some gidgee associations following disturbance. Burrows (1974) discusses control measures.

Firebush *(Cassia pleurocarpa)*. A plant that can be troublesome following development. Chemical methods of control are available but because of cost not practical on a large scale.

Gidgee *(Acacia cambagei)*. Suppressed seedlings may cause problems following disturbance by felling. Ring barking generally presents fewer problems. Purcell (1964) discusses the development of these lands.

Grey turkey bush *(Eremophila bowmanii)**. It may form dense stands on the mulga sandplains occupying some of the more productive areas. The extent of these stands appears to be increasing.

Hop bush *(Dodonaea angustissima)*. A troublesome weed of sandplains and dunefields.

Lignum *(Muehlenbeckia cunninghamii)*. It is usually not troublesome but does restrict stock movements near waterholes in some situations. The dense stands also may serve as a refuge for wild pigs.

Limebush *(Eremocitrus glauca)*. Although a problem in other areas of the State it is not considered a serious pest in thi area.

Mimosa bush *(Acacia farnesiana)*. This may form dense stands on the downs. Populations are increasing but this is probably due to an abnormal run of seasons of above average rainfall.

Mountain yapunyah *(Eucalyptus thozetiana)*. Limited in extent but populations should not be disturbed as suckering may cause problems.

Mulga *(Acacia aneura)*. An extremely useful plant although thinning to increase pasture production may be necessary (See Beale, 1973; Everist, 1949).

Prickly pear *(Opuntia inermis)*. In the past it was a major weed but it is now kept in check by *Castoblastis* and presents no problems.

Poplar box *(Eucalyptus populnea)*. This can be a problem following disturbance due to regrowth from lignotubers and the growth of suppressed seedlings. Tiller (1972) discusses control of poplar box.

Sandalwood *(Eremophila mitchellii)**. It is a problem weed in gidgee lands and brigalow lands following clearing. Control methods are given by Beeston and Webb, (1977), Purcell (1964, 1966) and Robertson (1965).

Silver Cassia *(Cassia artemisioides)**. It can be a serious problem especially on water-spreading developments.

GRAZING CAPACITIES

Estimated grazing capacities for the various land systems are presented in Table 8.1. These figures are to be used only as a regional guide. The estimates for each land system have been derived by assessment of data obtained from the Department of Lands, officers of the Department of Primary Industries and from limited discussions with station managers.

The grazing capacities are intended to apply for average seasonal conditions. Based on these rates the area could carry 2 million sheep and 80 000 cattle. This corresponds closely to the estimate arrived at by the Department of Lands of 75 000 cattle and over 2 million sheep.

During the last ten years there has been considerable substitution of cattle for sheep in the central and eastern part of the area. As in most arid areas, stock numbers vary considerably with pastoral conditions. For example in 1975 there were 205 000 cattle and 1 136 500 sheep in the area. When calculated on a stock equivalents basis this is approximately 17% higher than the estimated grazing capacity. During the 74 year period for which stock figures are available, five major drought periods occurred. In these periods stock numbers fell to around 60% of the estimated carrying capacity of the area.

The occurrence of these extended drought periods means that the quantity and quality of pasture available to the animal is subject to extreme fluctuations. Subject to practical considerations it is desirable to match stock numbers to the amount of feed available. If stock numbers are not reduced as the quantity and quality of available feed declines during a drought, the grazing pressure on the remaining pasture increases rapidly to high levels. On sensitive types of country this can cause irreversible damage to the land as well as resulting in severe loss of animal production and eventual death of stock.

Flexibility in setting grazing capacities is essential. A blanket year in year out grazing capacity is unrealistic from a manager's point of view because it does not take into account normal seasonal fluctuations in the condition of the country. The unpredictable duration and severity of drought in arid areas makes forward planning for financial, animal and pasture management difficult. Data collected by Childs (pers. comm). suggests that the use of conservative stocking rates allows managers to enter drought periods with both stock and pasture in relatively 'good' condition. This strategy reduces the severity of the effects of drought on both stock and land.

Detailed information on the interaction of grazing capacities with production per head in the form of wool cuts, weight gains and reproductive performance, is not readily available. However the narrowing gap between costs and returns is forcing the pastoral industry to look closely at the quantitative and qualitative aspects of production per head of stock. Again data collected by Childs (1973) in the region suggests that the highest returns to capital and management occurred to graziers who earned the highest income from each animal. A better understanding of the interaction between grazing capacities, pasture condition, and animal productivity in a drought-prone environment is needed to assist the pastoral industry to achieve stable, efficient and profitable long term use of the land resource.

PIGS

The feral pig originated from accidental or deliberate release of domestic stock. Feral pigs range from smaller black or red-black types to larger animals with predominantly black or white colours which resemble a poorly developed domestic pig.

Pigs are mainly concentrated around rivers, watercourses, and swamps but may also be found in thickly timbered country where adequate water is available. The damage done by pigs is confined to fences when populations are small and sufficient soft, green vegetative matter is available. Work in northern N.S.W. (Dunlop pers. comm.) has indicated that soft green grass shoots, succulents and salt and blue bushes are the first preference of pigs. If these are not available they move on to roots (where the ground is soft) and as the season becomes drier turn to carrion and then, if no other feed is available, to live animals. In normal seasons spring lambings mean that young lambs are on the ground at a time when green feed is non-existent, the ground is hard, and the pigs are hungry and turning to carrion and live animals for food.

The threat to young lambs is most serious when dry conditions resume after a prolonged wet or a number of good seasons, and pig populations which have built up are forced back onto the areas around permanent waterholes. The fouling of smaller waterholes by pigs also presents a problem.

The possibility of pigs acting as carriers of diseases such as bovine tuberculosis, leptospirosis, brucellosis, sparganosis, and foot and mouth disease has serious implications for disease control in the pastoral industry.

Poisoning of dead carcasses is the most commonly used and effective means of control. The main poisons used have been Lucijet (Organic Phosphate) and S.A.P. (no longer readily available). The 1080 vermin campaign (originally directed at dingoes) conducted by the Co-ordinating Board on a shire basis also has been effective against pigs. Doses of sodium fluroacetate (1080) of more than 0.15mg/kg bodyweight are lethal. A bounty of 20 cents per snout was paid for pigs destroyed but was discontinued in 1976.

DINGOES

Considerable loss of production in the pastoral industry in western Queensland has been attributed to dingoes. The Dingo Barrier Fence runs through the area from north to south, coming in west of the Thomson River past 'Warbreccan', south to 'Galway Downs', across the Cooper at 'Hammond Downs' near Windorah and south again down Kyabra Creek past 'Springfield'. This fence generally forms the western limit of the main woolgrowing and sheep breeding areas, and cattle predominate in areas to the west of the fence.

Landholders are required by the Stock Routes and Rural Lands Protection Acts to destroy all dingoes on their holdings. A bounty of $2.00 a scalp is paid on dingoes destroyed. In recent years 1080 and strychnine baiting campaigns have reduced the number of dingoes inside the Dingo Barrier fence to relatively low levels. However in rough country and areas of thick scrub dingoes still present a problem from time to time.

FOXES

Foxes are present in limited numbers throughout the area but are not normally considered to be significant predators of sheep. Their pest status is mainly due to reports of foxes biting young lambs. Foxes are readily susceptible to the poisoning campaigns conducted against pigs and dingoes. Rabbits have been shown to constitute a considerable part of the fox's diet under some conditions, and the interaction between the two populations may be important.

RABBITS

Two-thirds of the area is included within the Rabbit Control Area. The boundary of this area roughly follows the southern limit of the extensive areas of cracking clay soils of the downs and gidgee country of central western Queensland. Rabbit infestations in the south-west of the State are mainly limited to sandy or loamy soils of the mulga and sandplain land zones.

It is possible for rabbit populations to build up in good seasons without noticeably affecting the amount of pasture available but with the onset of drought conditions the rabbit population competes with livestock for the remaining available feed. At this time landholders may be too busy to launch an extensive rabbit control campaign. The maintenance of existing netting fences in rabbit proof conditions is one way to control the spread of rabbit outbreaks and adds to the effectiveness of control campaigns.

The rabbit control program is centred around myxomatosis innoculation, but where necessary, poisoning gangs may be employed to keep rabbit populations in check. Because of the rabbit's capacity to reproduce, very high kills are necessary for effective control. The declining effectiveness of myxomatosis has renewed interest in the adoption of poisoning techniques to supplement the kill achieved with the myxomatosis virus.

KANGAROOS

Kangaroos are regarded by graziers as being in direct competition with their grazing animals for available pasture and water during drier years. Before 1973 considerable numbers were shot both by landholders and commercial shooters. In that year a Federal ban was imposed on the export of kangaroo skins and in 1975 a system of quotas was introduced by the Queensland Government. Under this system shooters are required to obtain a permit to shoot on a certain property or properties, and then a limited number of tags are issued to the shooter at a cost expected to be 30 cents a tag in 1977. These tags are required to be affixed to carcasses and skins before they can be sold to commercial processors. The number of tags issued for a particular area allows the National Parks and Wildlife Service which administers the system to control the number of kangaroos harvested.

As with other forms of wildlife, kangaroo numbers fluctuate with the seasons. The movement of large numbers of kangaroos in from more remote thickly timbered country onto permanent waters in dry seasons means they are competitive with livestock for available feed in a relatively small area in the vicinity of the water. For this reason accurate assessment and control of kangaroos numbers during good seasons is desirable to prevent these animals becoming pests during drought periods.

TABLE 8.4 Numbers of Kangaroos Harvested for Skins or Meat

Shire		1971	1972	1973	1974	1975
Isisford	Grey	122	899	350	129	-
	Red	358	1 912	182	161	-
	Wallaroo	-	245	81	32	-
Barcoo	Grey	521	75	605	239	441
	Red	1 437	8 392	1 082	3 557	6 413
	Wallaroo	93	238	22	42	22
Blackall	Grey	16 629	1 563	20 590	6 573	8 357
	Red	5 553	4 796	5 015	4 718	3 265
	Wallaroo	1 564	55	673	238	25

Source: National Parks and Wildlife Service

LOCUSTS

Outbreaks of the Australian plague locust *(Chortoicetes terminifera)* occasionally cause damage to pastures and trees. These outbreaks are linked to seasons when favourable breeding conditions occur, and when suitable relative humidities and temperatures occur for swarming flights to take place. Areas with bare, loose soil surfaces are favoured by the locusts for oviposition and these are abundant throughout the area. While some patches of dead trees in the area are attributed to locust plagues, the damage caused by locusts on a regional basis has not been a severe in recent years. Of greater importance on a national level is the fact that in some years areas in western Queensland serve as a breeding ground for plague locusts which then move into the southern states, causing considerable damage to crops and pastures (Clark, 1969).

Control measures are difficult to implement in vast areas, such as these, and unless definite breeding patterns and specific breeding areas can be defined, early control measures are not likely to be feasible.

TERMITES

Termite infestations are associated mainly with the red earth soils. The damage done by the termites to fencing and structures is considerable. It has been suggested by Watson *et al.* (1973) that termites may consume 50-100 kg/ha of forage per year at common rates of infestation. Watson and Gay (1970) observed termites, mainly *Drepanotermes perniger*, removing grass from mulga lands which became denuded even though these areas had not been grazed by stock.

Watson and Gay also found that termite populations which build up during good seasons, normally retreat into mulga areas where mulga leaf-drop and debris provides feed when drought conditions occur. If these mulga areas have been reduced in size or density, additional pressure is placed on the grassed areas by the termites. In severe cases, the bases of tussocks may be completely destroyed leaving areas extremely susceptible to loss of surface soil and incapable of rapid regeneration.

Maintenance of adequate areas of mulga and a reasonable ground cover is the most practical solution.

STONE

Surfaces covered by stone and gravel are widespread throughout the gidgee, downs, hard mulga and dissected residuals land zones. Surface cover ranges from continuous pavements of stone and gravel to sparsely scattered pebbles. In some areas ironstone shot is present on the surface, while on parts of the western stony downs large silcrete stones and boulders occur. Stone cover throughout the area has been derived by erosion of silicified covers of the former Tertiary land surface.

The main effect of dense surface stone cover is to act as a surface mulch. This reduces susceptibility to erosion by protecting the soil from raindrop impact which can cause soil movement by splash erosion, and also result in undesirable surface sealing effects. Where runoff does occur velocities are reduced by stone cover and the susceptibility to erosion reduced. Dense stone cover may also reduce evaporation rates and lower surface soil temperatures in hot weather.

SHADE

Shade for stock on the open downs country is of particular significance in the sheep breeding areas of the Blackall and Isisford districts. In these areas scattered trees (wooded downs land zone) occur on the crests of many of the rises. Clumps of gidgee and boree are scattered throughout, particularly along the alluvia. Adequate shelter is desirable on open downs country used for breeding, and it is in these well shaded downs areas that some of the most successful Merino studs in Queensland are found.

FLOODING

Major floodplains in the area are associated with the Barcoo and Thomson Rivers which join to form the massive Cooper Creek floodplain. Further west, major flood plains occur on Farrar's Creek and the Diamantina River. Smaller areas subject to flooding occur in the south where Tampoon and Bulgroo creeks join Kyabra Creek, and along the Bulloo River, particularly south of its junction with Blackwater Creek.

The floodplains of the Diamantina and Thomson Rivers and Cooper Creek constitute the true 'Channel Country'. These flood plains are relatively fertile, and following flooding grow excellent quality pastures. Cooper Creek drains an area of approximately 23 million hectares in Queensland (13.5% of the State). The 15 million hectares of catchment above Windorah have a mean annual rainfall of 425 mm (17 inches) (Ogilvie, 1947).

The Channel Country land zone can be divided into the more frequently flooded channels and swamps (Cooper and Woonabootra land systems) and the occasionally flooded outer alluvial plains (Cunnawilla land system). Floods of 20 feet (6.1 m) at the Windorah gauge are thought to be required for general innundation of these outer alluvial plains (Skerman, 1947).

Approximate flooding frequencies for the period 1890 to 1976 have been estimated from the observations of Skerman (1947) and records of the Irrigation and Water Supply Commission for the Currareva gauge at Windorah. The majority of the Cooper Creek flood plain comprising Cooper, Woonabootra and most of Cunnawilla land system is inundated by general flooding one year in four on average. The swamps and channels comprising Woonabootra and part of Cooper land system are innundated one year in two. In addition smaller floods which provide pasture in the channels only occur one year in seven. There is no flood providing significant pasture production in one year in every three.

There have been much longer periods without flooding than would seem from these frequencies. For instance in the seven years 1899 to 1905 there appear to have been no general floods of sufficient size to provide good feed in the channels and swamps. Following a good flood in 1922 which inundated much of the flood plain it was eighteen years before another general inundation occurred in 1940, with only four floods in this period which would have provided feed in the channels and swamps.

Skerman (1947) also indicated that local rainfalls exceeding 37 mm (1.5 inches) in one fall can cause sufficient run-off to produce flooding of the major local alluvial plains. He stated that this flooding provides valuable feed in these areas which is independant of general flooding in Cooper Creek and may allow some turn off of fat cattle in years when the Cooper Creek flood is a poor one.

Outside the Channel Country zone, local alluvia receive valuable runoff from adjacent land types, although few are flooded for extended periods.

When in good condition the local alluvial plains produce valuable pasture and herbage. Much of this feed is comprised of different species to those growing in non-alluvial areas, and so provides some choice and variety in the grazing animals's diet. Because the species found on alluvial plains are often more palatable and of higher nutritional value than those in neighbouring areas the alluvia are prone to overgrazing, and the available feed is exhausted in a relatively short period.

WATER USE

In arid lands, the redistribution of water from one area to another is of considerable significance. It has been recognised by Perry (1972) that this occurs at all scales, microtopographic, local, regional and larger. The collection of water from 'run-off' areas and concentration of it on 'run-on' areas which are small but are made up of better type soils is a naturally occurring phenomena which increases productivity of the run-on area considerably.

Dawson (1974) cites the case of gilgais on the stony downs land type providing a small area of greater moisture storage where the bulk of the pasture grows, and where important species survive during drought periods. Groving of mulga in arid areas is another well known example of surface water concentration in the grove area. The concentration of run-off water on the alluvial plains and 'flats' in the mulga lands provided increased productivity from these areas.

Efforts by man to achieve the same effect through ponding or waterspreading schemes are hampered by the high costs and low returns from these schemes in the arid pastoral zone, and damage to earthworks caused by excessive run-off following heavy rains. On a larger scale, the channel country is an example of run-off water from a vast catchment being concentrated on a relatively small area of fertile soils.

The amount of water derived from run-off areas is dependent on many factors, particularly soil type, ground cover, infiltration rate, surface characteristics and slope. Goodspeed and Winkworth (1973) state that run-off from an intergrove area (in country similar to the hard mulga lands) ranged from 16-47% of rainfall, sometimes increasing to 80% in storms. Run-off from the dissected residuals land zone could be expected to be even higher than these figures.

DISTRIBUTION OF STOCK WATER

Stock water is available throughout most of the usable land types in the area in the form of permanent or semi-permanent natural water, dams and bores. In the east, bore-drains are used to distribute bore water over a large area. Country well served by bore-drains is particularly suitable for breeding sheep. However water from new bores is required to be reticulated by pipe to lessen water losses by evaporation and breaks in the drains.

Natural waters and to some extent dams suffer from silting problems, while dams are also subject to flood damage from excessive run-off if sites and designs are not carefully chosen. Cattle and sheep may both be lost where waters become boggy as they dry back. Fencing of these waters and pumping into troughs can overcome this problem. However regular checking of these mills or pump then become necessary.

FENCING

At present little new fencing is being erected. Nearly all properties have complete boundary fences, with the possible exception of some of the larger cattle holdings in the west. Lease conditions require all necessary fencing to be maintained in workable condition.

For various reasons such as ease of access, and taxation considerations, when new fences are built, they often follow the path of previous fences.

If a regime of favourable cost-price relationships and subsequent profits returns to the pastoral industries, a spate of fence replacement and maintenance could be expected to replace run down fencing and minimise income tax. The location of any future fencing should be closely examined with a view to grouping land types with similar management requirements and maintaining efficient stock control. Failing this it is desirable that any new fences erected at least endeavour where practical to separate unstable land types from those which are naturally stable. Once fencing is erected the divisions it imposes are set for the life time of the fence, in some cases up to 40 years. Intelligent location of new fences is particularly important on those land types susceptible to erosion.

TOURISM AND RECREATION

Parts of the area have considerable potential for tourism and recreation. The number of tourists who visit the area depends to a large extent on the promotion and publicity of the various scenic and other attractions. The construction of all-weather bitumen roads into the area has been a major factor in increasing the popularity of the area with tourists, particularly caravaners. At present bitumen roads link Blackall to the Capricorn and Warrego Highways, and extend from Quilpie to Windorah and out to Morney. Construction of a bitumen road between Quilpie and Charleville has commenced and this will link Windorah directly to Brisbane via the Diamantina Development Road and the Warrego Highway.

Hotels at Blackall, Isisford, Jundah, Windorah and Stonehenge provide accommodation, though in the smaller centres only very limited numbers of guests can be accommodated. A caravan park exists at Blackall and some facilities are available at Windorah for campers and caravan travellers. Petrol, water and food supplies are available in all towns except Stonehenge.

The main scenic attractions are the strikingly different types of country encountered (e.g. dunefields, channel country, open downs etc.) and the rugged landscapes associated with the jump-ups and tablelands throughout the area. The brilliant colours of the desert flowers in the dunefields after rain, and the lush colours of the channel country following flooding present a most attractive spectacle. Other areas such as the vast flat treeless plains in the west, and the larger semi-permanent lakes such asLake Cuddapan and Lake Dartmouth are of scenic value as well as supporting large populations of native fauna.

The town of Windorah is well situated for tourists to use as a base. Its location in sandhill country of the edge of the Cooper Creek floodplain places many different types of country such as the previously mentioned dunefields, open downs, 'jump-ups', channel country and some mulga land types within an hour's drive along the Diamantina Development Road. Cooper Creek at Windorah provides fishing for yellowbelly and other fish in the larger permanent waterholes, as well as pig shooting through the lignum channels and swamps. A large number of native birds and other fauna may be observed at these and other permanent waterholes. Aboriginal relics may be found in some of the more remote areas, but nearly a century of settlement has removed many of the traces of the numerous tribes which once inhabited this area.

Boss' Gorge on the Adavale-Blackall road and some of the mesas and buttes in the Yaraka district are interesting areas where relicts of vegetation, apparently from past less arid climates, occur. Opal mining has been carried out in the area west of Jundah (where a town called 'Opalville' once existed) and in the north-western parts of the Bulgroo plain between Adavale and Windorah. Fossickers can obtain more information on opal mining in these areas from the Mines Department.

Features of historical interest such as early homesteads and hotels occur throughout the area. Many are in poor condition and will be lost from the district's heritage unless enthusiastic local historical bodies are able to restore them. Homesteads on 'Warbreccan', 'Springfield' and 'Welford' have been classified as historical buildings by the National Trust. The 'Duniera' homestead at Blackall constructed of gidgee slabs, and the mud ruins of the J.C. hotel at Canterbury, west of Windorah, are interesting examples of early building materials and workmanship. Unfortunately the remains of the J.C. hotel have deteriorated rapidly since the roof was removed.

It is not known if there are any Dude Ranch style operations in the area, but it may be possible for a limited number of these to operate profitably, allowing visitors to see how work is performed on pastoral properties and enjoy the atmosphere of station life.

With the increasing popularity in urban communities of recreation forms associated with camping and four-wheel drive vehicles, it seems likely that a proportion of these people will contemplate visiting the area, either en route to other places, or as a holiday in itself. Publicity and reliable information concerning the attractions, facilities and relative costs of holidays in various places should be made available so that the area obtains its share of the growing tourist trade.

The gidgee lands in the higher rainfall zone in the east have been the only areas where successful development has taken place. At present it is unlikely that large scale agricultural development in the form of introduced pastures will find application in other parts of the area. This is in keeping with an extensive pastoral system entailing limited development and minimized costs and capital investment, which appears to form a basis for successful management systems in the arid environment of south-west Queensland (Childs, pers comm.).

Development of the gidgee lands has taken the form of scrub-pulling, following which natural pastures develop, or the pulled area may be burnt and either the natural pastures allowed to develop or introduced pasture species are seeded into the burn. Burning and seeding with introduced pasture species is the recommended and most commonly used system (Purcell, 1964). Purcell also indicates that regrowth of woody weeds, particularly sandalwood and butter-bush is likely to be a serious problem in areas where these species are present in the scrub before pulling. Easier mustering is a feature of those areas cleared and burnt.

Much of the development in the gidgee areas occurred in the 1950's and 1960's with the advent of large tractors and a number of good seasons which provided the necessary cash surplus and tax advantages. Limited development of this nature has taken place so far this decade due to low prices of products. Cost increases associated with the scrub pulling operation have also acted as a deterrent.

A few property operators have established small water storage and irrigation schemes. These schemes are usually intended for use by special animals such as stud stock, station horses, bulls etc. and usually rely on a large uncosted labour input by the operator. A number of irrigation licences have been granted for pumping from waterholes in the Barcoo and Thomson Rivers, but most of these appear to be used mainly for domestic fruit and vegetable gardens at the moment. Significant changes in cost-price relationships of agricultural food products in the distant future due to a growing world population could prompt further development of small irrigation schemes. The isolation of these areas could be advantageous if pest control problems arise. A number of large scale water storage schemes have been proposed for the Channel Country rivers, but due to the erratic nature of the floods in this country, and the cost of constructing storages, none have been shown to offer increases in production over that obtained from the natural reticulation system of the Channel Country (Skerman *et al.* 1947).

Foreseeable developments in the area are limited to the formal outlining of management systems which maintain the native pasture resource in a condition which allows the pastoral industry to operate efficiently, with maximum financial returns in both the short and long term, while utilizing the lowest possible inputs of capital and labour.

CONDITION AND TREND

The term'condition' is used to describe the suitability and adequacy of the vegetative cover on a particular type of country for both livestock production and stabilizing the surface to prevent soil erosion. It is a relative term, and only describes the state of a particular type of country in relation to other similar types of country in a similar climatic environment and is not known to be related to the vegetation climax.

For example an area of a land unit in good condition carries a large proportion of species suitable for livestock production, and a relatively low proportion of unpalatable species, when compared with other areas of the same land unit or other land units with broadly similar soils and climate. There would be sufficient vegetative cover to prevent soil erosion. An area in poor condition would have a higher proportion of inedible or weed problem species and ground cover would be insufficient to prevent soil loss.

The trend in condition of a particular land unit refers to the anticipated direction of change of condition in the future. While trend is highly dependent on seasonal conditions, subjective assessments of the future trend of the various land units have been given. These assessments have been based on changes occurring during the survey period and on the different levels of condition observed on land units throughout their geographical distribution.

Management of the land resource to obtain the most profitable short term production consistent with maintaining the land in 'acceptable' condition for future pastoral use requires detailed knowledge of the reaction of particular types of country to grazing pressures and varying seasonal conditions. An acceptable minimum level of condition for a particular land unit would be a state where, with due allowance for seasonal fluctuations, the condition could be adjusted up or down in the short to medium term by manipulation of stocking rates. Drastic measures such as complete destocking (meaning loss of production) are not required for the land to regain its former condition and productivity. Quantitative studies in this field are limited and it will be some time before reliable data defining this 'point of no return' are available. Under the present economic conditions complete destocking for a number of years is not feasible. Country which requires this type of treatment before it can be brought back into productive use can be regarded as being permanently and irreversibly degraded.

DEGRADATION

Degradation is not restricted to the familiar sequence of loss of vegetative cover leading to soil loss. It also applied where loss of production has occurred as a result of invasion by unpalatable species and woody weeds, even though ecologically and in soil terms the system is in a stable state.

The main problem in management of lands in this area is the regular drought periods which occur, producing major short term variations in pasture quantity and quality. Adjustment of levels of utilization to this fluctuating feed supply poses considerable managerial problems. Viability during these drought periods is a crucial factor for many pastoral enterprises.

Droughts result in excessive grazing pressure if stock numbers are not reduced sufficiently rapidly. Condon, Newman and Cunningham (1969) indicated that the greatest damage to pastures, topfeed and soils occurs during the early phase of a drought when stock numbers are still high or increasing as a result of a run of good years.

Data collected by Childs (1974) in the Tambo-Augathella area indicate that the rate of reduction of stock numbers at the onset of drought affects the financial success or otherwise of managers. Further research is required on this type of interaction.

As well, the level of condition which achieves maximum animal production over the range of seasons needs identifying for the various land types. This could be done by monitoring the reaction of major land units over long periods of time to varying management strategies.

EROSION

Soil erosion is generally considered to be the final step in the degradation process. Degradation starts with a long term downtrend in condition and if continued long enough, can lead to soil loss by erosion.

Erosion in arid lands is generally considered to comprise two components-natural or geological erosion and accelerated erosion. Natural geological erosion has resulted in complete or partial removal of much of the original Tertiary land surface and underlying weathered zones. Less than 40% of the area remains covered by Tertiary or weathered zone material. Natural erosion can be expected to be most active in these remaining areas. Following stripping of the Tertiary land surface the fresh Cretaceous sediments are exposed and levelled off, and natural erosion slows because of a lack of suitable erosion gradients.

In some areas acceleration of this natural erosion process has been caused by man's activities. The two forms of erosion are inseparable since both work through the same mechanisms of sheeting, rilling and subsequent gully erosion. Grazing pressure exerted by introduced animals, removal of tree and shrub cover, and fires started by man are obvious examples. The possibility of accelerated erosion is very much reduced in areas of the Cretaceous sediments where erosion gradients are low. It is considered that in the remaining areas of the Tertiary land surface a certain rate of erosion is an inherent feature of the geological process.

Limited quantitative information is available on the effect of man's activities on the condition of the country in western Queensland. Skinner and Kelsey (1964) reported that evidence available indicated a gradual but serious deterioration of the mulga lands was occurring. Data collected by Dawson (1974) showed that signs of degradation were present in the mulga country and along river and creek frontages. The explorer A.C. Gregory referred to areas of scalded frontage country in his journal when travelling through the area during a drought. The Western Division of New South Wales was recognised as susceptible to erosion and degradation, following the Royal Commission, many years ago. This led to the establishment of theWestern Lands Commission. Considerable work on the problems of degradation and erosion in Western New South Wales has been carried out by the New South Wales Soil Conservation Service.

It is essential that use be made of the experience gained in western New South Wales, the Northern Territory and other arid zone areas, in the administration and management of the arid lands of western Queensland.

The application of preventative measures is of the highest priority in areas susceptible to degradation. Given the marginal per hectare returns of the pastoral industries in these regions restorative measures are presently not an economic proposition for most landholders. The cost of these restorative measures, were they to be implemented would require government funds. Failing this, the degraded country will continue to be used, at a reduced level of productivity. Overall production of livestock products from these

areas will be lowered, and some landholders will be forced into a vicious circle of lowered production leading them to stock their country more heavily which in the longer term will lead to even lower levels of production and so on.

Assessments of condition and future trend for the land units and land systems are presented in Appendix V and Table 8.1 respectively. Further discussion of the condition of the various land systems, the main factors influencing this level of condition and the implications for management and administration follow.

1. Dunefields

These are moderately stable land systems occurring in the drier western areas. The spinifex pastures and associated annual species are grazed by cattle at very low stocking rates. Topfeed is insignificant. Dawson (1974) observed that dunefield areas adjacent to the Channel Country land systems and around watering points were often subject to overgrazing. A similar situation is evident in this area. Skerman (1947) observed sand drift and sand encroachment onto the Channel Country land systems. This was most noticeable in areas to the south of this survey. However even in the overgrazed or sacrifice areas referred to, soil erosion is not of great significance, particularly if a certain rate of sand encroachment onto the alluvial plains is considered to be a natural geological process.

Wind is the main agent causing soil particle movement in the dunefields land zone. The coarse textured soils with high infiltration rates are rarely affected by rainfall runoff. The maintenance of an adequate spinifex cover to prevent excessive sand movement is essential, though managers have reported that too thick a spinifex cover restricts the amount of annual herbage which can grow between the tussocks. Fire is used by some managers to remove coarse dry material and allow the growth of young spinifex shoots and herbage. Excessive use of fire may lead to a loss of the perennial species and a reduction in the stability of the dunefields.

Where mobile crests occur on dunes some sand movement is inevitable. Most dunes in the survey area have stabilized lower flanks and only minor reshaping and local movement of sand occurs on the mobile crests. Kyabra land system is the most susceptible of the dunefields land systems to damage as it is heavily grazed by stock during drought periods when feed on the surrounding alluvial plains has been exhausted. Some encroachment of woody weeds onto Kyabra land system has been observed and should serve as a warning to managers, even though the system remains stable from an ecological viewpoint.

2. Sandplains

The spinifex sandplains (Prairie and Galway land systems) have similar characteristics to the dunefields land zone. The foregoing discussion on the dunefields land zone applies to these two land systems also.

The mulga sandplains comprising Greenmulla, Fraser and Whitula land systems are inherently stable areas of flat to very gently undulating plains. There is little evidence of degradation in these areas, though undesirable wire grass species at times form a large proportion of the pasture particularly on areas of Greenmulla land system where thick mulga has been cleared on a face. Dawson and Boyland (1974) also referred to woody weed invasion of Greenmulla land system in areas to the south of this survey.

Isis land system has different characteristics to the other sandplain land systems. It forms a valuable drought reserve of lighter country which can respond to small falls of rain which are of no use on the clay soils of surrounding alluvial plains and gidgee areas. No evidence of degradation was observed on Isis land system, though woody weed invasion is a potential problem.

MULGA LAND ZONES

Ambathala land system is the most productive of the soft mulga land systems. Most of it is in fair condition and it contains a variety of different units with some valuable run-on areas. Woody weeds are a potential problem in the run-on areas, and in some cases smallareas of sodic soils may erode if stock concentrate on these areas. However little gully erosion was observed on this land system, probably because slopes in the run-on areas are very low. Evidence of some sheeting was observed on the mulga land units of this system and careful management of these areas is necessary. Because of the potential problems which could arise on this land system clearing of dense stands of mulga on a face cannot be recommended, though thinning to densities of 175 shrubs/ha should increase productivity without affecting the stability of the system.

The remaining three soft mulga land systems and the five hard mulga land systems comprise approximately 11 000 sq. km or 11% of the survey area. These land systems are considered the most likely lands to experience a significant decline in productivity as a result of degradation and erosion. One third of the soft mulga sites and half the hard mulga sites described, showed signs of soil loss. Monitoring of these land systems is necessary to determine the level of condition which represent the point of no return, meaning that the country will not recover in the short to medium term, if further degradation occurs.

Topography of these areas is gently undulating with slopes ranging from less than one to three percent. Soils are mostly acidic and available nutrient levels very low. The better quality pasture species in these lands depend to a large extent on a mobile pool of nutrients built up in the surface soil by the nutrient recycling action of the vegetation, particularly mulga. This has been shown by the data of Dawson (1974) and is supported by soil analytical data obtained during this survey (Chapter 3). Similarly Charley and Cowling (1968) indicated that in Australian arid zone soils (in particular those supporting saltbush communities) a marked pool of circulating or 'active' nutrients occurs close to the surface. They also point out that the stability of these plant communities depends on maintaining intact the decomposition phase of the system which operates in the surface litter deposit and the first few centimetres of soil.

Where fire or drought feeding demands have excessively thinned or completely removed the mulga it appears that the cycle of replenishment of this pool of nutrients through leaf fall and organic matter breakdown is broken. Available nutrient levels in the surface fall, and conditions for survival and re-establishment of desirable pasture species become unsuitable. A decline in productivity occurs.

Soil erosion begins when destruction of the tree and shrub layer exposes the soil surface to wind and water erosion, particularly during drought when ground cover is low as a result of high grazing pressure. Condon (1961) stated that in western New South Wales, for wind erosion to occur, the soil must be of a texture and structure which enable the particles to be freely removed, the soil must be dry, the surface bare or almost bare of protective cover, and a certain wind velocity (18km/hr) must occur within 15 cm of the surface.

Grazing pressure is particularly high in the vicinity where mulga is being pushed or cut as large numbers of stock are concentrated on a relatively small area. Sheet erosion of the surface begins, leading to unfavourable surface conditions, lower infiltration rates, increased run-off and loss of topsoil and the nutrients built up in this soil. Condon, Newman and Cunningham (1969) have suggested that in groved mulga lands the bare areas between the groves were originally smaller, but have increased as degradation proceeds. This leads to a vicious cycle of less vegetation, resulting in less moisture penetration and less nutrients recycling, and hence less vegetation. The vegetated areas may eventually cease to exist.

The replacement of lost nutrients and organic matter is not likely until mulga is re-established in these areas. Complete removal of stock until a run of good seasons occurs may be necessary for this mulga regeneration to occur.

In the long term the actual cost of nutrients lost through erosion emphasises the seriousness of the problem. Dawson (1974) estimated that the nutrients lost when the 0-10 cm zone over one hectare of a red earth soil is removed by erosion would approach a cost of $400 to replace at 1974 values. Replacement of these nutrients by natural processes is not likely in the short term. Possible benefits gained from the formation of new alluvial plains composed of this eroded soil and its associated nutrients are unknown. The highly productive channel country floodplain of Cooper Creek was laid down in this way, in the lower reaches of an extremely large and relatively fertile (for arid zone soils) catchment.

The decline in production from sheet eroded areas in the upper parts of a catchment is of particular significance to management. If the country becomes degraded and erodes not only is it no longer productive, but runoff will increase. This may aggrevate erosion problems in susceptible areas further down the catchment leading to —— loss of production in these areas as well. Also where a holding covers a number of different land types, degradation of the mulga areas to the point where they can no longer be used as a drought reserve means a reduction in overall productivity. This leads to a reduction in management flexibility as the operation becomes much more susceptible to drought. Utilization of the other (usually more productive) types of country on the holding is subsequently curtailed. In good seasons some of this pasture must be kept as a drought reserve while in dry periods there is likely to be serious overstocking of these other types of country with a subsequent effect on future productivity.

Damage due to stock along stock routes through the mulga land zones, particularly east from Windorah was of major significance in the period prior to the introduction of road transport. Severe denudation of country along stock routes was common, particularly in times of drought. Degradation and erosion of the hard mulga land zone is most noticeable on the stock routes east from Windorah. The use of road transport has alleviated this problem. Areas around watering points and other places where stock are concentrated, such as small holding paddocks, are prone to deterioration. Only relatively small areas are involved and the sacrifice of these areas appears unavoidable under present systems of use.

Overall, a delicate balance between topfeed, ground cover and stocking rates exists in these land systems and this balance must be preserved, even in drought periods, to maintain the land in acceptable condition. Research by Beale (1978) and Everist (1949) indicates that maintenance of adequate mulga densities is the key to stability and continuing productivity in these lands.

DISSECTED RESIDUALS

These are actively eroding remnants of a former land surface, and are generally of little pastoral significance. They provide valuable run-off for the sediments and alluvial plains below. Where topfeed occurs in these land systems its use is limited by access and available of permanent water.

GIDGEE. LAND. ZONE

The gidgee land systems are basically stable areas, with the exception of the incised valleys of Idalia land system where concentration of run-off has led to gully erosion of the texture contrast soils. The remaining land systems are not noticeably affected by erosion, even though the stone covered, cracking clay soils may have slopes as high as 3 to 5%.

Pasture condition depends mainly on seasonal conditions as most of the species in gidgee areas are annuals. This annual herbage provides high quality pasture for stock. Despite consequent high grazing pressures on these areas the species do not appear at this stage to be susceptible to permanent removal by overgrazing, except in continually overstocked areas such as holding paddocks.

The majority of Linden and Kiama land systems are so densely wooded that production in the natural state is low. Clearing of this country on a face has been carried out over considerable areas. Results have been reasonably successful but regrowth problems can be servere. Successful operators have pulled the scrub when the soil is wet and have been able to obtain a sufficient grass cover to carry a hot fire. This results in high regrowth kills and provides a good seedbed for the introduction of buffel grass species. In trials at 'Eastwood', Blackall, buffel grass pastures have carried one sheep to the acre (2.5 sheep/ha) for eleven years over a variety of seasons. During the recent run of better seasons the two sheep to the acre (5 sheep/ha) treatment produced similar animal production figures to the original 1 sheep/ac stocking rate (Orr pers. comm). Apart from regrowth problems the clearing of the gidgee lands has not resulted in any evident adverse effects on the country, although the possibility of salinity problems occurring downslope from cleared areas cannot be dismissed.

Salt accumulations in gidgee soils occur higher in the profile than in other groups of cracking clay soils in same area. Gidgee soils are strongly sodic and saline below 60 cm depth. It is possible that clearing of the gidgee scrubs will increase soil moisture levels in the profile, resulting in salts being brought to the surface lower down the slope by water movement through the subsoil. Problems of this nature are common in higher rainfall areas. No evidence of salt problems associated with cleared gidgee areas was noted in this survey, and rainfall in this area may be insufficient to cause significant movement of salts.

WOODED DOWNS

This land zone is basically stable and a very productive area which provides valuable feed and shade for animals. Animals congregate in the shade areas, resulting in reduced ground cover in these areas, but signs of widespread or serious deterioration in condition are absent. Where topfeed species are being cut for stock feed, care should be taken to retain adequate tree cover to provide shade for stock and a topfeed reserve for the future.

DOWNS

The condition of the downs land zone is stable in the long term. In the short term the quality of pasture available is entirely dependent on seasonal conditions. There is no significant evidence of deterioration in soil condition, or of a reduction in the abundance of desirable perennial species to levels where regeneration will not occur in good seasons on the eastern land systems (Blackall, Bimerah and Warbreccan). The western downs land systems (Plevna, Davenport and Morney) have a fluctuating pasture with a smaller component of perennial Mitchell grasses and an increase in annual species. There are dramatic seasonal fluctuations in the condition of this pasture, but the long term trend in condition is thought to be stable. A slight upward trend is evident in areas such as stock routes where severe overgrazing once occurred and Mitchell grass densities were greatly reduced. At present these land systems are in good condition. Palparara and Corrikie land systems are of much lower productivity than the other downs land systems. These two land systems are of different geological origin to the other downs land systems and occur mainly in the drier western areas. Palparara appears to be experiencing a short term downtrend in condition. The long term trend is not known.

On the more productive of the downs and wooded downs land systems adjustment of levels of utilization to obtain optimum herbage production and pasture growth needs further research. A trial being conducted by the Charleville Pastoral Laboratory at 'Burenda' Augethella will provide some of the necessary data, but further research in areas north and west of Blackall is needed.

ALLUVIAL PLAINS, WOODLANDS, OTHER ALLUVIA

The condition of these land systems is again dependent on seasonal conditions, particularly in the drier western areas where annual species predominate. Overgrazing and degradation of areas of these land systems are fairly common, mainly around watering points or adjacent to areas of topfeed. This results in seasonal and/or permanent scalding with consequent loss of production from these areas. Care must be exercised not to turn seasonal scalding into a permanent feature by placing too much grazing pressure on these land systems. This term 'scalding' as defined by Dawson (1974) is intended to refer to flat hardsetting bare surfaces created where the surface soil has been removed by wind and/or water erosion. 'Claypans' refer to areas with hard, massive surfaced, clay soils (typical heavy grey clays) occurring mainly in the dunefields and sandplains land zones.

It is considered that much of the scalding on both major and minor alluvial plains is of a seasonal nature, with vegetation of varying quality building up in good years, but reverting to bare scalded surfaces in drought periods. Historical records indicate that scalded areas existed on some alluvial plains before the introduction of domestic grazing animals.

The nutrient status of soils in the upper parts of catchments determines the nutrient status of alluvium formed in these catchments. Alluvia with higher levels of available nutrients are obviously less susceptible to scalding than alluvia with lower nutrient levels. Areas such as the lower reaches of the Powell Creek are typical of severely scalded alluvial plains with relatively low nutrient levels. Monitoring of all scalded areas is needed to separate long term trends from seasonal fluctuations. This is particularly so for the local alluvial plains, both in the mulga land zones and on the fresh Cretaceous sediments.

Excessive run-off from degraded lands in upper catchment areas is concentrated on the alluvial land zones, and contributes to increased scalding and gully erosion if the alluvial plains are in poor condition. This has an important bearing on reclamation attempts in the alluvial land zones.

Considerable work has been down on scald reclamation in western New South Wales. Jones (1966, 1967, 1969) and Newman (1966) showed that ponding of water on scalded areas is an effective reclamation technique. In parts of the survey area graziers have ripped scalds on local alluvia with apparently favourable results. Scalded areas on clay alluvia typically have strongly crusting surfaces which lower infiltration rates. Data collected in this survey indicated higher levels of magnesium cations and much higher salt levels on these surfaces than on normal alluvia (Chapter 3).

Again the establishment of an adequate ground cover in these areas is the first step in reclamation. Stannard (1959) showed ground cover in the form of grasses was more effective than shrubs in preventing wind erosion on scalded areas. Where ponding or spreader banks and other earthworks are carried out on scalded areas, the effect of flooding due to intense storms on the life of these structures must be considered. Ponding schemes appear to be the most successful reclamation technique on sheet eroded and scalded mulga lands suffering from loss of topsoil.

Limited information on the costs and benefits of scald reclamation work in the survey area is available. Most schemes so far constructed use 'unpaid' owner-operator labour. If reclamation can be successful and permanently carried out, the long term returns from maintaining the productivity of the land involved may justify the present cost of this reclamation. This applies particularly to scalded alluvia and run-on areas which are capable of high future productivity following reclamation. Mechanical measures such as ponding and ripping of scalds usually require complete or partial destocking of the areas in question. Costs associated with destocking such as extra fencing, loss of production, and stock movement must also be considered.

CHANNEL COUNTRY LAND ZONE

The condition of these land systems, in the short term, is dependent on the extent, duration and time of year when flooding occurs. In the long term Cooper and Woonabootra land systems are inherently stable lands on which there is little evidence of degradation. Cunnawilla land system which makes up the outer alluvial plains of the channel country land zone is subject to extensive seasonal scalding. These alluvial plains rely on local run-off as well as general flooding to provide moisture. Monitoring of the extent and severity of scalding on this land system is necessary to ascertain the long term trend.

SUMMARY

Because of the cost of reclamation procedures and the fact that a relatively small part of the survey area is suffering from degradation problems at present, major emphasis is placed on erosion prevention and control by management practices.

To prevent degradation, management practices must aim to maintain the condition of the country at least above the point of no return. Management practices decide when pastures are grazed and the

intensity of grazing pressure. Limited objective information is available on the effects and feasibility of deferred or seasonal grazing strategies in this area. Stocking rates are the major factor which can be manipulated by management to maintain pastures of a desired density and species composition. A long term outlook is essential in setting and manipulating stocking rates.

In particular, early reduction of stocking rates on land types most susceptible to damage during droughts is necessary. Condon, Newman and Cunningham (1969) have also described a technique for assessment of grazing capacity at various stages of a prolonged drought. This method was used by them in the Northern Territory to provide a guide for land administrators on what were considered safe stocking rates during drought periods. Financial losses incurred if stock are sold on a falling market during a drought are the main problem associated with destocking. These problems would be lessened to some extent where properties run 'safe' maximum stocking rates at all times (avoiding the situation where a drought is entered with high stock numbers which are still increasing) as in general fewer stock would have to be sold. The use of rainfall probabilities in determining stocking strategies is indicated (Mawson and Robinson 1975).

The development and extension of management strategies which will maintain areas identified as susceptible to erosion and degradation in acceptable condition, particularly during drought periods is of high priority. Following a run of good seasons most of these sensitive areas are in a reasonable condition and this would provide a sound basis for a program aimed at conservative long term management of these areas.

It is within the context of developing an overall approach to long term management of these predominantly arid lands that existing research and extension programs should be considered and new programs initiated. Any approach to solving specific erosion or woody weed problems should be considered within this context.

Before extension officers attempt to introduce desired management strategies to graziers these strategies must be shown to be profitable, on a medium to long term basis at least. Childs (pers. comm.) has indicated that insufficient attention has been paid to the needs of the actual resource managers (graziers) in the development of systems of land use by research and extension organisations. Where necessary administrators must adjust all factors within their control to enable land users to use sensible, flexible management strategies. The most important of these is to quickly reduce stock numbers during the early stages of drought. By the time the animals are in poor condition, damage will already have been done to some land types. Administrators are responsible for adequacy of living areas, permanency of land tenure, rentals and shire rates, as well as road maintenance tax and rail freight rebates which increase the mobility of stock in drought declared or erosion areas.

Taxation arrangements suited to coping with fluctuating seasonal conditions and incomes are desirable to encourage flexible management policies.

A prosperous landholder can afford to look after himself and his land; a poor landholder can only be expected to look after himself.

Many of the factors outlined above are already subject to adjustment by the authorities involved; further adjustments must be made, where necessary, as part of an integrated approach by all government departments and other organisations involved with the administration and management of these pastoral lands. The aim is to achieve stable long term land use and a profitable and efficient pastoral industry.

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APPENDIX I

CLIMATE

The area experiences a hot climate and may be classed as semi-arid in the east to arid in the west. This east-west transition is evident in most of the aspects of climate. There is a summer dominant rainfall regime and consistently warm to hot conditions, resulting in high evaporation rates. A moisture deficit is common but occasional surpluses occur and these are sometimes accompanied by floodwaters from outside the area.

High and low pressure systems traversing Australia from west to east are the main weather systems affecting the area. The highs lie north of the low pressure areas and it is mainly the circulation around the highs which determines the direction and types of airflows into the area in winter. These airflows are generally dry and produce only light falls of rain if any. In summer the inter-tropical convergence zone of low pressure moves south and reduces the dominance of the high pressure circulations. Isolated low pressure areas and troughs usually develop in summer and these may be intense enough to induce unstable, moist air to enter the area and produce rain. This rain is usually stormy in character.

RAINFALL AND EVAPORATION:

Annual rainfall declines from over 400 mm (median) in the east of the area to less than 200 mm in the west, as shown in Figure 1. This contrasts with the high evaporation rates, seen on the same figure, which vary from 3200 to over 3600 mm per annum.

The rainfall regime is summer dominant as can be seen in the monthly histograms for Windorah and Blackall, shown in Figure 2. 70 to 75 percent of rain falls in the summer months. Comparisons of median monthly and annual rainfall values for selected stations in the area may be made in Table 1.

Mean rainfall values are also shown above in brackets for Blackall, Adavale and Windorah. Occasional very large rainfall receipts boost mean values beyond the normal expectation of medium level; and, for assessment or planning purposes, use of median values is recommended.

Evaporation rates are also summer dominant as shown below:

TABLE 2 Evaporation Rates

	January	April	July	October	Year
mm	400-570	240-280	135-185	350-430	3200-3900

Source: Bureau of Meteorology (1975c)

From Figure 2 and the comparison between mean and median values in Table 1, it can be concluded that rainfall variability is high in this area. One means of expressing rainfall variability is that put forward by Gaffney (1975 a) in which he computes a variability index from the 90, 10 and 50 percentile values of the distribution of annual rainfall values.

$$\text{Variability Index} = \frac{\text{90 percentile} - \text{10 percentile}}{\text{50 percentile}}$$

This is a measure of the spread of the distribution normalized by the median. In the study area the index varies east to west from about 1.4, described as high, to more than 1.75 which is described as extreme.

Another approach to the description of the area's climatic variability is that by Dick (1964), in which he employs a climatic-year analysis based on the Koppen classification for arid, semi-arid, and humid years. This classifies climate on the basis of seasonal distribution of rainfall and mean annual temperature.

Although the classification is imprecise the static sense, Dick's application of it in classifying individual years is useful. The following approximate frequencies of arid, semi-arid and humid years for selected centres are taken from his maps of percentage frequency:

TABLE 3 Approximate Percentage Frequency Of Arid, Semi-Arid and Humid Years (After Dick 1974)

Station	Arid	Semi-Arid	Humid
Blackall	20	60	20
Adavale	50	45	5
Windorah	65	30	5
Haddon's Corner	80	20	0

From this, it appears that the north-eastern corner of the area can expect about two years in ten with an overall positive moisture status, and this is significant for land utilisation. Unfortunately, prediction of these humid phases is presently impossible and intensification of agricultural practices, based on expectations of these occasional wet years, is ill-advised unless accompanied by a large water conservation investment.

TEMPERATURE AND RADIATION

Mean temperatures in the area increase with a south-east to north-west trend (see Figure 3). The extremes of temperature which can be reached are seen in Figure 4. Heatwaves are common in summer, and winters are mild with only a few frosts mainly in July.

Global radiation is defined by Gaffney (1975b) as 'the total short wave radiation received at the earth's surface and comprises the energy reaching the ground directly from the sun and diffuse energy received indirectly from the sky such as radiation scattered earthwards by clouds and aerosols. Global radiation is the basic energy source for the physical and biological processes operating at the earth's surface (and) is a significant parameter in climatic studies (of) agriculture ....'. Approximate radiation values and sunshine hours are given below:

TABLE 4 Approximate Average Daily Global Radiation and Bright Sunshine

	January	April	July	October	Year
Radiation (1) ($mWh.cm^{-2}$)	750-850	530-560	410-450	720-750	590-610
Sunshine (2) (hours)	9-10.5	9-9.6	8.8-9.2	10.5-11<	9.4-10<

Sources: (1) Gaffney, D.O. (1975b)
(2) Bureau of Meteorology (1975 e)

WIND

Surface wind data for three years of record at Windorah suggest the following conclusions.

- 3 p.m. winds blow predominantly from the eastern south-eastern or southern sectors i.e. between 53 and 76 per cent of observations.
- most wind speeds recorded are in the 5 - 11 km/hr range.
- there is a tendency in the September-November quarter for wind speeds to increase into the 13 to 18 km/hr range.
- 9 a.m. winds blow predominantly from the north-eastern and south-eastern sectors, except in the December-February quarter when there is a stronger northerly component.

Source: Bureau of Meteorology,
Information Services Section, Brisbane.

RAINFALL EFFECTIVENESS

Rainfall receipts fall far short of evaporative demand, and a moisture deficit is therefore the most common situation. This is accentuated by high temperatures and steady winds, but is relieved occasionally by incursion of moist, usually tropical air masses. Floodwaters from catchments outside the area are also important elements in the moisture budget for channel and floodplain communities.

Winkworth and Thomas (unpubl.) have analysed frequencies of rainfall events for stations in the area. The annual frequency of wet periods at Blackall is 23, at Adavale 20, and 18 at Windorah. Wet periods are made up of days on which 1 mm of rain or more is received, and are ended by two consecutive dry days. About 50 percent of these periods are single day events at Blackall and Adavale, and 57 percent are single day events at Windorah.

Taking a limiting value of 15 mm rain as a quantity sufficient only to wet soil and plant surfaces, annual wet periods above this limit are only eight at Blackall, six at Adavale and four at Windorah. Of these, only about 40 percent are single day events.

Winkworth and Thomas have used a soil-water balance model to determine the frequency and duration of plant growth periods for natural vegetation. Three versions of the model were used, involving different assumptions related to maximum soil water storage and evapotranspiration rates. From the three models, ranges of annual frequencies of growth periods for stations in the area have been extracted and are shown below:

TABLE 5 Range of Annual Frequency of Growth Periods of Specified Duration

Station	Duration (Weeks)					
	1-3	4-7	8-11	12-15	>15	All
Blackall	1.3-2.3	0.4-1.0	0.1-0.6	0.1-0.3	0.4-0.8	2.8-4.5
Adavale	2.0-2.5	0.4-1.2	0.2-0.6	0.1-0.3	0.2-0.4	3.0-4.9
Windorah	1.7-2.5	0.4-1.0	0.2-0.3	0.1	0.1-0.2	2.4-3.9

Blackall's higher frequency of growth periods longer than 15 weeks is evident, and is to be expected with its location in the far north-east of the study area. This is in accordance with Dick's findings in Table 3 and suggests that the eastern part of the study area experiences a semi-arid climate more than a purely arid one.

REFERENCES:

Bureau of Meteorology (1975a) - *Climatic Averages - Queensland.* Australian Government Publishing Service (AGPS), Canberra.

(1975b) - *Climatic Atlas of Australia, Map Set 1 - Temperature.* AGPS, Canberra.

(1975c) - *Climatic Atlas of Australia, Map Set 3 - Evaporation.* AGPS, Canberra.

(1975d) - *Climatic Atlas of Australia, Map Set 5 - Rainfall.* AGPS, Canberra.

(1975e) - *Maps of Bright Sunshine - Average Daily Hours.* (Jan, Apr, Jul, Oct, Annual). Melbourne.

Dick, R.S. (1964) - Frequency patterns of arid, semi-arid and humid climates in Queensland. *Capricornia,* 1:21-30.

Gaffney, D.O. (1975a) - Rainfall deficiency and evaporation in relation to drought in Australia. Paper presented at *46th ANZAAS Congress,* Canberra, Jan 75.

(1975b) - Global radiation in the Australian region with reference to some climatic variations. *Proc. Aust. Conf. on Climate and Climatic Change,* Monash, Univ., Melbourne.

Winkworth, R.E. and Thomas, P.R. (unpublished) - Maps and tables supplied as part of overall Queensland western arid region climatic study.

STATION	J	F	M	A	M	J	J	A	S	O	N	D	YEAR
Blackall	57 (82)	62 (84)	36 (68)	23 (37)	18 (32)	17 (27)	14 (26)	7 (16)	6 (19)	18 (34)	27 (38)	53 (68)	459 (531)
Adavale	39 (63)	35 (58)	23 (51)	13 (24)	15 (25)	15 (26)	12 (21)	8 (13)	5 (16)	16 (26)	18 (27)	29 (39)	333 (389)
Emmet Downs	37	39	21	17	15	10	9	4	4	13	14	40	374
Isisford	25	49	32	16	11	11	7	5	4	14	19	39	409
Bimerah	35	33	24	13	9	9	4	1	2	10	9	26	320
Jindah	23	37	21	7	7	10	5	3	3	10	11	17	270
Windorah	23 (36)	24 (48)	16 (44)	6 (20)	7 (17)	10 (18)	5 (14)	3 (10)	3 (11)	5 (18)	8 (19)	18 (30)	248 (285)
Tambar	14	26	5	3	9	5	3	1	1	4	5	13	193

Sources: (1) Bureau of Meteorology, (2) (1975 a) - Information Services Section, Brisbane.

TABLE 1 Median Rainfall Values for Selected Stations (mm)

(Mean values shown in brackets)

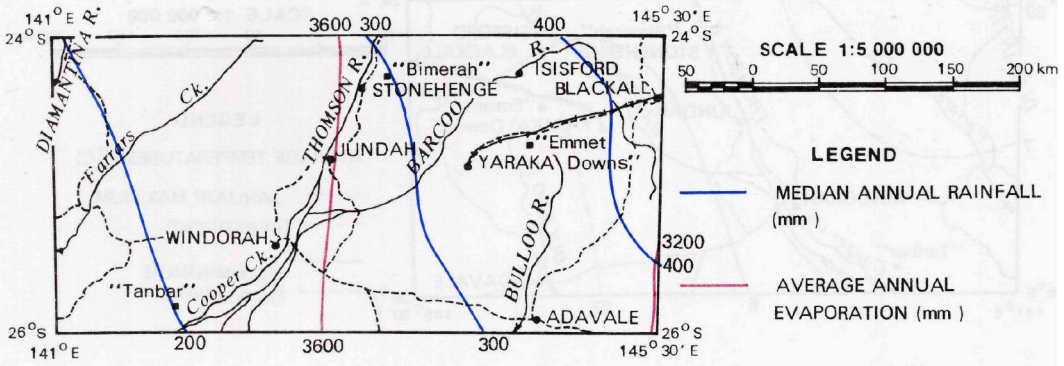
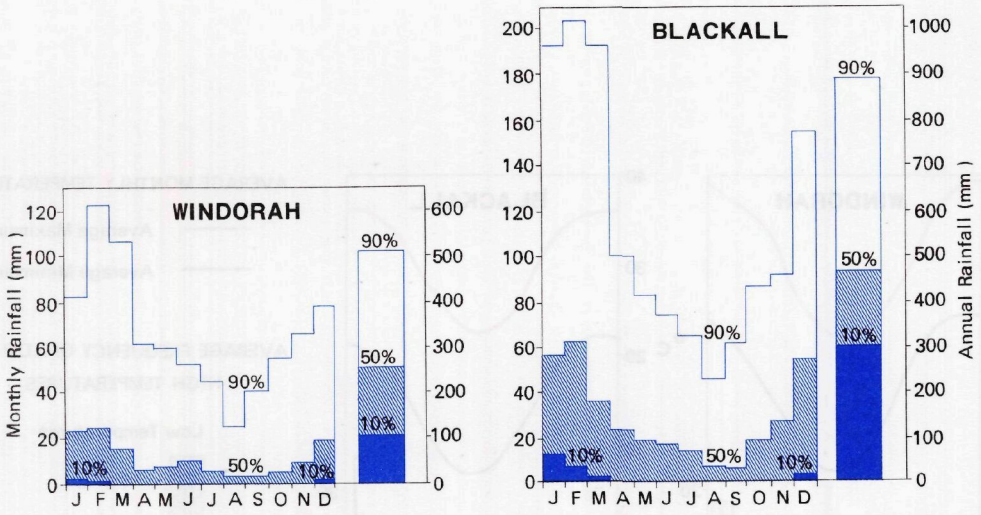


Fig. 1 RAINFALL AND EVAPORATION
(Source: Bureau of Meteorology, 1975c and 1975d)



Note: 90% - rainfall values likely to be equalled or exceeded once in ten years
50% - rainfall values likely to be equalled or exceeded five times in ten years
10% - rainfall values likely to be equalled or exceeded nine times in ten years

Fig. 2 MONTHLY AND ANNUAL RAINFALL VARIABILITY
(Source: 1 Bureau of Meteorology, Information Services Section, Brisbane.
2 Bureau of Meteorology, 1975a)

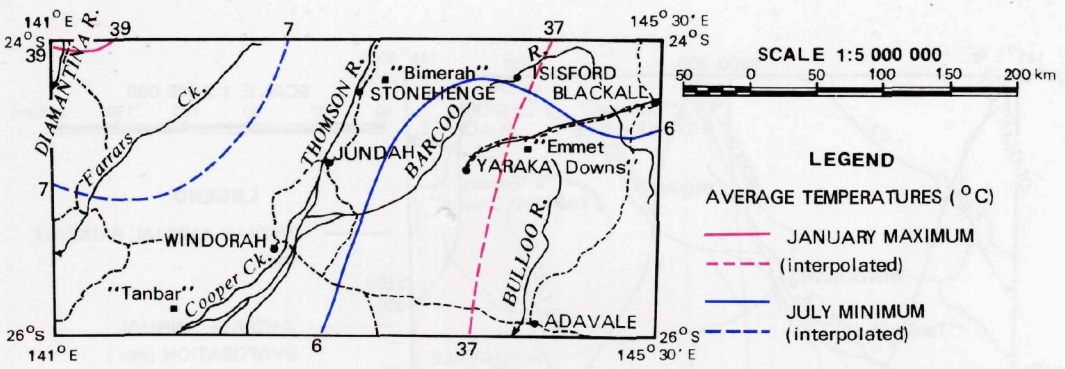


Fig. 3 TEMPERATURES
(Source: Bureau of Meteorology 1975b)

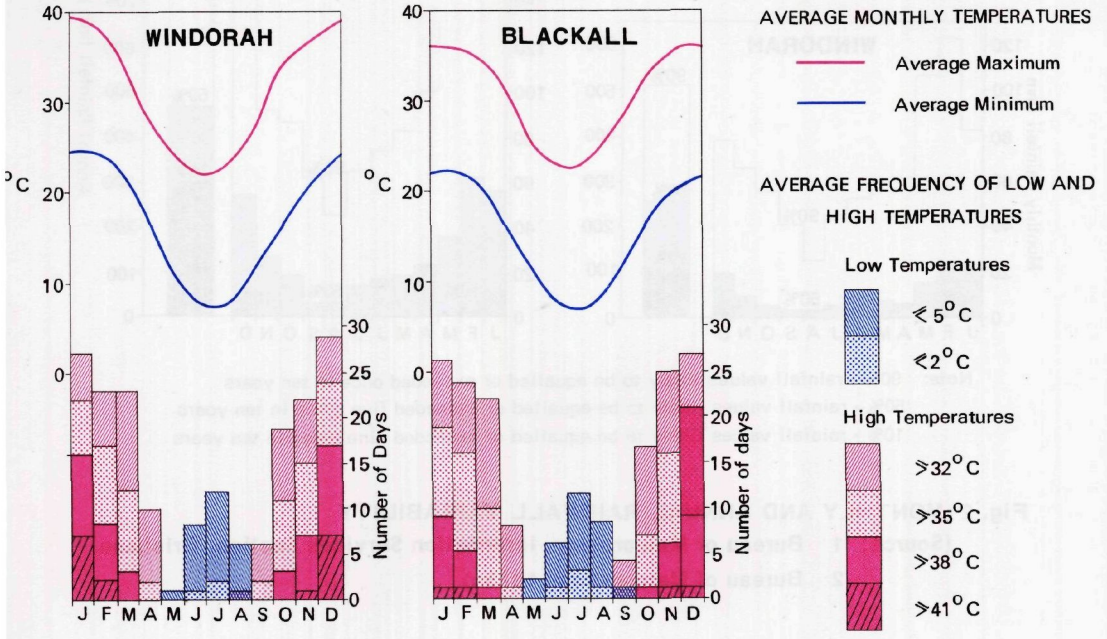


Fig. 4 MONTHLY TEMPERATURE AVERAGES AND EXTREMES
(Source: 1 Bureau of Meteorology, Information Services Section, Brisbane.
2 Bureau of Meteorology, 1975a)

LIST OF ABBREVIATIONS, SYMBOLS, RATING AND TERMS *

Ratings used are general, and are only a guide to assist qualitative description.

A.D. Moist - Air dried moisture, % moisture of a sample dried at 40°C.
A.P. - Acid extractable P (see Appendix VI).
A.W.C. - Available soil water capacity. The difference between equilibrium moisture contents at suctions of -0.33 bar and -15 bar.

Available Soil Water Capacity Ratings - % A.W.C.

Very high	>16
High	13 - 16
Medium	9 - 12
Low	5 - 8
Very Low	< 5

Biomass - Total weight of aerial and underground organs of a plant.
B.P. - Bicarbonate extractable P (see Appendix VI).

C - Organic carbon (see Appendix VI)
Ca - Calcium
$CaCO_3$ - Calcium carbonate, lime (see Appendix VI)
C.E.C. - Cation exchange capacity (see Appendix VI)
Cl - Chloride (see Appendix VI) for ratings see salinity.
Claypan - Areas (sometimes scalded) with hard,massive, surface soil which are predominantly clayey.
C/N - Ratio of % organic carbon to % total nitrogen.
Condition - The character of the vegetal cover and the soil under man's use, in relation to its potential.

Condition Classes	Description
Excellent	No erosion. Few or no bare spaces. General ground cover greater than 50 percent. Very high proportion of valuable pasture species.
Very good	No erosion. Some bare spaces. General ground cover greater than 30 percent. High proportion of valuable pasture species.
Good	Occasional minor sheeting by wind or water erosion with some bare spaces - (10 to 30 percent). General ground cover 20-30 percent. Moderate to high proportion of valuable pasture species.
Fair	Some minor sheeting by wind or water erosion with some rilling and gullying - frequent bare spaces (30-50 percent). General ground cover 10-20 percent. Moderate proportion of valuable pasture species.
Mediocre	Frequent moderate sheeting by wind or water erosion (50-60 percent bare space) with moderate rilling and gullying. General ground cover 5-10 percent. Moderate to low proportion of valuable pasture species.
Poor	Frequent moderate and severe sheeting by wind or water erosion (60-70 percent bare spaces) with severe rilling and gullying throughout. General ground cover less than 5 percent. Low proportion of valuable pasture species.
Very poor	Extensive moderate and severe sheeting by wind or water, or scalding (70-90 percent bare space) with extensive moderate and severe rilling and gullying, especially on drainage lines and flats.

This is not a complete list of terms but rather a list of terms used which are not adequately defined in the concise Oxford Dictionary.

C.V. Coefficient of Variation %

Edaphic Conditions of the plant environment that are determined by the physical, chemical and biological characteristics of the soil.
E.C. Electrical conductivity mS/cm (see Appendix VI).

Erosion Class

Class 1	Little or no erosion.
2	Wind erosion - scalding with little or no drift.
3	Wind erosion or scalding with moderate or plentiful drift.
4	Wind erosion - wind sheeting with little drift
5	Wind erosion - wind sheeting with moderate to plentiful drift.
6	Wind erosion - drift and dune activation.
7	Water erosion - sheet erosion with or without associated rilling and gullying.
8	Water erosion - gully erosion with or without associated sheet erosion.
9	Water erosion - gullying and sheet erosion and low slopes of steep rocky hills and ranges
10	Special class - sandhill - claypan complex
11	Special class - sloping scalds.
12	Special class - scalding and hummocking

E.S.P. Exchangeable sodium percentage. Ratio of exchangeable sodium to cation exchange capacity expressed as %.

Ferricrete A ferruginous natural material formed in a zone of iron oxide or hydroxide accumulation in the earth's crust.
Floristics The kinds of species included in a community or a region.
Fluctuating climax A term used to denote a condition which appears relatively stable but which in reality is in a state of unstable equilibrium.
Forb Herbs other than grass like plants and ferns
F.S. Fine sand

G.C. Grazing Capacity
Gilgai Small scale surface undulations, the alternate hummocks and hollows of which show some degree of regularity.
Grove Clumps of trees or shrubs roughly aligned with the contour forming a banded pattern.

Ht Height

K Potassium
K (Total) Potassium (Total) X-ray fluorescent. See Appendix VI.

K Rating - Exchangeable K, (m. equiv/100 g soil)

Very low	<.15
Low	.15 - .25
Fair	.25 - .34
Very Fair	.25 - .54
High	>.54

Crack and Isbell (1970) use value of 0.2 m.equiv./100 g ex. K as critical deficiency level.

Land system - An area or group of areas throughout which there is a recurring pattern of topography soils and vegetation.
Land Unit - A group of related sites associated with a particular landform within a land system and wherever the land unit recurs it has the same sites and similar, within defined limits, soils, vegetation and topography.
Land zone - A broad grouping of land systems based on similarity of physiography, soils, vegetation and geomorphology.

Mantled pediment - Gently undulating to undulating bedrock plains sloping away from adjacent hills which carry a veneer of transported detritus the thickness of which varies from place to place.
m equiv/100 g - milli equivalents per 100 grams soil
Mosic - Moist
Mg - Magnesium

N - Nitrogen (see Appendix VI)

Nitrogen Ratings - % Total N

Very low	<0.05%
Low	0.05 - 0.09
Fair	0.10 - 0.14
Very fair	0.15 - 0.24

Na - Sodium

Carbon Ratings - % C (uncorrected Walkley and Black Values)

Very low	<0.5
Low	0.5 - 0.9
Fair	1.0 - 1.4
V. Fair	1.5 - 2.4

P - Phosphorus
A.P. - Phosphorus (acid extraction N/100 H_2SO_4). See Appendix VI.
B.P. - Phosphorus (bicarbonate extraction). See Append.x VI
T.P. - Phosphorus (Total) X-ray fluorescence

Phosphorus Ratings - Acid Extraction

Very low	<11
Low	11 - 20
Fair	21 - 35
Very fair	36 - 45
High	46 -100

- Bicarbonate Extraction

Very Low	<11
Low	11 - 20
Fair	21 - 30
Very fair	31 - 40
High	>40

PFC - Projective foliage cover

pH Ratings - pH

Extremely acid	<4.5
V. strongly acid	4.5 - 5.0
Strongly acid	5.1 - 5.5
Med. acid	5.6 - 6.0
Slightly acid	6.1 - 6.5
Neutral	6.6 - 7.3
Mildly alkaline	7.4 - 7.8
Mod. alkaline	7.9 - 8.4
Strongly alkaline	8.5 - 9.0
V. strongly alkaline	>9.0

PPF - Principal profile form (Northcote, 1971)

RP - Representative profile
Run-on area - An area which receives runoff water from adjacen land.

Saline - Definition Northcote and Skene (1972)

	% Cl
Non-Saline	<0.06
Saline surface soil light textured	0.06 - 0.12
Saline surface soil heavy textured	0.13 - 0.18
Saline sub soil	>0.18

Salinity Ratings	E.C.	% Cl
Very low	0.15	0.01
Low	0.16 - 0.45	0.01 - 0.03
Medium	0.46 - 0.90	0.04 - 0.06
High	0.91 - 2.0	0.07 - 0.20
Very high	2.0	.20

Saltpan - The term has been applied to soils with loose, puffy surface soil containing visible salt crystals. They commonly have a surface crust which is easily broken.
Sandplain - Gently undulating to flat plains with well sorted fine to medium quality sand with reddish coating of iron oxides with increasing clay admixtures in sub-surface horizons. Little if any dune development.
Scald - Those areas which are bare because of wind and water erosion.
Silcrete - A siliceous natural material formed in a zone of silica accumulation in the earth's crust.
Sodic - Definition Northcote and Skene (1972)

Sodicity Ratings	E.S.P.
Non Sodic	< 6
Sodic	6 - 14
Strongly sodic	>14

PLANT SPECIES LIST

by D.E. Boyland and Philippa Goodchild

Two species list have been prepared. The first one is a scientific name - common name list covering all species identified in the area during the study. An indication of the land zones in which the species was observed is given. An assessment of toxicity and acceptability to stock is given where it is known. The second list gives the common name and equivalent botanical name for selected species.

A. Species, species distribution, toxicity, acceptability and common name

The families are arranged alphabetically, the genera listed alphabetically within the family and the species are ordered alphabetically within the genus.

The presence of species in the various land zones is indicated by +.

Land zones are represented by the columns as indicated:-

1.	Dunefields	6.	Undulating Gidgee Lands
2.	Mulga Sandplains	7.	Undulating Downs
3.	Soft Mulga Lands	8.	Alluvial Woodlands
4.	Hard Mulga Lands	9.	Channel Country
5.	Dissected Residuals	10.	Other Alluvia

Each species has been rated according to its acceptability and toxicity. Acceptability varies and may be dependent on the stage of growth of the plant, the composition of the pasture, the availability of more palatable species and the kind of grazing animal. Acceptability is based on where the species most commonly occurs and the usual grazing animal in that area. The following abbreviations are used for the three classes of acceptability.

H - High M - Medium L - Low * - in the drying off stage.

Toxicity of the various species to animals is indicated as follows:-

- T - shown to be toxic by feeding trials.
- C - known to contain toxins but has not been implicated in field cases of poisoning.
- S - suspected on strong field evidence.
- U - the plant is not known to be toxic and has not been suspected on reliable field evidence.
- * - toxic when it is the only component of the diet.

Plants known to be toxic are not always dangerous and may be useful components of the pasture (See Poisonous Plants section).

FAMILY/SPECIES	LAND ZONES										ACCEPTABILITY	TOXICITY	COMMON NAME
	1	2	3	4	5	6	7	8	9	10			
ACANTHACEAE													
Brunoniella australis			+	+		+					L	U	
Dipteracanthus prumilaceus					+	+	+				L	U	
Justicia procumbens							+	+		+	L	S	
AIZOACEAE													
Aizoon sygophylloides					+					+	L	U	
Glinus lotoides	+	+									L	U	
Mollugo cerviana	+		+	+	+						L	U	
Trianthema pilosa	+										L	U	
Trianthema portulacastrum						+	+	+	+	+	L	S/C	Giant pigweed or black pigweed
Trianthema triquetra				+		+	+	+		+	*M	T	Red spinach
Zaleya galericulata	+					+	+	+	+	+	L	S	Hogweed
ALISMATACEAE													
Damasonium minus	+								+	+	L	U	Star fruit
AMARANTHACEAE													
Alternanthera denticulata			+					+		+	L	S	Lesser joyweed
Alternanthera nodiflora	+		+			+	+	+	+	+	L	S	Common joyweed
Alternanthera pungens				+							L	S	Khaki-weed
Amaranthus mitchellii						+	+	+	+		*H	T	Boggabri
Gomphrena browni	+										L	U	
Gomphrena canescens						+	+				L	U	
Gomphrena celosioides	+		+								L	T	Gomphrena weed
Ptilotus atriplicifolius	+										L	U	
Ptilotus calostachys	+										L	U	
Ptilotus exaltatus					+	+	+				M	U	Fox brush or Prince-of-Wales
Ptilotus gaudichaudii			+	+	+						L	U	
Ptilotus helipteroides			+	+	+						L	U	
Ptilotus latifolius	+										L	U	
Ptilotus leucocoma		+	+	+	+						L	U	
Ptilotus macrocephalus	+		+	+	+	+		+		+	L	U	Pussy tails
Ptilotus murrayi									+	+	L	U	
Ptilotus nobilis			+	+		+					L	U	
Ptilotus obovatus	+		+	+	+	+	+	+			M	U	
Ptilotus polystachyus	+	+	+	+	+					+	M	U	Fox brush or Pussy tails
Ptilotus schwartzii					+						L	U	
AMARYLLIDACEAE													
Calostemma luteum								+	+	+	M/L	S	Wilcannia lily
Crinum angustifolium								+	+		M/L	S	A spider lily
APOCYNACEAE													
Alstonia constricta	+	+			+			+		+	M	T	Bitter bark
Carissa lanceolata						+		+			M/L	S	Conker berry or Current bush
Carissa ovata						+		+			M/L	U	Woodbine
Parsonsia eucalyptophylla						+		+			M	U	Gargaloo
ASCLEPIADACEAE													
Cynanchum floribundum	+										L	U	
Maredenia australis					+						L	U	
Pentatropis linearis	+							+			L	U	
Sarcostemma australe					+			+			M	T	Caustic-vine
BIGNONIACEAE													
Pandorea doratoxylon					+						L	U	Wonga vine
BORAGINACEAE													
Cynoglossum australe var. *drummondii*			+	+							L	U	Australian Forget-me-not
Heliotropium curassavicum										+	L	U	
Heliotropium falcinoides							+				L	U	
Heliotropium strigosum	+	+		+							L	U	
Heliotropium tenuifolium	+	+		+							L	U	
Trichodesma zeylanicum	+		+					+			M	S	Camel bush
BRUNONIACEAE													
Brunonia australis				+	+						L	U	Native cornflower
CACTACEAE													
Opuntia inermis						+	+				L	U	Common prickly pear
CAMPANULACEAE													
Isotoma petraea					+						L	S	Rock isotome
Pratia puberula								+			L	U	
Wahlenbergia gracilis								+	+		L	U	A native bluebell
Wahlenbergia graniticola								+	+		L	U	A native bluebell
Wahlenbergia queenslandica			+	+							L	U	A native bluebell
Wahlenbergia tumidifructa	+										?	U	A native bluebell
CAPPARIDACEAE													
Apophyllum anomalum						+	+	+			H/M	U	Broom bush
Capparis lasiantha					+	+	+				H	U	Nipan or split jack
Capparis loranthifolia	+	+		+							M	U	Narrow-leaf bumble
Capparis mitchellii								+			H	U	Bumble
Capparis spinosa var. *nummularia*								+			H	U	Flinders rose
CARYOPHYLLACEAE													
Polycarpaea arida	+										L	U	
Polycarpaea brevriflora	+		+								L	U	
Sagina apetala	+										L	U	
CASUARINACEAE													
Casuarina cristata										+	H/M	U	Belah
CELASTRACEAE													
Denhamia obscura					+	+					L	S	
Maytenus cunninghamii					+	+					L	U	

FAMILY/SPECIES	LAND ZONES										ACCEPTABILITY	TOXICITY	COMMON NAME
	1	2	3	4	5	6	7	8	9	10			
CHENOPODIACEAE													
Arthrocnemum halocnemoides var. pergranulatum								+		+	M/L	U	Samphire
Arthrocnemum leptostachyum						+		+		+	M/L	U	Samphire
Atriplex crassipes							+		+		M	U	A saltbush
Atriplex saraleyae						+	+	+		+	M	U	A saltbush
Atriplex elachophylla								+		+	M	U	A saltbush
Atriplex flesivalvis	+										L	U	A saltbush
Atriplex holocarpa	+							+		+	M	U	A saltbush
Atriplex limbata					+				+	+	M	U	A saltbush
Atriplex lindleyi					+	+	+	+	+	+	L	U	A saltbush
Atriplex muelleri						+	+	+			*H	T	Annual saltbush
Atriplex nummularia									+	+	H	C	Oldman saltbush
Atriplex semilacoata							+	+		+	M	S	Creeping saltbush
Atriplex spongiosa	+					+	+	+	+	+	M	U	Pop saltbush
Atriplex stipitata	+					+					I	U	Mallee saltbush
Atriplex vesicaria					+	+	+	+			M	U	Bladder saltbush
Babbagia sclerolepis	+					+		+		+	L	U	
Bassia anderconi						+		+	+	+	L	U	
Bassia anisacanthoides	+						+	+		+	H	C	Yellow burr
Bassia biacrnis	+	+	+	+		+	+	+	+	+	L	U	Goathead burr
Bassia biacrnis var. *horrida*	+	+					+				L	U	Goathead burr
Bassia biflora var. *cephalocarpa*						+	+	+		+	L	U	
Bassia birchii		+	+		+		+	+		+	L	U	Galvanized burr
Bassia brachyptera										+	M	U	Short winged saltbush
Bassia calcarata						+	+	+		+	H	C	Red burr
Bassia convexula	+	+			+			+		+	M	U	Copper burr
Bassia cornishiana			+	+	+						L	U	Cartwheel burr
Bassia decurrens										+	L	U	
Bassia divaricata	+		+	+	+	+	+	+	+	+	L	U	Copper burr
Bassia eriacantha				+			+	+			M	U	
Bassia intricata	+			+	+	+		+		+	L	U	
Bassia lanicuspis	+		+	+	+	+	+	+		+	L	U	Woolly spined burr
Bassia paradoxa	+					+		+		+	M	U	Curious saltbush
Bassia quinquecuspis			+				+	+	+		L	S/L	Prickly or black roly-poly
Bassia stelligera	+							+	+	+	M	U	
Bassia tetracuspis						+		+			M/L	U	Brigalow or dog burr
Bassia tricuspis				+	+	+		+			L	U	Three-spined roly-poly
Bassia ventricosa	+					+	+		+		L	U	
Chenopodium auricomum	+		+				+	+	+	+	*H	C	Queensland bluebush
Chenopodium cristatum			+					+		+	M	T	Crested goosefoot
Chenopodium hubbardii						+					M	U	
Chenopodium melanocarpum	+		+		+			+			M	T	Black crumbweed
Chenopodium polygonoides								+			M	U	
Chenopodium rhadinostachyum		+	+	+	+	+					M	C	Green crumbweed
Chenopodium trigonon			+	+			+	+			M	U	Fish-weed
Enchylaena tomentosa	+		+	+	+	+	+	+		+	M	C	Ruby saltbush
Maireana aphylla								+		+	M	U	Round-leaf toadflax
Maireana astrotricha	+										M	U	
Maireana brevifolia	+										M	S	
Maireana campanulata					+						M	U	
Maireana coronata					+	+	+	+	+	+	M	U	
Maireana diaptera							+	+		+	M	U	
Maireana georgei				+	+						M	U	
Maireana lanosa	+										M	U	
Maireana triptera				+	+	+		+		+	M	U	
Maireana villosa		+		+	+	+	+	+			L	U	
Pachycornia tenuis	+									+	M/L	U	A samphire
Rhagodia hastata							+				M	U	
Rhagodia nutans	+					+		+			M	U	Climbing saltbush
Rhagodia parabolica						+					M	U	
Rhagodia spinescens	+				+	+		+			M	U	A berry saltbush
Salsola kali	+			+	+	+	+	+	+	+	*H/M	T	Soft roly-poly
Threlkeldia proceriflora						+	+	+		+	M	T	Soda-bush
CLEOMACEAE													
Cleome viscosa	+	+	+		+	+	+				L	U	Tick-weed
COMMELINACEAE													
Commelina cyanea						+	+	+	+	+	M	U	Scurvy-weed or wandering jew

FAMILY/SPECIES	LAND ZONES										ACCEPTABILITY	TOXICITY	COMMON NAME
	1	2	3	4	5	6	7	8	9	10			
COMPOSITAE													
Actinobole uliginosum	+	+									L	U	
Brachyscome ciliaris													
var. *lanuginosa*	+	+		+		+		+	+	+	H	U	
Brachyscome ciliocarpa	+										H	U	
Brachyscome curvicarpa							+				H	U	
Brachyscome heterodonta							+				M	U	
Brachyscome melanocarpa								+			H	U	
Brachyscome tetrapterocarpa								+	+	+	M	U	
Calocephalus multiflorus	+				+						L	U	
Calotis ancyrocarpa								+	+	+	L	U	
Calotis cuneata							+	+			L	U	
Calotis erinacea	+							+			M	U	
Calotis hispidula	+			+				+	+	+	H	U	Bogan-flea
Calotis inermis	+					+			+		L	U	
Calotis lappulacea	+	+	+	+							M	U	Yellow daisy-burr
Calotis latiuscula			+							+	M	U	
Calotis multicaulis	+		+	+			+	+	+	+	M	U	
Calotis porphyroglossa	+										M	U	
Calotis squamigera							+				M	U	
Calotis xanthocordea			+	+						+	M	U	
Centipeda minima			+					+			L	U	Spreading sneezeweed
Centipeda thespidioides	+		+			+	+	+	+	+	L	U	Desert sneezeweed
Craspedia chrysantha	+	+							+	+	H	S	Golden billy-buttons
Craspedia pleiocephala									+		M	U	Soft billy-buttons
Eclipta alatocarpa									+		L	U	
Epaltes cunninghamii									+		L	U	
Flaveria australasica						+	+				L	U	Speedy weed
Glossogyne tenuifolia		+	+	+							M	U	Native cobbler's peg
Gnaphalium diamantinense									+	+	L	U	
Gnaphalium involucratum			+								M	U	A cudweed
Gnephosis eriocarpa	+										M	U	
Gnephosis foliata	+	+	+	+				+			M	U	
Helichrysum bracteatum		+	+								M	U	Yellow everlasting
Helichrysum odorum	+		+	+							M	U	
Helichrysum odorum													
var. *arachnoideum*	+										M	U	
Helichrysum podolepideum					+		+				L	U	
Helichrysum ramosissimum	+		+	+	+						M	U	Yellow buttons
Helipterum corymbiflorum								+	+	+	M	U	Small white paper daisy
Helipterum floribundum	+	+	+	+			+	+	+	+	M	U	Paper daisy
Helipterum hyalospermum								+		+	M	U	
Helipterum molle	+										M	U	Golden paper daisy
Helipterum moschatum	+	+						+			M	U	Musk sunray
Helipterum pterochaetum		+	+	+							M	U	
Helipterum striatum	+		+				+	+	+	+	M	U	
Ixiolaena breviscompta			+					+		+	H	U	
Ixiolaena leptolepis			+					+		+	H	U	Stalked ixiolaena
Ixiolaena tomentosa			+								M	U	Woolly ixiolaena
Minuria denticulata								+			M	U	Woolly minuria
Minuria integerrima			+					+	+	+	M	U	Smooth minuria
Minuria leptophylla			+						+	+	M	U	Minnie daisy
Myriocephalus stuartii	+										L	U	Poached-egg plant
Olearia subspicata								+			L	U	Turkey bush
Pluchea tetranthera								+	+	+	L	U	
Pterigeron adscendens	+					+	+	+		+	H	S	
Pterocaulon sphacelatum						+		+			L	U	
Rutidosis helichrysioides	+		+	+							M	U	
Senecio gregorii	+										M/L	U	Annual yellow top
Senecio lautus	+								+		L	U	
Senecio magnificus								+		+	L	C/S	
Sonchus oleraceus			+								H	U	
Vittadinia arida ms.							+				M	U	
Vittadinia constricta ms.			+	+							M	U	
Vittadinia pterochaeta							+				M	U	
Vittadinia pustulata	+	+									M	U	
Vittadinia sulcata ms.			+	+		+					M	U	
Xanthium pungens			+			+		+		+	L	T	Noogoora burr
Xanthium spinosum								+		+	L	T	Bathurst burr
CONVOLVULACEAE													
Bonamia media	+										M	U	
Convolvulus erubescens	+	+		+			+	+			H	U	Australian bindweed
Cressa cretica										+	L	U	
Evolvulus alsinoides	+	+	+	+			+	+		+	H	U	
Ipomoea calobra			+	+	+						M	U	
Ipomoea diamantinensis								+		+	L	U	
Ipomoea lonchophylla							+		+	+	H	C	Cow vine
Ipomoea muelleri							+	+	+		M/L	T	Morning glory or convolvulus
Ipomoea polymorpha	+										M/L	U	
Ipomoea racemigera							+	+			M	C	Bell-vine
Operculina sp. aff. *O. turpethum*							+				M/L	U	
Polymeria longifolia							+		+		M	U	
Polymeria marginata							+				L	U	

FAMILY/SPECIES	LAND ZONES										ACCEPTABILITY	TOXICITY	COMMON NAME
	1	2	3	4	5	6	7	8	9	10			
CRUCIFERAE													
Arabidella eremigena	+	+				+					H	U	
Arabidella nasturtium								+	+	+	M	U	
Arabidella trisecta					+						L	U	
Arabidella sp. aff. *A. glaucescens*							+				H	U	
Blennodia canescens	+	+									H	U	
Blennodia pteroperma	+										H	U	
Harmsiodoxa blennodioides	+		+					+		+	H	U	
Lepidium muelleri-ferdinandi							+				L	U	
Lepidium oxytrichum	+					+	+	+		+	L	U	A peppercress
Lepidium rotundum	+			+	+	+	+	+		+	H	U	A peppercress
Lepidium strongylophyllum					+						M	U	A peppercress
Stenopetalum decipiens					+						H	U	
Stenopetalum nutans			+	+	+	+	+			+	H	U	
CUCURBITACEAE													
Citrullus colocynthis	+	+	+	+							L	C/S	Colocynth
Citrullus lanatus	+	+									L/M	S	Wild water melon or piemelon
Cucumis myriocarpus	+	+				+	+				L	T	Prickly paddy melon
Cucumis trigonus			+	+							L/M	S	Paddy melon or wild cucumber
Melothria maderaspatana		+									M	U	
CUSCUTACEAE													
Cuscuta australis	+		+					+			L	U	Dodder
CYPERACEAE													
Bulbostylis barbata	+		+								L	U	A sedge
Cyperus betchii								+		+	L	U	
Cyperus bifax							+	+		+	H	U	Downs nut-grass
Cyperus bulbosus								+			M	U	
Cyperus dactylotes								+			L	U	
Cyperus difformis	+							+		+	L	U	
Cyperus exaltatus								+			L	U	
Cyperus fulvus var. *viscidus*						+		+			L	U	
Cyperus gilesii						+					L	L	
Cyperus gymnocaulis									+	+	L	U	
Cyperus iria	+		+			+		+			L	U	
Cyperus pygmaeus							+	+		+	L	U	
Cyperus rigidellus						+	+	+			L	U	
Cyperus squarrosus			+					+		+	L	U	
Cyperus victoriensis								+			H	U	Channel nut grass
Eleocharis pallens	+		+		+			+		+	L	U	Pale spike-rush
Fimbristylis dichotoma	+		+	+	+	+		+	+	+	M	U	
Schoenus subaphyllus	+	+						+			L	U	
Scirpus diesachanthus										+	L	U	
Scirpus laevis								+			L	U	
Scleria sphacelata					+						L	U	
DICRASTYLIDACEAE													
Newcastelia cephalantha var. *cephalantha*	+										H	U	
Newcastelia cephalantha var. *oblonga*	+										H	U	
Spartothamnella juncea			+	+							H	U	
DYSPHANIACEAE													
Dysphania myriocephala			+	+	+	+		+			M	T	Nettle-leaf goosefoot or red crumbweed
EHRETIACEAE													
Ehretia membranifolia								+			H	C	Peach bush
Halgania cyanea	+										L	U	
ELATINACEAE													
Bergia ammanioides										+	L	U	
EUPHORBIACEAE													
Euphorbia boophthona				+	+		+			+	M	T	Gascoyne spurge
Euphorbia coghlanii		+	+								M	S	Sandhill caustic
Euphorbia drummondii	+	+	+	+	+	+	+	+	+	+	M	T	Caustic weed
Euphorbia tannensis ssp. *eremophila* var. *eremophila*	+	+	+				+				M	U	Desert spurge
Euphorbia parvicarunculata										+	M	U	
Euphorbia sarcostemmoides					+						L	U	
Euphorbia stevenii		+				+	+		+	+	M	S	Bottle-tree caustic
Euphorbia wheeleri	+		+					+			M	U	
Phyllanthus fuernrohrii	+										L	T	
Phyllanthus maderaspatensis			+				+	+	+		M	U	
Phyllanthus rhytidospermus	+										L	U	
Phyllanthus rigens					+						L	U	
Poranthera microphylla		+		+		+		+			M	C	
FLINDERSIACEAE													
Flindersia maculosa				+	+	+	+	+		+	H	U	Leopardwood
FRANKENIACEAE													
Frankenia pauciflora										+	L	U	
Frankenia serpyllifolia							+			+	L	U	
Frankenia uncinata									+	+	L	U	
GENTIANACEAE													
Centaurium spicatum								+	+	+	L	S	Native Centaury
GERANIACEAE													
Erodium aureum							+				M	U	
Erodium crinitum	+	+		+							H	U	Blue crowfoot
Erodium cygnorum ssp. *glandulosum*	+										M	U	

FAMILY/SPECIES	LAND ZONES										ACCEPTABILITY	TOXICITY	COMMON NAME
	1	2	3	4	5	6	7	8	9	10			
GOODENIACEAE													
Goodenia cycloptera	+										L/M	U	
Goodenia glabra			+	+							L/M	U	
Goodenia lunata			+	+							M	U	
Goodenia mitchellii	+										L	U	
Goodenia strangfordii						+	+				L	U	
Goodenia subintegra			+	+			+	+			M	U	Silky goodenia
Leschenaultia divaricata	+										L	U	
Scaevola aemula	+										L	U	
Scaevola depauperata	+										L	U	
Scaevola ovalifolia	+										L	U	
Scaevola spinescens				+	+	+					L	U	
Velleia connata						+							
Velleia glabrata		+	+	+	+	+	+	+		+	H	U	Pee-the-bed
GRAMINEAE													
Amphipogon carcinus var. *sericeus*		+	+								L	U	Grey-beard
Aristida anthoxanthoides	+		+			+	+	+	+	+	M	U	Yellow threeawn
Aristida armata	+	+	+	+							L	U	Number 8 wire grass
Aristida benthamii		+	+	+							L	U	Wire grass
Aristida browniana	+	+	+								M	U	Erect Kerosene grass
Aristida calycina			+				+				M/L	U	Number 8 wire grass
Aristida contorta	+	+	+	+	+			+		+	M	U	Kerosene grass
Aristida helicophylla	+		+								L	U	
Aristida inaequiglumis		+	+	+							L	U	
Aristida ingrata	+	+	+	+							M	U	
Aristida jerichoensis		+	+	+	+			+			M	U	Jericho threeawn
Aristida jerichoensis var. *subspinulifera*			+	+							M	U	
Aristida latifolia						+	+				L	U	White spear grass or feathertop
Aristida leptopoda							+				M/H	U	White spear grass Wire grass
Aristida muricata							+				L	U	
Aristida obscura							+			+	L	U	
Astrebla elymoides						+	+	+	+	+	H	U	Hoop Mitchell grass
Astrebla lappacea						+	+	+			H	U	Curly Mitchell grass
Astrebla pectinata						+	+	+	+	+	H	U	Barley Mitchell grass
Astrebla squarrosa							+	+			H	U	Bull Mitchell grass
Austrochloris dichanthoides			+				+				M	U	
Bothriochloa bladhii								+			h	U	Forest Blue grass
Bothriochloa ewartiana			+			+	+				H	L	Desert Blue grass
Brachiaria gilesii			+	+		+					H	U	Hairy-edged armgrass
Brachiaria miliiformis	+		+					+		+	H	U	Green summer grass or armgrass millet
Brachiaria piligera			+								H	U	Hairy armgrass
Brachiaria windersii			+								H	U	
Brachyachne convergens			+			+	+	+		+	H	T	Native couch grass or spider grass
Cenchrus ciliaris	+	+				+	+	+			H	U	Buffel grass
Chloris divaricata			+			+	+				M	U	Slender chloris
Chloris pectinata	+	+	+	+		+	+	+	+	+	M	U	Comb chloris
Chloris scariosa						+		+		+	L	U	Large-flower chloris or winged chloris
Chloris virgata							+	+			L	U	Feather top Rhodes grass
Chrysopogon fallax	+		+	+				+			H	U	Golden-beard grass
Cymbopogon obtectus		+	+	+				+			M	U	Silky-heads
Cymbopogon refractus								+			L	U	Barb-wire grass
Cynodon dactylon			+					+		+	H	U	Couch
Lactyloctenium radulans	+	+	+	+		+	+	+	+	+	H	T	Button grass
Dichanthium affine			+			+	+	+			H	U	Dwarf bluegrass
Dichanthium sericeum			+	+		+	+	+		+	H	U	Queensland bluegrass
Digitaria ammophila			+	+	+	+	+			+	H	U	Silky umbrella grass
Digitaria brownii	+	+	+	+	+			+			H	U	Cotton panic grass or silver spike grass
Digitaria ciliaris		+									M	U	
Digitaria coenicola	+							+			H	U	Finger panic grass
Digitaria divaricatissima		+	+				+				H	U	Blow-away grass
Digitaria hystrichoides		+									M	U	
Eriachne mueller			+				+	+		+	M	U	Water grass
Echinochloa colona			+			+		+		+	H	C	Awnless barnyard grass
Echinochloa turneriana								+	+	+	H	L	Channel millet
Elytrophorus spicatus									+	+	L	U	Spike grass
Enneapogon avenaceus	+	+				+	+			+	H	U	Ridge grass
Enneapogon lindleyanus						+	+				M	U	A bottle washer grass
Enneapogon pallidus						+		+			M	U	A bottle washer grass
Enneapogon polyphyllus	+	+	+	+	+	+	+	+		+	M	L	A bottle washer grass
Enteropogon acicularis	+	+	+		+	+	+	+			H	U	Curly windmill grass
Eragrostis australasica									+	+	L	U	Swamp cane grass
Eragrostis brownii	+							+			M	L	
Eragrostis ciliaris			+					+			M	U	Stink grass
Eragrostis cumingii	+										M	L	
Eragrostis dielsii	+		+	+		+		+	+	+	H	L	Mallee lovegrass

FAMILY/SPECIES	LAND ZONES										ACCEPTABILITY	TOXICITY	COMMON NAME
	1	2	3	4	5	6	7	8	9	10			
GRAMINEAE Contd													
Eragrostis elongata			+				+	+			M	U	Clustered lovegrass
Eragrostis eriopoda	+	+	+	+	+						M	U	Woollybutt grass
Eragrostis kennedyae	+		+	+							M	U	Small-flowered lovegrass
Eragrostis lacunaria				+							M	U	Purple lovegrass
Eragrostis laniflora		+	+								M	U	
Eragrostis leptocarpa			+		+			+	+	+	M	U	Drooping lovegrass
Eragrostis parviflora			+	+			+	+			M	U	Weeping lovegrass
Eragrostis pergracilis			+		+	+					M	U	
Eragrostis setifolia	+		+				+	+	+	+	M	U	Neverfail grass
Eragrostis speciosa										+	M	U	
Eragrostis tenellula	+		+	+		+	+	+	+		M	U	Delicate lovegrass
Eragrostis xerophila							+	+			H	U	Knotty-butt neverfail grass
Eriachne aristidea	+	+									M	U	Three awned Wanderrie
Eriachne armitii	+	+									L	U	
Eriachne helmsii	+	+	+	+							L	U	Woollybutt Wanderrie
Eriachne mucronata	+	+	+	+	+						L on ridges H on sand plains	U	Rock grass
Eriachne pulchella		+		+	+						L	U	Pretty Wanderrie
Eriochloa pseudoacrotricha			+			+	+	+		+	H	U	Early spring grass
Eulalia fulva			+				+	+		+	H	U	Silky browntop
Heteropogon contortus							+				L	U	Bunch spear grass or Black spear grass
Iseilema membranaceum	+		+	+		+	+	+	+	+	H	U	Small Flinders grass
Iseilema vaginiflorum							+		+	+	H	U	Red Flinders grass
Leptochloa digitata								+			M	U	Umbrella cane grass
Leptochloa peacockii			+								L	U	
Monachather paradoxa	+	+	+	+	+			+			H	U	Mulga oats or bandicoot grass
Neurachne munroi		+	+	+							M	U	
Panicum decompositum	+	+	+	+		+	+		+	+	M	S	Native or wild millet
Panicum effusum			+				+	+		+	M	U	
Panicum whitei	+					+	+	+	+	+	M	U	Pepper grass
Paraneurachne muelleri	+				+						H	U	
Paspalidium caespositum					+	+					M	U	
Paspalidium clementii		+	+		+						M	U	Belah grass
Paspalidium constrictum						+	+				M	U	Belah grass
Paspalidium gracile					+						M/H	U	Slender panic
Paspalidium jubiflorum								+		+	H	U	Warrego summer grass
Paspalidium rarum		+	+	+	+						H	U	
Perotis rara	+	+	+				+	+			L	U	Comet grass
Plagiosetum refractum	+										H	U	Bristle-brush grass
Plectrachne pungens	+										L	U	
Setaria surgens							+				M	U	
Sporobolus actinocladus			+	+		+	+	+	+	+	H	U	Katoora
Sporobolus australasicus			+	+	+	+	+		+	+	H	U	
Sporobolus caroli			+			+	+	+		+	H	U	Fairy grass
Sporobolus elongatus						+					L	U	Slender rats-tail grass
Sporobolus mitchellii								+	+	+	L	U	Rats-tail couch
Sporobolus scabridus						+					H	U	
Themeda australis		+	+	+		+		+			H	U	Kangaroo grass
Themeda avenacea			+					+			H	U	Native oat grass
Thyridolepis mitchelliana		+		+	+						H	U	Mulga mitchell
Thyridolepis xerophila			+								H	U	Mulga mitchell
Tragus australianus	+	+	+	+		+	+	+		+	M	U	Small burr grass
Triodia basedowii	+										L	U	Spinifex
Triodia longiceps					+						L	U	Hard spinifex or porcupine grass
Triodia pungens					+						L	U	Hard spinifex
Tripogon loliiformis		+	+	+	+	+	+	+		+	H	U	Five-minute grass
Triraphis mollis	+	+					+				H	T	Purple plume grass
Uranthoecium truncatum						+	+		+	+	M	U	
Xerochloa laniflora	+									+	M	U	
Zygochloa paradoxa	+										L	U	Sand-hill cane grass

FAMILY/SPECIES	LAND ZONES										ACCEPTABILITY	TOXICITY	COMMON NAME
	1	2	3	4	5	6	7	8	9	10			
GYROSTEMONACEAE													
Codonocarpus cotinifolius	+	+	+	+							L	S	Desert poplar
Gyrostemon ramulosus	+										L	U	
HALORAGIDACEAE													
Haloragis aspera								+			L	U	
Haloragis heterophylla			+	+							L	U	Raspweed
Haloragis glauca forma glauca									+	+	L	U	
Haloragis glauca forma salopetifera								+	+	+	L	U	
Haloragis gossei	+										L	U	
Haloragis odontocarpa			+								H	U	Mulga nettle
JUNCACEAE													
Juncus aridicola								+			L	U	A reed
JUNCAGINACEAE													
Triglochin calcitrapa										+	L	U	
LABIATAE													
Basilicum polystachyon						+				+	L	U	
Mentha australis						+	+				L	S	Native mint
Ocimum sanctum						+	+	+			L	U	
Plectranthus parviflorus					+						L	U	
Prostanthera megacalyx					+						L	U	
Prostanthera suborbicularis					+						L	U	Mint bush
Salvia reflexa						+	+				M/L	T	Mint weed
Teucrium integrifolium						+	+				M	U	Peak Downs curse
Teucrium racemosum	+		+				+	+	+	+	L	S	Grey germander
Westringia rigida					+						L	U	
LEGUMINOSAE													
Acacia acradenia					+						L	U	
Acacia adsurgens	+				+						L	U	
Acacia aneura	+	+	+	+	+	+		+			H	U	Mulga
Acacia brachystachya					+						M	U	Turpentine
Acacia calcicola	+										L	U	
Acacia cambagei					+	+	+	+		+	L	U	Gidgee
Acacia cana						+	+	+			H	U	Boree
Acacia catenulata					+						L	U	Bendee
Acacia clivicola				+	+						L	U	Bastard mulga
Acacia coriacea	+	+									L	U	Desert Oak
Acacia cowleana	+										L	U	
Acacia cyperophylla					+		+			+	M	U	Minerritchie
Acacia dictyophleba	+										L	U	
Acacia ensifolia					+						L	U	
Acacia excelsa	+	+		+	+		+				M	U	Ironwood
Acacia farnesiana							+	+	+	+	H	U	Mimosa bush
Acacia harpophylla						+	+	+			L	C	Brigalow
Acacia kempeana					+						L	U	Wichetty bush
Acacia ligulata	+										L	U	
Acacia ligulata - broad leaf form					+						L	U	
Acacia maitlandii	+										L	U	
Acacia melleodora	+										L	U	
Acacia microsperma					+			+			M	U	Bowyakka
Acacia murrayana	+	+								+	L	U	Colony wattle
Acacia omalophylla								+		+	M	U	Yarran
Acacia pendula							+			+	H	U	Myall
Acacia petraea					+						L	C	Lancewood
Acacia ramulosa	+										M	U	Horse mulga
Acacia salicina								+		+	M	S/C	Doolan
Acacia shirleyi					+						L	U	Lancewood
Acacia sparsiflora					+						M/H	S	Currawong
Acacia stenophylla	+	+	+					+	+	+	M	U	Belalie
Acacia tenuissima					+						L	U	
Acacia tetragonophylla	+		+	+	+					+	H	U	Dead-finish
Acacia victoriae ssp. *arida*	+										H	U	Desert gunda-bluey
Acacia victoriae ssp. *victoriae*		+	+				+	+	+	+	H	U	Gunda-bluey
Aeschynomene indica								+	+	+	L/M	S	Budda pea
Albizia basaltica					+		+	+		+	H	U	Eastern dead-finish
Cassia artemisioides	+	+	+	+	+	+		+			L	U	Silver cassia
Cassia barclayana										+	L	S	Ant bush or pepperleaf senna
Cassia desolata	+		+	+		+		+			L	U	
Cassia helmsii			+	+	+					+	L	U	
Cassia remophila	+	+	+	+		+		+			L	U	Desert cassia or butter bush

FAMILY/SPECIES	LAND ZONES										ACCEPTABILITY	TOXICITY	COMMON NAME
	1	2	3	4	5	6	7	8	9	10			
LEGUMINOSAE Contd													
Cassia nemophila var. zygophylla	+							+			L	U	
Cassia notabilis	+										L	U	Beetle bush or fire bush
Cassia oligophylla	+		+	+	+	+	+				L	U	
Cassia phyllodinea			+	+		+	+	+		+	M	U	Silver cassia
Cassia pleurocarpa	+										L	U	Bean Bush or fire bush
Cassia pruinosa					+						L	U	
Cassia pumila							+	+			M	U	
Cassia sturtii			+				+				M	U	
Crotalaria cunninghamii	+										L	C	Parrot-pea
Crotalaria dissitiflora							+			+	M	S	Grey rattlepod
Crotalaria eremaea	+										H	T	Bluebush pea
Crotalaria linifolia							+	+			L	S	
Crotalaria mitchellii var. *tomentosa*							+				L	S	
Crotalaria trifoliastrum										+	L	T	
Desmodium campylocaulon							+				H	U	
Desmodium muelleri							+				H	U	
Desmodium varians							+			+	H	U	Slender tick trefoil
Erythrina vespertilio										+	M	S	Bat-wing coral tree
Glycine clandestina			+								M	U	Twining glycine
Glycine falcata							+				M	U	
Glycine tomentella	+									+	M	U	Woolly glycine
Indigofera brevidens								+			L	U	
Indigofera colutea	+										L	U	Sticky indigo
Indigofera linnaei	+	+	+				+	+			H	T	Birdsville indigo
Indigofera linifolia			+					+			M	S	Native indigo
Indigofera sp. aff. *I. leucotricha*					+						L	U	
Kennedia prorepens	+										M	U	
Lotus cruentus	+							+			H	S/C	Red-flower lotus
Lysiphyllum gilvum	+					+	+	+		+	H	U	Bauhinia
Muelleranthus stipularis	+										M	U	
Muelleranthus trifoliatus			+								M	U	
Neptunia dimorphantha			+	+			+		+	+	M	U	
Neptunia gracilis							+				M	U	Native sensitive plant
Petalostylis labicheoides		+	+	+	+						M/L	U	Butterfly bush
Prosopis limensis								+			L	U	
Psoralea cinerea				+			+	+	+	+	M/L	U	Annual verbane
Psoralea eriantha								+			M/L	U	Bullamon lucerne
Psoralea patens								+	+		M/L	U	
Psoralea tenax				-			+				M/L	U	Emu foot
Psoralea sp. aff. *P. eriantha*	+										M/L	U	
Rhynchosia minima						+	+				M	U	
Sesbania brachycarpa							+		+	+	L	U	
Sesbania campylocarpa							+			+	L	U	
Sesbania cannabina								+			L/M	U	Sesbania pea
Swainsona campylantha	+	+	+	+							M	S	
Swainsona morophylla ssp. *affinis*	+	+									M	S	
Swainsona oligophylla								+	+	+	M	S	
Swainsona oroboides	+							+	+	+	M	S	
Swainsona phacoides	+										M	U	
Tephrosia benthamii	+										L	S	
Tephrosia leptoclada								+			L	U	
Tephrosia sphaerospora	+										L	U	
Tephrosia supina	+										L	S	
Trigonella suavissima								+	+		H	U	Cooper clover
Vigna lanceolata var. *latifolia*									+	+	H	U	
LILIACEAE													
Bulbinopsis bulbosa			+					+		+	L/M	S	Native leek or Onion weed
Bulbinopsis sembarbata	+								+	+	L/M	S	Native leek or Onion weed
Dianella sp. aff. *D. laevis*		+								+	L	S	
Thysanothus tuberosus	+										L	U	Fringed violet
LORANTHACEAE													
Amyema miquelii								+			H	U	A mistletoe
Amyema quandang			+	+				+			H	U	A mistletoe
Lysiana linearifolia			+								H	U	A mistletoe
Lysiana subfalcata ssp. *subfalcata*							+	+			H	U	A mistletoe
LYTHRACEAE													
Ammannia multiflora								+		+	M	U	
MALVACEAE													
Abutilon calliphyllum						+	+				L	U	
Abutilon cryptopetalum							+			+	L	U	
Abutilon fraseri				+	+						L	U	A flannel-weed
Abutilon leucopetalum			+					+			L	U	Lantern bush
Abutilon malvifolium			+			+	+	+			M	U	
Abutilon otocarpum	+		+	+	+	+		+			M	U	Flannel-weed or desert Chinese lantern
Abutilon oxycarpum			+		+		+	+			L	U	
Abutilon oxycarpum var. *sub. sagittatum*						+					L	U	
Gossypium australe	+			+	+						L	S	
Hibiscus burtonii			+	+							M	U	
Hibiscus krichauffianus	+										M	U	
Hibiscus sturtii				+	+						M	U	
Hibiscus sturtii var.					+						M	U	
Hibiscus trionum			+			+	+	+		+	L	U	Bladder ketmia
Lavatera plebeia								+		+	M	U	Australian hollyhock
Lawrencia glomerata	+										L	U	
Malvastrum americanum			+			+	+	+		+	M	C	Malvastrum
Sida ammophila	+										L	U	
Sida aprica			+		+						L	U	
Sida corrugata							+				M	U	Corrugated sida
Sida cunninghamii		+	+	+	+						M	U	
Sida fibulifera							+				M	U	Silver sida
Sida filiformis		+	+	+	+	+		+			M	U	
Sida goniocarpa								+		+	L	U	
Sida platycalyx		+	+	+	+						L	U	Lifesaver burr
Sida rohlenae							+				L	U	
Sida spenceriana									+	+	L	U	
Sida trichopoda			+			+	+	+			H	U	High sida
Sida virgata						+	+				H	U	

FAMILY/SPECIES	LAND ZONES										ACCEPTABILITY	TOXICITY	COMMON NAME
	1	2	3	4	5	6	7	8	9	10			
MELIACEAE													
Owenia acidula	+			+	+	+		+			H	U	Emu apple
MENYANTHACEAE													
Nymphoides crenata								+			L	U	Wavy marshwort
MYOPORACEAE													
Eremophila bignoniiflora							+	+		+	H	S	Gooramurra
Eremophila bowmanii	+	+		+							L	U	Silver turkey bush
Eremophila cordatisepala	+				+						L	U	
Eremophila dalyana						+					L	U	
Eremophila duttonii	+			+						+	L	U	
Eremophila freelingii					+						L	T	Limestone fuchsia bush
Eremophila gilesii	+	+	+	+	+			+			L	U	Charleville turkey bush
Eremophila glabra						+		+		+	M	U	Black fuchsia
Eremophila goodwinii	+	+		+							L	U	
Eremophila latrobei	+	+		+	+						M	T	
Eremophila longifolia		+	+	+		+					H	T	Berrigan
Eremophila macgillivrayi					+					+	L	U	
Eremophila maculata	+		+	+		+	+	+		+	H	T	Fuchsia bush
Eremophila mitchellii			+	+	+	+	+	+			L	U	Sandalwood
Eremophila obovata	+										L	U	
Eremophila oppositifolia var. *rubra*					+	+					L	U	Mountain sandalwood
Eremophila polyclada						+	+	+		+	H	U	Lignum fuchsia
Eremophila sturtii	+			+		+		+			L	U	Budda bush
Myoporum acuminatum								+		+	H	T	Boobialla or water bush
Myoporum deserti	+					+	+	+			H	T	Illangowan poison bush
MYRTACEAE													
Calytrix longiflora	+										L	U	Fringe myrtle
Eucalyptus camaldulensis								+		+	L	U	River red gum
Eucalyptus cambageana								+			L	U	Dawson gum or blackbutt
Eucalyptus exserta					+						L	U	Bendo
Eucalyptus melanophloia				+			+				L	U	Silver-leaved ironbark
Eucalyptus microtheca	+		+					+	+	+	M	U	Coolibah
Eucalyptus normantonensis					+						L	U	
Eucalyptus ochrophloia								+	+		M	U	Yapunyah
Eucalyptus papuana	+		+	+	+						M	U	Desert gum
Eucalyptus polycarpa			+					+			L	U	Long fruited bloodwood
Eucalyptus populnea		+	+	+				+			L	U	Poplar box
Eucalyptus terminalis	+	+	+	+	+			+			L	U	Western bloodwood
Eucalyptus tessellaris								+			L	U	Moreton Bay ash or carbeen
Eucalyptus thozetiana					+	+		+			L	U	Mountain yapunyah
Melaleuca linariifolia								+			L	U	A paper-bark tea-tree
Thryptomene hexandra					+						L	U	
NYCTAGINACEAE													
Boerhavia diffusa	+	+	+	+	+	+	+	+	+	+	H	S	Tar-vine
NYMPHACEAE													
Nymphaea gigantea								+			L	U	
OLEACEAE													
Jasminum lineare								+			L	U	Jasmin vine
OXALIDACEAE													
Oxalis corniculata			+	+			+	+			M	T	Yellow wood sorrel
PAPAVERACEAE													
Argemone ochroleuca								+			L	T	Mexican poppy
PEDALIACEAE													
Josephinia eugeniae	+	+									L	U	Josephinia burr
PITTOSPORACEAE													
Pittosporum phillyraeoides	+		+	+		+				+	H/M	U	Meemeei or cattle bush
PLANTAGINACEAE													
Plantago pritzelii	+						+	+	+	+	H	U	A plantain
PLUMBAGINACEAE													
Plumbago zeylanica								+		+	M	U	
POTAMOGETONACEAE													
Potamogeton tricarinatus								+			L	U	Floating pondweed
POLYGONACEAE													
Muehlenbeckia cunninghamii	+							+	+	+	M/L	U	Lignum
Polygonum glabrum								+		+	L	S	A smart weed
Rumex crystallinus								+		+	L/M	S	A dock
PTERIDOPHYTA													
AZOLLACEAE													
Azolla pinnata										+	L	U	Ferny azolla
THELYPTERIDACEAE													
Cyclosorus interruptus					+						L	U	
SINOPTERIDACEAE													
Cheilanthes distans						+		+			M	S	Rock fern
Cheilanthes sieberi		+	+	+				+			M/H	T	Mulga or rock fern
MARSILEACEAE													
Marsilea drummondii								+	+	+	M	S	Nardoo
Marsilea hirsuta								+	+	+	M	S	Nardoo

FAMILY/SPECIES	LAND ZONES										ACCEPTABILITY	TOXICITY	COMMON NAME
	1	2	3	4	5	6	7	8	9	10			
PORTULACACEAE													
Calandrinia balonensis	+	+	+	+							H	T	Broad-leaf parakeelya
Calandrinia polyandra	+										H	T	Parakeelya
Calandrinia ptychosperma	+	+	+					+			M	C	
Calandrinia pumila	+		+								M	C	
Portulaca filifolia		+		+		+	+				M	C	A pigweed
Portulaca sp. aff. *P. oleracea*	+	+		+	+	+	+	+		+	H	T	Munyeroo
PROTEACEAE													
Grevillea juncifolia	+										L	U	Honeysuckle oak
Grevillea stenobotrya	+										M	U	
Grevillea striata	+	+	+	+				+			H	U	Beef wood
Hakea chordophylla	+	+									M/L	U	Bootlace oak
Hakea collina					+						L	U	Dwarf needlewood
Hakea divaricata	+				+						L	U	
Hakea leucoptera	+						+				M	U	Needlewood
RANUNCULACEAE													
Ranunculus pentandrus var. *pentandrus*								+		+	M	S	A buttercup
Ranunculus pentandrus var. *platycarpus*								+			M	S	A buttercup
Ranunculus rivularis								+		+	M	S	River buttercup
RHAMNACEAE													
Ventilago viminalis	+		+	+		+	+	+			H	T*	Vinetree or supplejack
RUBIACEAE													
Canthium oleifolium										+	H	U	Myrtle tree
Canthium latifolium				+	+						H	U	
Hedyotis caerulescens							+				L	U	
Hedyotis trachymenoides		+									L	U	
RUTACEAE													
Eremocitrus glauca							+	+			L/M	U	Lime fruit
Erostemon difformis					+						L	U	
Geijera parviflora					+	+	+	+		+	H	U	Wilga
Phebalium glandulosum					+						L	U	
SANTALACEAE													
Santalum lanceolatum	+		+			+	+	+			H	U	Plumwood
SAPINDACEAE													
Atalaya hemiglauca	+		+	+		+	+	+			H	T	Whitewood
Dodonaea adenophora				+	+						L	U	A hopbush
Dodonaea angustissima	+	+									L	U	A hopbush
Dodonaea coriacea	+										L	U	A hopbush
Dodonaea petiolaris				+	+						L	U	A hopbush
Heterodendrum oleifolium							+	+			H	T	Boonaree
SCROPHULARIACEAE													
Mimulus gracilis									+	+	L	U	
Mimulus prostratus	+							+	+		L	U	
Morgania floribunda	+							+	+	+	L	T	Morgan flower or blue rod
Morgania glabra							+	+		+	L	S	
Peplidium maritimum			+					+		+	L	U	
SOLANACEAE													
Datura ferox								+			L	S/C	Fierce thornapple
Datura leichhardtii								+		+	L	T	Native thornapple
Nicotiana exigua			+				+				M	T	A native tobacco
Nicotiana goodspeedii							+				L	S	A native tobacco
Nicotiana megalosiphon							+				L	S/C	A native tobacco
Nicotiana velutina	+										L	T	A native tobacco
Solanum chenopodinum	+							+			L	S	
Solanum ellipticum	+	+	+	+	+	+	+	+			L	T	Potato-bush
Solanum esuriale	+	+	+	+	+	+	+	+	+	+	H	S	Quena
Solanum ferocissimum			+					+			L	S	Narrow leaved gin's whiskers
SOLANACEAE Contd													
Solanum nigrum			+					+			M	T	Black-berry nightshade
Solanum oligacanthum								+		+	L	U	
Solanum quadriloculatum				+	+	+		+			M	S	Wild tomato
STACKHOUSIACEAE													
Macgregoria racemigera	+	+	+								L	U	Carpet-of-snow
STERCULIACEAE													
Brachychiton australe			+				+				H	U	Broad-leaf bottle tree
Brachychiton populneum			+				+				M/L	U	Kurrajong
Keraudrenia collina	+				+						L	U	
Keraudrenia integrifolia	+		+	+	+						L	U	
Melhania oblongifolia			+	+							L	U	
Melhania ovata						+					L	U	
Rulingia loxophylla	+										L	U	
Waltheria indica							+				L	U	
STYLIDACEAE													
Stylidium eglandulosum	+										L	U	
TETRAGONIACEAE													
Tetragonia tetragonioides	+					+		+	+		*H	T	New Zealand spinach
THYMELIACEAE													
Pimelea continua			+					+		+	L	T	
Pimelea microcephala								+			L	S	Flax weed
Pimelea trichostachya	+							+			L	T	Poverty bush or broom bush
Pimelea trichostachya form b.			+	+			+	+			L	T	
TILIACEAE													
Corchorus olitorius							+				L	S	Jute
Corchorus trilocularis						+	+			+	L	U	
TYPHACEAE (m)													
Typha domingensis						+	+	+		+	M	U	Bullrush

FAMILY/SPECIES	LAND ZONES										ACCEPTABILITY	TOXICITY	COMMON NAME
	1	2	3	4	5	6	7	8	9	10			
UMBELLIFERAE													
Apium leptophyllum							+				M	U	Slender celery
Daucus glochidiatus	+							+	+		H	U	Australian carrot
Eryngium plantagineum	+								+		H	U	Blue devil
Eryngium supinum	+								+	+	H	U	Blue devil
Trachymene cyanantha		+	+		+						H/M	T	A native parsnip
Trachymene glaucifolia	+										H/M	T	Blue parsnip
Trachymene ochracea		+	+					+			H/M	T	Wild parsnip
Trachymene sp. nov.					+						M	U	
VERBENACEAE													
Clerodendrum floribundum	+			+	+						M	S	Lollybush
Verbena officinalis							+	+			L	C	Common verbena
VIOLACEAE													
Hybanthus aurantiacus			+	+							L	S	
Hybanthus monopetalus	+										L	U	Lady's slipper
XANTHORRHOEACEAE													
Lomandra leucocephala	+										M	U	A mat rush
Lomandra longifolia								+			M	S	Long-leaved mat rush
ZYGOPHYLLACEAE													
Tribulus astrocarpus										+	M	U	
Tribulus hystrix	+										M	U	
Tribulus occidentalis	+										L	U	Perennial caltrop
Tribulus terrestris	+		+	+	+	+	+	+	+		H	T	Caltrop
Zygophyllum ammophilum						+	+	+		+	L	T	Sand twin-leaf
Zygophyllum apiculatum				+			+				L	S	Gall-weed
Zygophyllum aurantiacum				+	+						L	U	
Zygophyllum billardieri										+	L	U	
Zygophyllum howittii	+										L	U	

B. Common names - scientific names for the more common species

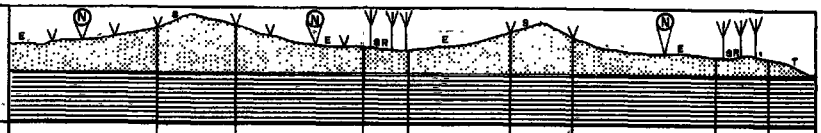
Common Name	Scientific Name	Common Name	Scientific Name
Armgrass, hairy	*Brachiaria piligera*	Cucumber, wild	*Cucumis trigonus*
Armgrass, hairy-edged	*Brachiaria gilesii*	Cudweed	*Gnaphalium involucratum*
Azolla, ferny	*Azolla pinnata*	Currawong	*Acacia sparsiflora*
Bandicoot grass	*Monachather paradoxa*	Current bush	*Carissa lanceolata*
Barb-wire grass	*Cymbopogon refractus*	Daisy, minnie	*Minuria leptophylla*
Barnyard grass, awnless	*Echinochloa colona*	Daisy, paper	*Helipterum floribundum*
Bauhinia	*Lysiphyllum gilvum*	Daisy, small white paper	*Helipterum corymbiflorum*
Bean bush	*Cassia pleurocarpa*	Dead-fanish	*Acacia tetragonophylla*
Beefwood	*Grevillea striata*	Dead-finish, eastern	*Albizia basaltica*
Beetle bush	*Cassia notabilis*	Dock	*Rumex crystallinus*
Belah	*Casuarina cristata*	Dodder	*Cuscuta australis*
Belah grass	*Paspalidium clementii*	Doolan	*Acacia salicina*
Belah grass	*Paspalidium constrictum*	Ellangowan poison bush	*Myoporum deserti*
Belalie	*Acacia stenophylla*	Emu apple	*Owenia acidula*
Bell-vine	*Ipomoea racemigera*	Emu foot	*Psoralea tenax*
Bendee	*Acacia catenulata*	Everlasting, yellow	*Helichrysum bracteatum*
Bendo	*Eucalyptus exserta*	Fairy grass	*Sporobolus caroli*
Berrigan	*Eremophila longifolia*	Fern, mulga	*Cheilanthes sieberi*
Billy buttons, golden	*Craspedia chrysantha*	Fern, rock	*Cheilanthes sieberi*
Billy buttons, soft	*Craspedia pleiocephala*	Fern, rock	*Cheilanthes distans*
Bindweed, Australian	*Convolvulus erubescens*	Fire bush	*Cassia notabilis*
Bitter bark	*Alstonia constricta*	Fish-weed	*Chenopodium trigonon*
Blackbutt	*Eucalyptus cambageana*	Five-minute grass	*Tripogon loliiformis*
Bloodwood, long-fruited	*Eucalyptus polycarpa*	Flannel weed	*Abutilon fraseri*
Bloodwood, western	*Eucalyptus terminalis*	Flannel weed	*Abutilon otocarpum*
Blow-away grass	*Digitaria divaricatissima*	Flannel weed	*Abutilon oxycarpum*
Bluebell, native	*Wahlenbergia gracilis*	Flax weed	*Pimelea microcephala*
Bluebell, native	*Wahlenbergia granitiocola*	Flinders grass, red	*Iseilema vaginiflorum*
Bluebell, native	*Wahlenbergia queenslandica*	Flinders grass, small	*Iseilema membranaceum*
Bluebell, native	*Wahlenbergia tumidifructa*	Forget-me-not, Australian	*Cynoglossum australe* var. *drummondii*
Bluebush, Queensland	*Chenopodium auricomum*	Fuchsia, black	*Eremophila glabra*
Bluebush pea	*Crotalaria eremaea*	Fuchsia bush	*Eremophila maculata*
Blue devil	*Eryngium plantagineum*	Fuchsia, lignum	*Eremophila polyclada*
Blue devil	*Eryngium supinum*	Fuchsia, limestone	*Eremophila freelingii*
Blue grass, desert	*Bothriochloa ewartiana*	Gall-weed	*Zygophyllum apiculatum*
Blue grass, dwarf	*Dichanthium affine*	Gargaloo	*Parsonsia eucalyptophylla*
Blue grass, forest	*Bothriochloa bladhii*	Germander, grey	*Teucrium racemosum*
Blue grass, Queensland	*Dichanthium sericeum*	Gidgee	*Acacia cambagei*
Bogan-flea	*Calotis hispidula*	Gin's whiskers, narrow-leaved	*Solanum ferocissimum*
Boggabri	*Amaranthus mitchellii*	Glycine, twining	*Glycine clandestina*
Boobialla	*Myoporum acuminatum*	Glycine, woolly	*Glycine tomentella*
Boonaree	*Heterodendrum oleifolium*	Golden-beard grass	*Chrysopogon fallax*
Boree	*Acacia cana*	Gomphrena weed	*Gomphrena celosioides*
Bottle-tree, broad leaf	*Brachychiton australe*	Goodenia, silky	*Goodenia subintegra*
Bottle-washer grass	*Enneapogon lindleyanus*	Gooramurra	*Eremophila bignoniiflora*
Bottle-washer grass	*Enneapogon pallidus*	Goosefoot, crested	*Chenopodium cristatum*
Bottle-washer grass	*Enneapogon polyphyllus*	Goosefoot, nettle-leaf	*Dysphania myriocephala*
Bowyakka	*Acacia microsperma*	Grey-beard grass	*Amphipogon caricinus* var. *setiosus*
Box, poplar	*Eucalyptus populnea*	Gum, Dawson	*Eucalyptus cambageana*
Brigalow	*Acacia harpophylla*	Gum, desert	*Eucalyptus papuana*
Bristle-brush grass	*Plagiosetum refractum*	Gum, river red	*Eucalyptus camaldulensis*
Broom bush	*Apophyllum anomalum*	Gunda-bluey	*Acacia victoriae*
Broom bush	*Pimelea trichostachya*	Hogweed	*Zaleya galericulata*
Browntop, silky	*Eulalia fulva*	Hollyhock, Australian	*Lavatera plebeia*
Budda bush	*Eremophila sturtii*	Hopbush	*Dodonaea adenophora*
Budda pea	*Aeschynomene indica*	Hopbush	*Dodonaea angustissima*
Buffel grass	*Cenchrus ciliaris*	Hopbush	*Dodonaea boroiaosa*
Bullrush	*Typha domingensis*	Hopbush	*Dodonaea petiolaris*
Bumble	*Capparis mitchellii*	Indigo, Birdsville	*Indigofera linnaei*
Bumble, narrow leaf	*Capparis loranthifolia*	Indigo, native	*Indigofera linifolia*
Burr, Bathurst	*Xanthium spinosum*	Indigo, sticky	*Indigofera colutea*
Burr, brigalow	*Bassia tetracuspis*	Ironbark, silver-leaved	*Eucalyptus melanophloia*
Burr, cartwheel	*Bassia cornishiana*	Ironwood	*Acacia excelsa*
Burr, copper	*Bassia convexula*	Isotome, rock	*Isotoma petraea*
Burr, copper	*Bassia divaricata*	Ixiolaena, stalked	*Ixiolaena leptolepis*
Burr, dog	*Bassia tetracuspis*	Ixiolaena, woolly	*Ixiolaena tomentosa*
Burr, galvanized	*Bassia birchii*	Jasmin vine	*Jasminum linearo*
Burr, goathead	*Bassia bicornis*	Joyweed, common	*Alternanthera nodiflora*
Burr, goathead	*Bassia bicornis* var. *horrida*	Joyweed, lesser	*Alternanthera denticulata*
Burr, Josephinia	*Josephinia eugeniae*	Jute	*Corchorus olitorius*
Burr, lifesaver	*Sida platycalyx*	Kangaroo grass	*Themeda australis*
Burr, noogoora	*Xanthium pungens*	Katoora	*Sporobolus actinocladus*
Burr, red	*Bassia calcarata*	Kerosene grass	*Aristida contorta*
Burr, woolly spined	*Bassia lanicuspis*	Kerosene grass, erect	*Aristida browniana*
Burr, yellow	*Bassia aricacanthoides*	Ketmia, bladder	*Hibiscus trionum*
Burr, yellow daisy	*Calotis lappulacea*	Khaki-weed	*Alternanthera pungens*
Burr grass, small	*Tragus australianus*	Kurrajong	*Brachychiton populneum*
Butter bush	*Cassia nemophila*	Lady's slipper	*Hybanthus monopetalus*
Buttercup	*Ranunculus pentandrus* var. *glabrescens*	Lancewood	*Acacia petrasa*
		Lancewood	*Acacia shirleyi*
Buttercup, river	*Ranunculus rivularis*	Lantern bush	*Abutilon leucopetalum*
Butterfly bush	*Petalostylis labicheoides*	Leek, native	*Bulbinopsis bulbosa*
Button grass	*Dactyloctenium radulans*	Leek, native	*Bulbinopsis barbata*
Buttons, yellow	*Helichrysum ramosissimum*	Leopardwood	*Flindersia maculosa*

Caltrop	*Tribulus terrestris*	Lignum	*Muehlenbeckia cunninghamii*
Caltrop, perennial	*Tribulus occidentalis*	Lily, spider	*Crinum angustifolium*
Camel bush	*Trichodesma zeylanicum*	Lily, Wilcannia	*Calostemma luteum*
Canegrass, sandhill	*Zygochloa paradoxa*	Lime bush	*Eremocitrus glauca*
Canegrass, swamp	*Eragrostis australasica*	Lollybush	*Clerodendrum floribundum*
Canegrass, umbrella	*Leptochloa digitata*	Lotus, red-flower	*Lotus cruentus*
Carbeen or Moreton Bay ash	*Eucalyptus tessellaris*	Lovegrass, clustered	*Eragrostis elongata*
Carpet-of-snow	*Asagregoria racemigera*	Lovegrass, delicate	*Eragrostis tenellula*
Carrot, Australian	*Daucus glochidiatus*	Lovegrass, drooping	*Eragrostis leptocarpa*
Cassia, desert	*Cassia nemophila*	Lovegrass, mallee	*Eragrostis dieleii*
Cassia, silver	*Cassia artemisioides*	Lovegrass, purple	*Eragrostis laevaria*
Cassia, silver	*Cassia phyllodinea*	Lovegrass, small-flowered	*Eragrostis kennedyea*
Cattle bush	*Pittosporum phillyraeoides*	Lovegrass, weeping	*Eragrostis parviflora*
Caustic-creeper	*Euphorbia drummondi*	Lucerne, Bullamon	*Psoralea eriantha*
Caustic, bottle tree	*Euphorbia stevenii*	Malvastrum	*Malvastrum americanum*
Caustic, sandhill	*Euphorbia coghlanii*	Marshwort, wavy	*Nymphoides crenata*
Caustic-vine	*Sarcostemma australe*	Meemeei	*Pittosporum phillyraeoides*
Celery, slender	*Apium leptophyllum*	Melon, wild water	*Citrullus lanatus*
Centuary, native	*Centaurium spicatum*	Millet, armgrass	*Brachiaria miliiformis*
Chinese lantern, desert	*Abutilon otocarpum*	Millet, channel	*Echinochloa turnerana*
Chloris, comb	*Chloris pectinata*	Millet, wild	*Panicum decompositum*
Chloris, large flower	*Chloris scariosa*	Mimosa bush	*Acacia farnesiana*
Chloris, slender	*Chloris divaricata*	Manerichie	*Acacia cyperophylla*
Chloris, winged	*Chloris scariosa*	Mint, native	*Mentha australis*
Clover, Cooper	*Trigonella suavissima*	Mint bush	*Prostanthera eburbicularis*
Cobbler's peg, native	*Glossogyne tenuifolia*	Mint weed	*Salvia reflexa*
Colocynth	*Citrullus colocynthis*	Minuria, smooth	*Minuria integerrima*
Comet grass	*Perotis rara*	Minuria, woolly	*Minuria denticulata*
Conker berry	*Carissa lanceolata*	Mistletoe	*Amyema quandang*
Convolvulus	*Ipomoea muelleri*	Mistletoe	*Lysiana linearifolia*
Coolibah	*Eucalyptus microtheca*	Mitchell grass, barley	*Astrebla pectinata*
Coral tree, batwing	*Erythrina vespertilio*	Mitchell grass, bull	*Astrebla squarrosa*
Cornflower, native	*Brunonia australis*	Mitchell grass, curly	*Astrebla lappacea*
Couch	*Cynodon dactylon*	Mitchell grass, hoop	*Astrebla elymoides*
Couch, rats tail	*Sporobolus mitchellii*	Morgan flower	*Morgania floribunda*
Couch grass, native	*Brachyachne convergens*	Morning glory	*Ipomoea muelleri*
Cow vine	*Ipomoea lonchophylla*	Mulga	*Acacia aneura*
Crowfoot, blue	*Erodium cruinum*	Mulga, bastard	*Acacia olivicola*
Crumbweed, black	*Chenopodium melanocarpum*	Mulga, horse	*Acacia ramulosa*
Crumbweed, green	*Chenopodium rhadinostachyum*	Mulga grass, dwarf	*Neurachne munroi*
Crumbweed, red	*Dysphania myriocephala*	Mulga Mitchell	*Thyridolepis mitchelliana*

Common Name	Scientific Name	Common Name	Scientific Name
Mulga Mitchell	*Thyridolepis xerophila*	Saltbush, ruby	*Enchylaena tomentosa*
Munyeroo	*Portulaca* sp.aff. *P. oleracea*	Saltbush, short-winged	*Bassia brachyptera*
Myall	*Acacia pendula*	Samphire	*Arthrocnemum halocnemoides* var. *pergranulatum*
Myrtle, fringe	*Calytrix longiflora*		
Myrtle tree	*Canthium oleifolium*	Samphire	*Arthrocnemum leiostachyum*
Nardoo	*Marsilea drummondii*	Samphire	*Pachycornia tenuis*
Nardoo	*Marsilea hirsuta*	Sandalwood	*Eremophila mitchellii*
Needlewood	*Hakea leucoptera*	Sandalwood, mountain	*Eremophila oppositifolia* var.*rubra*
Needlewood, dwarf	*Hakea collina*	Scurvy-weed	*Commelina cyanea*
Nettle, mulga	*Haloragis odontocarpa*	Senna, pepper-leaf	*Cassia barclayana*
Neverfail grass	*Eragrostis setifolia*	Sensitive plant, native	*Neptunia gracilis*
Neverfail grass, knotty-butt	*Eragrostis xerophila*	Sesbania pea	*Sesbania cannabina*
Nightshade, black-berry	*Solanum nigrum*	Sida, corrugated	*Sida corrugata*
Nipan	*Capparis lasiantha*	Sida, high	*Sida trichopoda*
Nut-grass, channel	*Cyperus victoriensis*	Sida, silver	*Sida fibulifera*
Nut-grass, downs	*Cyperus bifax*	Silky-heads	*Cymbopogon obtectus*
Oak, bootlace	*Hakea chordophylla*	Smart weed	*Polygonum glabrum*
Oak, desert	*Acacia coriacea*	Sneezeweed, desert	*Centipeda thespidioides*
Oak, honeysuckle	*Grevillea juncifolia*	Sneezeweed, spreading	*Centipeda minima*
Oats, mulga	*Monachather paradoxa*	Soda-bush	*Threlkeldia proceriflora*
Oat grass, native	*Themeda avenacea*	Sowthistle	*Sonchus oleraceus*
Onion weed	*Bulbinopsis bulbosa*	Spear grass, black	*Heteropogon contortus*
Onion weed	*Bulbinopsis semibarbata*	Spear grass, bunch	*Heteropogon contortus*
Paddy melon	*Cucumis trigonus*	Spear grass, white	*Aristida latifolia*
Paddy melon, prickly	*Cucumis myriocarpus*	Spear grass, white	*Aristida leptopoda*
Panic grass, cotton	*Digitaria brownii*	Speedy weed	*Flaveria australasica*
Panic grass, slender	*Paspalidium gracile*	Spider grass	*Brachyachne convergens*
Parakeelya	*Calandrinia polyandra*	Spinach, New Zealand	*Tetragonia tetragonioides*
Parakeelya, broad-leaf	*Calandrinia balonensis*	Spinach, red	*Trianthema triquetra*
Parrot-pea	*Crotalaria cunninghamii*	Spike grass	*Elytrophorus spicatus*
Parsnip, blue	*Trachymene glaucifolia*	Spike grass, silver	*Digitaria brownii*
Parsnip, native	*Trachymene cyanantha*	Spike-rush, pale	*Eleocharis pallens*
Parsnip, wild	*Trachymene ochracea*	Spinifex	*Triodia basedowii*
Peach bush	*Ehretia membranifolia*	Spinifex, hard	*Triodia longiceps*
Peak Downs curse	*Teucrium integrifolium*	Spinifex, hard	*Triodia pungens*
Pee-the-bed	*Velleia glabrata*	Split jack	*Capparis lasiantha*
Peppercress	*Lepidium oxytrichum*	Spring grass, early	*Eriochloa pseudoacrotricha*
Peppercress	*Lepidium rotundum*	Spurge, desert	*Euphorbia tannensis* ssp. *eremophila* var.*eremophila*
Peppercress	*Lepidium strongylophyllum*		
Pepper grass	*Panicum whitei*	Spurge, Gascoyne	*Euphorbia boophthona*
Pie melon	*Citrullus lanatus*	Star fruit	*Damasonium minus*
Pigweed	*Portulaca filifolia*	Summer grass, Warrego	*Paspalidium jubiflorum*
Pigweed, black	*Trianthema portulacastrum*	Summer grass, green	*Brachiaria miliiformis*
Pigweed, giant	*Trianthema portulacastrum*	Sunray, musk	*Helipterum moschatum*
Plantain	*Plantago pritzelii*	Supplejack	*Ventilago viminalis*
Plume grass, purple	*Tripraphis mollis*	Tar-vine	*Boerhavia diffusa*
Plumwood	*Santalum lanceolatum*	Tea-tree, paper bark	*Melaleuca linariifolia*
Poached-egg plant	*Myriocephalus stuartii*	Thornapple, fierce	*Datura ferox*
Poplar, desert	*Codonocarpus cotinifolius*	Thornapple, native	*Datura leichhardtii*
Poppy, Mexican	*Argemone ochroleuca*	Threeawn, Jericho	*Aristida jerichoensis*
Porcupine grass	*Triodia longiceps*	Threeawn, yellow	*Aristida anthoxanthoides*
Potato bush	*Solanum ellipticum*	Tick-weed	*Cleome viscosa*
Poverty bush	*Pimelea trichostachya*	Toadflax, round-leaf	*Mairecna aphylla*
Prickly pear	*Opuntia inermis*	Tobacco, native	*Nicotiana exigua*
Prince-of-Wales	*Ptilotus exaltatus*	Tobacco, native	*Nicotiana goodspeedii*
Pussy tails	*Ptilotus macrocephalus*	Tobacco, native	*Nicotiana megalosiphon*
Pussy tails	*Ptilotus polystachyus*	Tobacco, native	*Nicotiana velutina*
Quena	*Solanum esuriale*	Tomato, wild	*Solanum quadriloculatum*
Ragweed	*Pterocaulon sphacelatum*	Trefoil, slender tick	*Desmodium varians*
Raspweed	*Haloragis heterophylla*	Turkey bush	*Olearia subspicata*
Rats-tail grass, slender	*Sporobolus elongatus*	Turkey bush, Charleville	*Eremophila gilesii*
Rattlepod, grey	*Crotalaria dissitiflora*	Turkey bush, silver	*Eremophila bowmanii*
Reed	*Juncus aridicola*	Turpentine	*Acacia brachystachya*
Rhodes grass, feathertop	*Chloris virgata*	Twin-leaf, sand	*Zygophyllum ammophila*
Ridge grass	*Enneapogon avenaceus*	Umbrella grass, silky	*Digitaria ammophila*
Rock grass	*Eriachne mucronata*	Verbena, common	*Verbena officinalis*
Rod, blue	*Morgania floribunda*	Verbine, annual	*Psoralea cinerea*
Roly-poly, black	*Bassia quinquecuspis*	Violet, fringed	*Thysanotus tuberosus*
Roly-poly, prickly	*Bassia quinquecuspis*	Wandering jew	*Commelina cyanea*
Roly-poly, soft	*Salsola kali*	Wanderrie, pretty	*Eriachne pulchella*
Roly-poly, three-spined	*Bassia triancpis*	Wanderrie, threeawned	*Eriachne aristidea*
Rose, Flinders	*Capparis spinosa* var. *nummularia*	Wanderrie, woollybutt	*Eriachne helmsii*
Rush, mat	*Lomandra leucocephala*	Water bush	*Myoporum acuminatum*
Rush, long-leaved mat	*Lomandra longifolia*	Water grass	*Diplachne muelleri*
Saltbush	*Atriplex crassipes*	Wattle, colony	*Acacia murrayana*
Saltbush	*Atriplex eardleyae*	Whitewood	*Atalaya hemiglauca*
Saltbush	*Atriplex elachophylla*	Wilga	*Geijera parviflora*
Saltbush	*Atriplex fissivalvis*	Windmill grass, curly	*Enteropogon acicularis*
Saltbush	*Atriplex holocarpa*	Wire grass	*Aristida benthamii*
Saltbush	*Atriplex limbata*	Wire grass, feathertop	*Aristida latifolia*
Saltbush	*Atriplex lindleyi*	Wire grass, number 8	*Aristida armata*
Saltbush, annual	*Atriplex muelleri*	Wire grass, number 8	*Aristida calycina*
Saltbush, berry	*Rhagodia spinescens*	Wongo vine	*Pandorea doratoxylon*
Saltbush, bladder	*Atriplex vesicaria*	Woodbine	*Carissa ovata*
Saltbush, climbing	*Rhagodia nutans*	Wood sorrel, yellow	*Oxalis corniculata*
Saltbush, creeping	*Atriplex semibaccata*	Woollybutt grass	*Eragrostis eriopoda*
Saltbush, mallee	*Atriplex stipitata*	Yapunyah	*Eucalyptus ochrophloia*
Saltbush, oldman	*Atriplex nummularia*	Yapunyah, mountain	*Eucalyptus thozetiana*
Saltbush, pop	*Atriplex spongiosa*	Yarran	*Acacia omalophylla*
		Yellowtop, annual	*Senecio gregorii*

by J.R. Mills and D.E. Boyland

D1 Mayfield (1010 km²)



Land Unit and/or Associated Land System	5	1	5	10	5	1	5	10	Alluvial Land Zones
Site and/or special comment		B83, 186	B77, 78, 82, 91, 113, 232, 259	B112					
Est. % of Land System		5-10	90	<5					

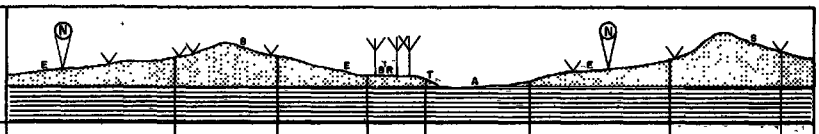
LANDFORM: Plains with longitudinal dunes (7-15m high). Dunes are partially oriented but converge and diverge in places. Crests are mobile with steep slopes (20-60%). Flanks have slopes 1-8%.

GEOLOGY: Quaternary windblown sands, usually over older Quaternary alluvial deposits and Quaternary alluvia. Qs / Q.

SOILS: Red earthy sands, UC 5.11, UC 1.43, are dominant on the interdune areas and lower flanks with red siliceous sands UC 1.23 on mobile crests. Occasional areas of sandy red earths GN 2.12 occur on the sandplains.

VEGETATION: Predominantly spinifex open hummock grassland to wooded open hummock grassland on duneflanks and interdune plains. Mobile crests support sand-hill canegrass open hummock grassland or bluebush pea sparse forbland to Grevillea stenobotrya forby low open shrubland. Infrequently mulga tall open shrubland occurs on interdune plains.

D2 Poongamulla (1000 km²)



Land Unit and/or Associated Land System	5	1	5	10	73, 87	5	1	5
Site and/or special comment		B104		B105		B77, 78, 82		
Est. % of Land System		5-10		5	10-15	75		

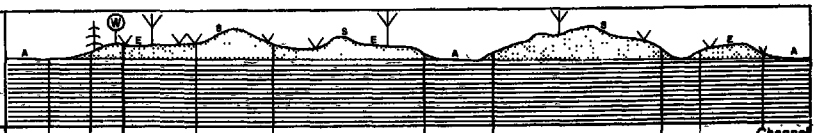
LANDFORM: Plains with longitudinal dunes (8-12m high), partially oriented, converging and diverging in places. Crests are steeply sloping and mobile with stable lower slopes on the duneflanks. Claypans occur in the interdune area.

GEOLOGY: Quaternary windblown sand over Quaternary alluvia and older Quaternary alluvial deposits. Qs / Qa.

SOILS: Red earthy sands UC 5.11, UC 1.43 predominate on lower duneflanks, with red siliceous sands UC 1.23 on the mobile crests. Grey clays UG 5.2 occur in the claypans and occasional areas of sandy red earths GN 2.12 occur fringing claypans in the interdune area.

VEGETATION: Spinifex wooded hummock grassland. Predominantly spinifex open hummock grassland to wooded open hummock grassland on duneflanks and interdune plains. Mobile crests support sandhill canegrass open hummock grassland or bluebush pea sparse forbland to Grevillea stenobotrya forby low open shrubland. Infrequently mulga tall open shrubland occurs on interdune plains. Claypans support bluebush, lignum low open shrubland or swamp canegrass open tussock grassland, rarely coolibah low open woodland.

D3 Kyabra (850 km²)



Land Unit and/or Associated Land System	C2	99	4	3	1	3	77, 95	3	95	3	Channel Country Land Zone
Site and/or special comment		R904, A197	B95		B63		B240	B170, 171		B128	
Est. % of Land System		<1	<5		5-10		15-25	70			

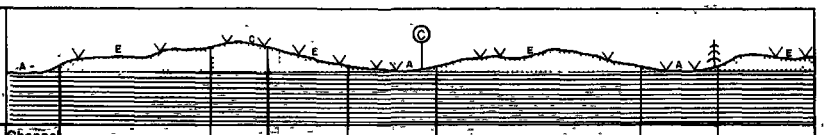
LANDFORM: Isolated low dunes and sand mounds (1-7m high) usually occurring in groups on alluvia. Longitudinal dunes are beginning to form on top of these mounds in some areas.

GEOLOGY: Quaternary windblown sands over Quaternary alluvia. Qs / Qa.

SOILS: Red and yellow siliceous sands UC 1.23 and earthy sands UC 5.11 on the dune with sandy surfaced texture contrast soils DY 5.53 on the lower duneflanks. In some areas cemented aprons (exposed hardpans) fringe the base of the dune. Brown and grey clays occur on adjacent alluvia.

VEGETATION: Predominantly wooded forbland and woollybutt, bluebush pea open herbfield. In places, the low sloping flanks may support mulga, hopbush tall open shrubland. Scalded areas may be devoid of vegetation or support sparse herbfields. Limited areas of buddah bush low open shrubland may be found at the base of the extended flanks.

D4 Carranya (500 km²)



Land Unit and/or Associated Land System	Channel Country Land Zone	2	1	2	73,87	2	87, 88, 97	2
Site and/or special comment					B108, 175	B176		
Est. % of Land System	5		<5		15-25	60-70	5	

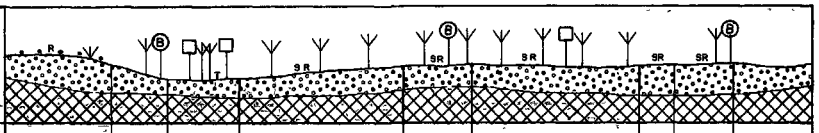
LANDFORM: Rounded dunes (5-8m high) commonly with mobile crests and gently sloping flanks (1-5%). Dunes are reticulate, separated by seasonally flooded claypans which are commonly interconnected.

GEOLOGY: Quaternary windblown sands over Quaternary alluvia. Qs / Qa.

SOILS: Red siliceous sands UC 1.23 and red earthy sands UC 5.21 are dominant on the dune, with mottled grey clays and texture contrast soils, UG 5.28, DY 3.12, in the claypan areas.

VEGETATION: Predominantly spinifex open hummock grassland on the duneflanks with bluebush pea open herbfield or Grevillea stenobotrya low open shrubland on dune crests. Claypans support bluebush low open shrubland or swamp canegrass open tussock grassland, infrequently open herbfield and rarely coolibah low open woodland.

S1 Greenmulla (2010 km²)



Land Unit and/or Associated Land System	H4	8	13	7	8	7	9	8	R1, R6
Site and/or special comment			B16		B17, 18	B20, 21, 22	A12		
Est. % of Land System	5-10		<5		10-20	60-70	5		<5

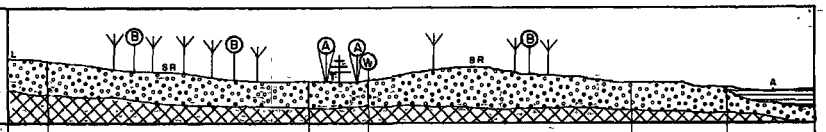
LANDFORM: Flat plains of very low relief with gentle slopes <1% around the margins. Occassional stony outcrops occur throughout and are also associated with the margins. Drainage lines are not well defined. Some minor run-on areas occur.

GEOLOGY: Sandplains of Quaternary sands (dominantly aeolian) overlying Tertiary Sandstone Glendower Formation. Qs / Tg.

SOILS: Deep, acid to neutral, sandy red earths GN 2.11, GN 2.12 occupy most of the area. Small areas of shallow, gravelly surfaced red earths occur. In run-on areas deep, red earths GN 2.12 and texture contrast soils DR 2.42 are present.

VEGETATION: Predominantly mulga tall open shrubland to tall shrubland with limited areas of woollybutt, mulga, western bloodwood shrubby open tussock grassland. Poplar box / mulga low open woodland or rarely ironwood, sandalwood tall open shrubland is associated with local depressions and run-on areas. Mulga sparse tall open shrubland to mulga, western bloodwood tall open shrubland or mulga, bastard mulga tall open shrubland occur on the occasional stony outcrops throughout the area and around the margins.

S2 Fraser (1740 km²)



Land Unit and/or Associated Land System	R3	6	92	6	S3,S5	Other Alluvia Land Zone
Site and/or special comment		B69, 70 (213)	B(212)			
Est. % of Land System	<5	80-90	<1		5	<5

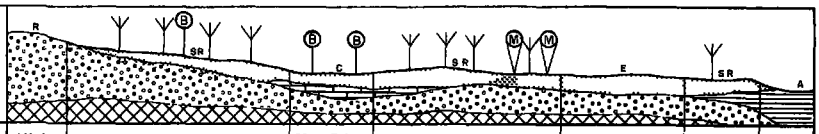
LANDFORM: Flat to slightly undulating plains with slopes <1% with occasional stony outcrops.

GEOLOGY: Sandplains formed by movement of Quaternary sands over Tertiary Glendower Formation. Qs / Tg.

SOILS: Mainly deep to very deep, acid, sandy red earths in the intergrove, becoming more clayey in the grove. GN 2.11. Sandy surfaced texture contrast soils occur in the drainage lines. DR 2, DR 4.

VEGETATION: Groved mulga. Predominantly mulga tall shrubland to mulga, western bloodwood tall open shrubland, distinctly groved. In the north, eastern dead finish open woodland to low open woodland or rarely leopardwood, bauhinia low open woodland may occur in run-on areas. Bastard mulga, mulga, hard spinifex low open shrubland or mulga sparse tall open shrubland is associated with occasional stony outcrops.

S3 Whitula (1400 km²)



Land Unit and/or Associated Land System	H3, H5 R Land Zone	10	89 or Other Alluvia Land Zone	10	Extensive Areas of S4, S6	10	A, C Land Zone
Site and/or special comment		B105	B85, 87	B112, 177			
Est. % of Land System	5		5-10	80-90			

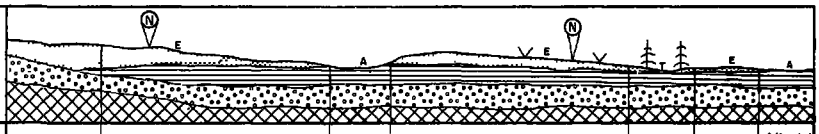
LANDFORM: Flat to gently sloping plains usually in run-on situations with slopes <1%.

GEOLOGY: Quaternary sands over Quaternary alluvia, gravels and Tertiary Glendower Formation. Qs / Qa, Qs / Tg.

SOILS Moderately deep to deep, slightly acid sandy red earths are dominant GN 2.12, GN 2.11, with shallow to moderately deep, neutral, sandy red earths where old land surfaces have been covered. Areas of red clays UG 5.32, UG 5.37 and texture contrast soils DR 2.13 commonly occur in the centre of this land system.

VEGETATION· Predominantly mulga tall open shrubland to mulga, western bloodwood tall open shrubland infrequently mulga, witchetty tall open shrubland western bloodwood low open woodland to wooded open herbfield occurs on the clay and texture contrast soils. Open herbfields to cassia low open shrubland are associated with the alluvia.

S4 Prairie (820 km²)



Land Unit and/or Associated Land System	S3	5	87	5	97	5	Alluvial Land Zones
Site and/or special comment			B175, 233	B77, 78, 91, 232	B76		
Est. % of Land System	10-20		5-10	60-70	5		5

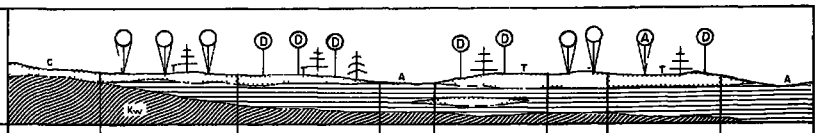
LANDFORM: Gently undulating to flat plains with slopes <1% with claypans and depressions which may be linked to form drainage lines.

GEOLOGY: Quaternary sands over Quaternary alluvia and Tertiary Glendower Formation. Qs / Qa, Qs / Tg.

SOILS. Mainly deep to very deep, red earthy sands UC 5.11, UC 1.43, with some occurrences of red siliceous sands UC 1.23. Deep texture contrast soils DY 5.42, DY 3.12 and grey and brown clays UG 5.28, occur in depressions and claypans.

VEGETATION Predominantly spinifex open hummock grassland to wooded open hummock grassland. Swamp canegrass open hummock grassland bluebush low open shrubland occurs in depressions and claypans. Infrequently depressions support beefwood, cassia low open woodland or rarely coolibah, lignum low open woodland.

S5 Isis (1420 km²)



Land Unit and/or Associated Land System	F,T Land Zones	93	92	77, 78	92	93	92	A and W Land Zones
Site and/or special comment		B52,214			B51,132,212			
Est. % of Land System		30-40		5-10	40-50			5

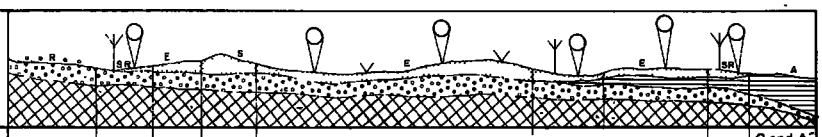
LANDFORM Flat alluvial plains with some low rises. Associated with the Thomson River are some elevated undulating plains where alluvium has been deposited on the older land surfaces.

GEOLOGY· Recent alluvium over Quaternary alluvia, or occasionally Winton Formation or Tertiary Glendower Formation.

SOILS Very deep texture contrast soils with sands and sandy loams overlying alkaline sandy clays DB 3 12, DB 4.13, DR 3.13, DY 5.43. Associated are areas of deep earthy sands UC 1.23 and grey and brown alluvial clays.

VEGETATION· Predominantly eastern dead finish open woodland to low open woodland and gidgee shrubby tall open shrubland to open woodland rarely leopardwood, bauhinia low open woodland. Limited areas of Mitchell grass open tussock grassland and herbfields to sparse herbfields occur.

S6 Galway (3080 km²)



Land Unit and/or Associated Land System	H5	10	5	D1	5	10, 97	5	10	C and A Land Zones
Site and/or special comment		B112			B77, 78, 82, 91, 113, 232, 259	B110			
Est. % of Land System	<5	10-20		<5	70-80	<2			

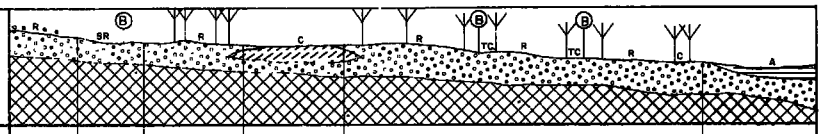
LANDFORM· Flat to very slightly undulating sandplains with slopes <1% without major dune formations. Small dunes are being formed in some areas.

GEOLOGY· Quaternary sands derived from Tertiary Glendower Formation and deposited as aeolian and alluvial sands over the Glendower, Winton Formations and alluvia. Qs / Tg, Kw, Qa.

SOILS: Mainly red earthy sands UC 5.11 and some red, siliceous sands UC 1.23 occur. Small areas of sandy red earths GN 2.12 are associated in run-on areas and on the fringes of the sandplain

VEGETATION: Predominantly spinifex open hummock grassland to wooded open hummock grassland. Restricted areas of mulga tall open shrubland to mulga, western bloodwood tall open shrubland occur. Limited areas of mulga, witchetty tall open shrubland are associated with run-on areas and fringe the sandplains in places.

M1 Wuringle (460 km²)



Land Unit and/or Associated Land System	R3,25	6	11	F8	11	A4
Site and/or special comment	B198	B69, 70	B168, 169		B88, 89	B90
Est. % of Land System	<5	5		5	80	<10

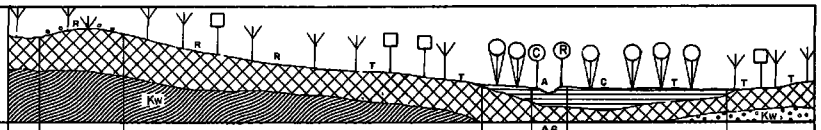
LANDFORM· Gently undulating plains with slopes <1% and occasional stony outcrops on tops of low ridges.

GEOLOGY Quaternary deposits over Tertiary Glendower Formation and fine Tertiary sediments and alluvia and altered Winton Formation. Qs.

SOILS. Mainly moderately deep to deep, loamy red earths GN 2.12 in the intergrove, with deep, red clays UG 5.38 and texture contrast soils DR 2.12 in grove areas where sink holes are common. Some shallow stony red earths occur on the tops of ridges.

VEGETATION: Predominantly mulga / western bloodwood tall shrubland to tall open shrubland, forming distinct groves. Limited areas of short grass forby open tussock grassland occur. Stony outcrops support mulga / bastard mulga (sparse) tall open shrubland.

M2 Ambathala (640 km²)



Land Unit and/or Associated Land System	M4	23	12	44	A6, 75, 84, 86	44	12
Site and/or special comment		B4	B1, 2		R1202	B3	
Est. % of Land System	10	<5	60		<5	20	

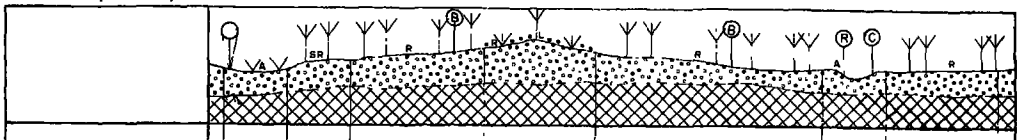
LANDFORM. Flat to very slightly sloping plains with slopes <0 5% with large internal run-on areas.

GEOLOGY Quaternary sands overlying Tertiary sandstones and altered Winton Formation. Qs.

SOILS: Mainly deep to very deep, red and brown texture contrast soils DR 2 43, DR 2.13 with acid loams overlying clay subsoils. In the central run-on areas brown and occasionally grey cracking clays occur, UG 5.25. Around the margins deep, red earths and some shallow gravelly red earths occur.

VEGETATION Predominantly mulga, poplar box shrubby low open woodland to woodland. Gidgee shrubby low open woodland to tall open shrubland with sandalwood conspicuous in places is associated with the clays. Limited areas of yapunyah open woodland or river red gum / coolibah open woodland to low open woodland occur. Associated with the shallow gravelly red earths on upper slopes is bastard mulga / mulga low open shrubland to mulga tall open shrubland.

M3 Chandos (2570 km²)



Land Unit and/or Associated Land System	14, A2, 81	S1	18	17, R Land Zone	18	A6	18 M,H Land Zones
Site and/or special comment	B118, 244, 268			B114	B116, 117, 228, 229, 230, 243		
Est. % of Land System	<5	<5		10-15	75	5	

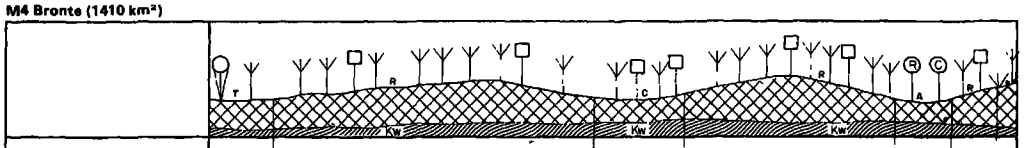
LANDFORM: Gently undulating to flat plains with slopes < 1% with well defined drainage lines.

GEOLOGY: Quaternary deposits over Tertiary sandstones Glendower Formation, alluvia and minor altered Winton Formation. Qs.

SOILS: Mainly shallow to moderately deep, red earths and texture contrast soils. GN 2.12, DR 2.12 in the grove usually with slump holes evident. Shallow red earths with scattered surface gravel occur in the intergrove. GN 2.12, UM 1 23. Texture contrast soils and red and brown clays are associated with the drainage lines.

VEGETATION: Predomintly mulga, western bloodwood tall open shrubland to mulga tall shrubland, distinctly groved, rarely mulga, poplar box tall open shrubland. Limited areas of bastard mulga / mulga low open shrubland to mulga, bastard mulga tall open shrubland occur. Sparse herbfield to herbfield is associated with the alluvia. River red gum / coolibah low open woodland or mulga tall open shrubland fringe the channels and drainage lines.

M4 Bronte (1410 km²)



Land Unit and/or Associated Land System	M2	15	14	15	A6	15 R6
Site and/or special comment		B257	B119, 256			B5
Est. % of Land System	<5	80	10-15		<5	<5

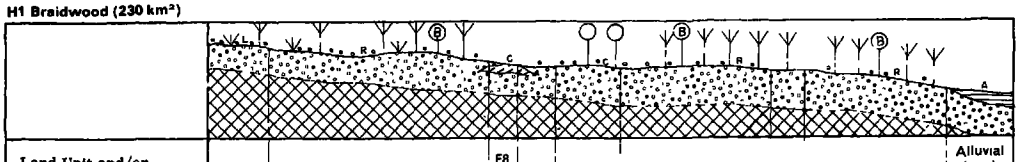
LANDFORM: Gently undulating to flat plains with slopes <2%.

GEOLOGY Quaternary deposits over Tertiary sandstones, altered Winton Formation and minor alluvia. Qs.

SOILS: Mainly deep to moderately deep, loamy red earths, usually with ironstone shot on the surface and throughout the profile GN 2.12, GN 2.11. Shallow stony red earths and lithosols may occur on the upper slopes. Texture contrast soils and red and brown clays UF 4.43 are associated with run-on areas.

VEGETATION: Predominantly mulga grassy tall shrubland to tall open shrubland, diffusely groved, with areas of poplar box, mulga low open woodland to mulga tall shrubland. Mulga, bastard mulga tall open shrubland to bastard mulga low open shrubland is associated with shallow stony red earths and lithosols.

H1 Braidwood (230 km²)



Land Unit and/or Associated Land System	R3	25	F8, H3	25	42	25	S2	25 Alluvial Land Zones
Site and/or special comment	R82	B198			R578, 750			B129
Est. % of Land System	5-10	75-80	5		10		5	

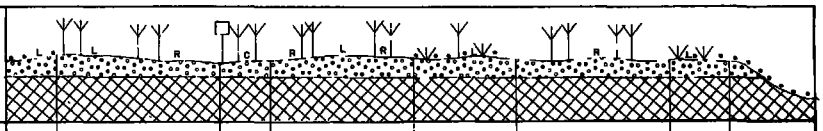
LANDFORM. Gently undulating to undulating plains and low hills with slopes <3% commonly grading into dissected residuals along the upper margins.

GEOLOGY Thin superficial deposits over Tertiary Glendower Formation. Qs / Tg

SOILS. Moderately deep, red earths and hardpan soils becoming alkaline at depth DR 3.12, UM 5 31. Surfaces have gravel cover. Red and brown clays occur in the drainage lines, with some shallow red earths and lithosols on upper margins.

VEGETATION Predominantly mulga / western bloodwood tall open shrubland to sparse tall open shrubland Limited areas of gidgee forby tall open shrubland occur on the red and brown clays Bastard mulga / mulga low open shrubland is associated with the shallow red earths and lithosols on upper margins

H2 Carella (1380 km²)



Land Unit and/or Associated Land System	R Land Zone	19	14	19	17	19	R2	R Land Zone
Site and/or special comment			R745		B73	B71, 72, R88, 748		
Est. % of Land System			<5		10	75	5-10	<5

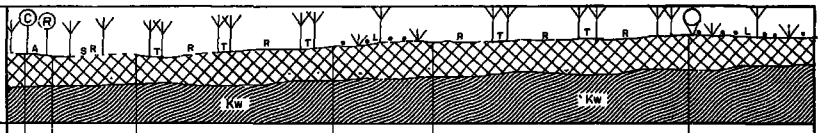
LANDFORM· Flat to gently undulating tops of dissected tablelands, slopes <1%.

GEOLOGY· Very thin cover over Tertiary Glendower Formation which is silicified in some areas. Tg.

SOILS: Mainly shallow to very shallow, stony acid red earths and lithosols UM 5.21, UM 5.51. Some moderately deep, red earths occur in the drainage lines. Lithosols and exposed rock are present around the margins.

VEGETATION Predominantly mulga tall open shrubland to sparse tall open shrubland with limited areas of bastard mulga / mulga low open shrubland to mulga, bastard mulga tall open shrubland. The moderately deep, red earths on the drainage lines support mulga tall shrubland to poplar box, mulga low open woodland.

H3 Onoto (1980 km²)



Land Unit and/or Associated Land System	21	A6, W6	S3, 16	21	17, 26	21	R7, R8
Site and/or special comment			B206		B193, 194	B265	
Est. % of Land System		<5	15-20		<5	70-80	5-10

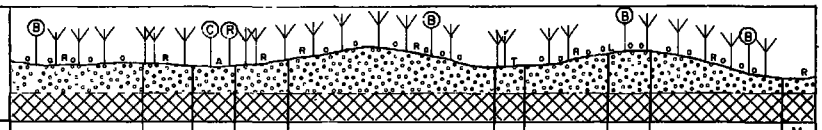
LANDFORM· Flat to gently undulating plains with slopes <2%, usually 1% or less, sloping towards central drainage lines.

GEOLOGY Quaternary deposits over altered Winton Formation, and Tertiary Glendower Formation. Qs.

SOILS. In intergrove areas shallow red earths are dominant, GN 2.12 ,UM 1.43, with moderately deep, red earths and texture contrast soils in the gilgaied grove areas DR 2.12. On the lower slopes sandy red earths occur, associated with red and brown clays in the drainage lines. Shallow stony lithosols occur around the upper margins.

VEGETATION Predominantly mulga grassy tall open shrubland to mulga, western dead finish tall open shrubland occasionally mulga, horse mulga tall open shrubland, distinctly groved in places. Bastard mulga low open shrubland to mulga, bastard mulga tall open shrubland occasionally lancewood low open woodland and rarely western dead finish, desert gum sparse tall open shrubland occur on the shallow stony lithosols.

H4 Cothalow (890 km²)



Land Unit and/or Associated Land System	24	M3	A6, W6	M3	24	13	24	22	24	M Land Zone
Site and/or special comment					R445, A39, 98	B16		R1213, R1218		
Est. % of Land System		10-20	<5		75	5		5		

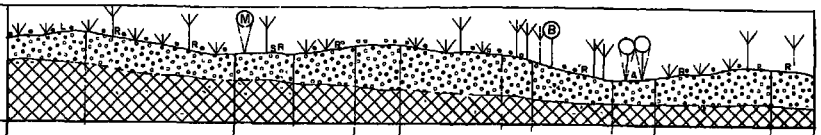
LANDFORM· Undulating to gently undulating convex plains, with slopes <2% with well defined drainage lines.

GEOLOGY: Tertiary Glendower Formation covered in places with thin Quaternary deposits. Q / Tg.

SOILS Mainly shallow to very shallow loamy red earths UM 5.51, GN 2.12 with silcrete stone cover. Very stony lithosols may occur on the tops of rises while texture contrast soils DR 2.83 occur in run-on areas.

VEGETATION. Predominantly mulga, western bloodwood tall open shrubland to sparse tall open shrubland rarely mulga tall open shrubland, groved in places. Limited areas of rock grass, mulga, western bloodwood open tussock grassland occur. Run-on areas support herbfields. Fringing low woodlands of river red gum / coolibah / box or gidgee tall open shrubland to open woodland occur on channels.

H5 Tenham (2070 km²)



Land Unit and/or Associated Land System	R2	17	10	17	22	17	34	18	W4, 81	17	M,H Land Zones
Site and/or special comment	B114	B73, 92, 98, 231, 238	B112		R1213 R1218		B86	B116, 117	B115		
Est. % of Land System	5	60	10		<5		5	10-20	<5		

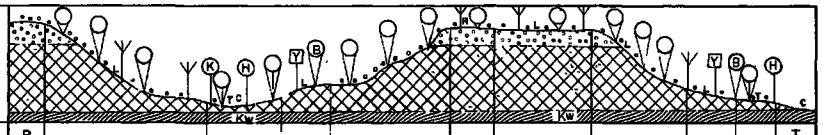
LANDFORM Gently undulating to undulating convex plains with occasional rocky outcrops on the tops of ridges.

GEOLOGY: *Quaternary deposits on Tertiary Glendower Formation and altered Winton Formation.*

SOILS Mainly shallow to very shallow red earths and lithosols GN 2.12, UM 5.51, UM 1.43, UC 1.43, with some shallow, rocky red earths on tops of ridges. Shallow to moderately deep, red earths, sandy red earths and some texture contrast soils occur on lower slopes and run-on areas.

VEGETATION Predominantly bastard mulga, mulga low open shrubland to mulga, bastard mulga tall open shrubland rarely bastard mulga low open shrubland. Limited areas of mulga, western bloodwood tall open shrubland to mulga tall shrubland, distinctly groved, occur. Upper slopes may support mulga, lancewood tall open shrubland to lancewood low open woodland. Rock grass / western bloodwood / mulga open tussock grassland occur on the shallow rocky red earths on the tops of ridges. Run-on areas may support open herbfields, cassia low open shrubland or gidgee / yapunyah low open woodland to gidgee tall open shrubland.

R1 Gilmore (4710 km²)



Land Unit and/or Associated Land System	R Land Zone	Complex of 26, 31	G4, 12, rarely 92	33	31	32	26	31	33	40,48	T Land Zone
Site and/or special comment			R1259	B10	B7, R866, 867	B24	B25			B216, 217, 218	
Est. % of Land System			<10	10	60	<5	20			<5	

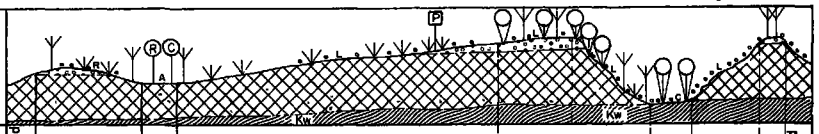
LANDFORM Scarps, dissected areas and flat tops of tablelands, mesas and buttes, slopes range from 3% to vertical, deeply incised valleys occur around the edges.

GEOLOGY: Tertiary Glendower Formation overlying altered Winton Formation sediments which are exposed on scarps. Fresh Winton Formation sediments may be exposed in the lower slopes, usually with a veneer of rock and stone from the erosion of the overlying formations. Tg / Kw.

SOILS Mainly very shallow, red loamy lithosols with stone and gravel throughout, with some shallow gravelly red earths UM 1.23, UM 1.43, GN 2.12. Areas of exposed rock common. On the lower slopes moderately deep to deep, red and brown cracking clays and some texture contrast soils occur. UG 5.38, DR 2.12.

VEGETATION Predominantly bendee tall shrubland to low woodland or mulga tall open shrubland with areas of bastard mulga low open shrubland, occasionally lancewood low open woodland and rarely western dead finish, desert gum tall open shrubland. Limited areas of mulga, grey lancewood tall open shrubland also occur. Mountain yapunyah, bowyakka shrubby open woodland is associated with the lower slopes of scarp retreat zones. The deeply incised valleys support gidgee or brigalow, gidgee predominant associations.

R2 Mawson (3590 km²)



Land Unit and/or Associated Land System	H,M Land Zones	H3, H5	A6	26(b)	26(a)	R1, 5, 6, 7, 8	G2, 3, 4	R Land Zone	19, 26	R Land Zone
Site and/or special comment		B92		B5, 6, 25, 60, 101, 114					B71 72	
Est. % of Land System		10	<2	75		10	<5		<5	

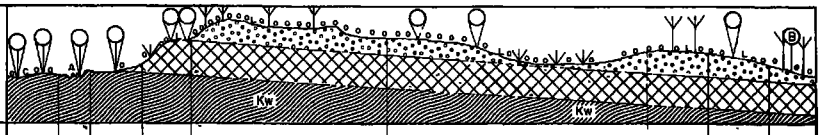
LANDFORM Eroded remnants of dissected tablelands, forming low hills and undulating to flat plains. Slopes commonly 1-3%, greater in more dissected areas.

GEOLOGY Tertiary Glendower Formation and altered Cretaceous Winton Formation sediments. Very thin veneers of Quaternary material may be present. Tg / Kw.

SOILS Very shallow, acid, gravelly lithosols. Large areas of exposed rock occur. Textures range from gritty loams to gritty clay loams. Ironstone gravel is common on the surface. UM 1 43

VEGETATION Predominantly bastard mulga low open shrubland to bastard mulga, mulga tall open shrubland. A complex of bendee, lancewood and mulga forming tall shrubland to low woodland may occur on the steep upper slopes. Mulga sparse tall open shrubland occurs on the undulating plains. Frequently areas devoid of vegetation are associated.

R3 Valetta (1020 km²)



Land Unit and/or Associated Land System	42	W7	35	28	27	28	27	28	H1, H3
Site and/or special comment	B200	B210	B65		367, 368	B66, 209			
Est. % of Land System	5	<5	<5		20-30	60			5

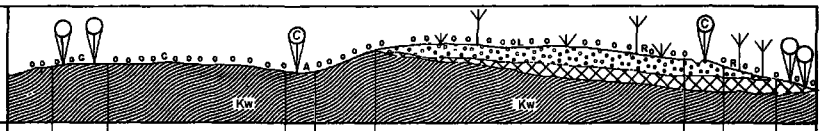
LANDFORM Undulating plains, dissected low hills, and scarps. Slopes range from 3-20%.

GEOLOGY. Scattered shallow soil cover over Tertiary Glendower Formation. Silcrete and sandstones, and altered Winton Formation. Cretaceous Winton Formation, overlain in elevated areas by Tertiary Glendower Formation. Quaternary erosion deposits cover most of the lower slopes. Fresh Winton Formation sediments may be exposed on these slopes.

SOILS Very shallow, loamy lithosols with dense stone cover. Areas of exposed rock are common. On the lower slopes gravelly desert loams DR 2.12 and very shallow, brown clays with ironstone gravel cover may occur.

VEGETATION Predominantly hard spinifex, Acacia spp. open hummock grassland to Acacia spp. hard spinifex tall open shrubland with mulga sparse tall open shrubland in places. The dissected slopes may support grey lancewood, Eucalyptus normantonensis, hard spinifex low open woodland. Limited areas of bastard mulga low open shrubland and mulga, western bloodwood tall open shrubland occur. In places gidgee tall open shrubland is associated with lower slopes.

R4 Durham (850 km²)



Land Unit and/or Associated Land System	F3, F4	42	69	75, A5	69	36	85	43, H5	43
Site and/or special comment		R786	R564, 1238, A120, 162, 164	B109 R562 R563		R787, A134	R788		B102, 103
Est. % of Land System	<5	<5	20-30	<5		50	<2	<5	5

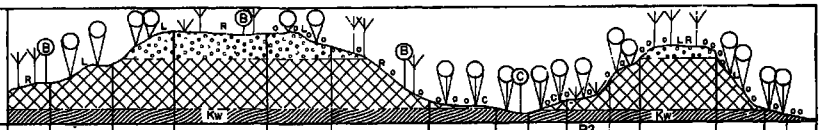
LANDFORM. Flat to gently undulating tops of dissected tablelands, and associated scarps, mesas and buttes.

GEOLOGY Thin silcrete cover overlying altered and unaltered Cretaceous Winton Formation. Tg / Kw.

SOILS· Very shallow, red, acid, loamy lithosols and red earths with abundant silcrete stone and boulder intermixed, UM 1.43, UM 5.51, UM 5.31, UM 1.23 on scarps and upper slopes. Occasional stony, red and brown cracking clays UG 5.38, UG 5.32 and desert loams on the flat tops and lower slopes

VEGETATION Predominantly bastard mulga low open shrubland and bastard mulga, mulga tall open shrubland with gidgee forby tall open shrubland on some slopes. Herbfield ranging from forbland to Mitchell grass open tussock grassland occur depending on seasonal conditions. Drainage lines *and small creeks support mineritchie tall open shrubland or mimosa low open shrubland. Coolibah, river red gum fringing woodland or mulga tall* shrubland occur on major channels.

R5 Cheviot (3000 km²)



Land Unit and/or Associated Land System	H5, M3	31	26	17, 18	26	H5, M3 (Southern Areas)	41, 40 (in east)	W6, A5	41	R3 (North -west only)	31	19	31	41	T Land Zone
Site and/or special comment		R636	B60	R133		R134, 135	R655, 657	R137		R742	R746	B71, 72, R744, 745			
Est. % of Land System		20	15	20		10	10	<5		5-10		10			<5

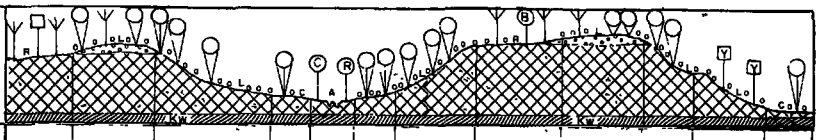
LANDFORM Dissected tablelands, scarps and low hills. Slopes range from 1-3% on tops to near vertical on scarps.

GEOLOGY Tertiary Glendower Formation (silicified in places) overlies altered Winton Formation which is commonly exposed through erosion of the Tertiary sediments.

SOILS Very shallow to shallow acid loamy lithosols and red earths with silcrete cover UM 5 51, UM 5 21, UM 1.43, UM 1.23. Exposed rock is common. Some shallow brown clays with stone cover occur on the lower slopes.

VEGETATION Predominantly mulga tall open shrubland and bastard mulga low open shrubland to mulga, bastard mulga tall open shrubland with lancewood / mulga / bendee low open woodland on some scarps. In the central north limited areas of hard spinifex, Acacia spp. open hummock grassland to Acacia spp. hard spinifex tall open shrubland occur. The lower slopes support gidgee tall open shrubland.

R6 Gumbardo (1150 km²)



Land Unit and/or Associated Land System	M3, M4	26	31	45	W3	G2, G4	31	M3	25	31	33	G Land Zone
Site and/or special comment			B7	B9		R101			B5, 6		B10	
Est. % of Land System	5		50	5	<5				20		20	

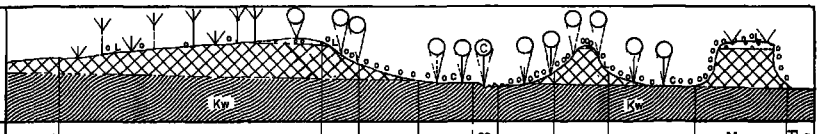
LANDFORM Scarps and tops of dissected tablelands, mesas and buttes. Slopes range from 5% to near vertical on scarps, with lower slopes 3-8%.

GEOLOGY Altered Winton Formation capped in places by Tertiary Glendower Formation. Thin veneers of deposits derived by erosion of the Tertiary land surface occur. Small areas of fresh Winton Formation sediments may be exposed on lower slopes. Kw.

SOILS Very shallow, acid loamy lithosols with stone and rubble cover. UM 1 43. Shallow red earths also occur GN 2.12. Areas of exposed rock are common. On the lower slopes, gravelly red clays UG 5 37, UF 5.34 and some stony brown clays occur.

VEGETATION Predominantly a complex of bendee tall open shrubland to tall shrubland and lancewood open woodland on scarps with bastard mulga / mulga low open shrubland on adjacent flat tops. Limited areas of mulga, western bloodwood tall open shrubland to mulga tall open shrubland, distinctly groved, occur in places. Gidgee shrubby tall open shrubland and, gidgee low open woodland are associated with incised valleys, creeks and drainage lines. Limited areas of silver-leaved ironbark, mulga low open woodland and mountain yapunyah shrubby low open woodland occur on detrital slopes.

R7 Kurran (2530 km²)



Land Unit and/or Associated Land System	H Land Zone	26		28	35	47	82, W7	47	26, 28	35, 47	Moses Sandstone 30	F Land Zone
Site and/or special comment				B209	B263	B264	B210 R833				B184	
Est. % of Land System		40		15	20	20	<5				<2	

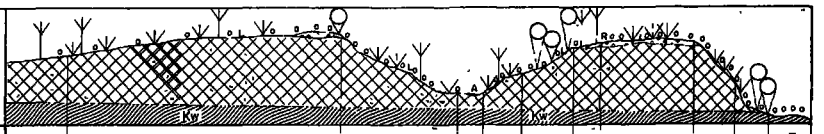
LANDFORM Mesas, buttes and dissected tablelands separated by gently undulating plains. Slopes range from 3% to near vertical on the remnants and from 1-3% on the plains separating them.

GEOLOGY Altered Cretaceous Winton Formation, in places capped by Tertiary Glendower Formation. Fresh Winton Formation sediments may be exposed in lower parts of the landscape. Tg, Kw.

SOILS Mainly very shallow acid loamy lithosols UM 1.43, UM 1.23 with areas of exposed rock common. On the plains between the remnants desert loams with ironstone gravel pavements, DR 2.52 and some brown cracking clays occur UG 5.32.

VEGETATION. Mainly bastard mulga low open shrubland to mulga, bastard mulga sparse tall open shrubland with lancewood low open woodland on the scarps and areas of hard spinifex, Acacia spp. open hummock grassland to Acacia spp., hard spinifex tall open shrubland. The desert loams and brown cracking clays support gidgee tall open shrubland with the ironstone gravel pavements devoid of vegetation. Gidgee tall open shrubland and mineritchie low open woodland are associated with drainage lines.

R8 Waverney (1640 km²)



Land Unit and/or Associated Land System	17, 27	26	29	85, A6	29	31	19	26	29	G3	F Land Zone
Site and/or special comment	B99	B101	B100	R788		R109	R769			B178	
Est. % of Land System	10	40	25	<5	5	5-10				10	

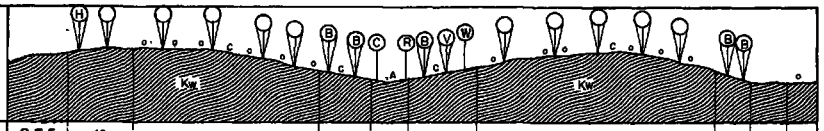
LANDFORM Dissected tablelands, mesas and buttes with associated undulating plains. Slopes range from 1° on flat tops to near vertical on scarps.

GEOLOGY Altered Cretaceous Winton Formation capped in places by Tertiary Glendower Formation. Thin layers of Quaternary deposits may be present. a Kw.

SOILS Very shallow, acid, loamy lithosols and shallow red earths commonly with stone and gravel cover. UM 1.43, UM 1 23. GN 2 12, UM 5.21, UM 5 51. Exposed rock is common. On the lower slopes, desert loams and red and brown cracking clays occur, with dense stone and gravel cover. DR 2 12, UG 5.37.

VEGETATION Predominantly bastard mulga, mulga low open shrubland to mulga, bastard mulga tall open shrubland, occasionally bastard mulga low open shrubland or mulga sparse tall open shrubland. Limited areas of gidgee tall open shrubland occur on the lower slopes of the dissected tablelands associated with the desert loams and brown and red cracking clays.

G1 Linden (3560 km²)



Land Unit and/or Associated Land System	G,T,F Land Zones	46 (eastern only)	39	51, 53	W3	T3	38	51	F5	38
Site and/or special comment		B252	B26, 249				B30, 31, 32, 33, 50, 146, 156, 247, 248, 251, 253			
Est. % of Land System		<5	10-15	5	5	5-10	60-70		5-15	

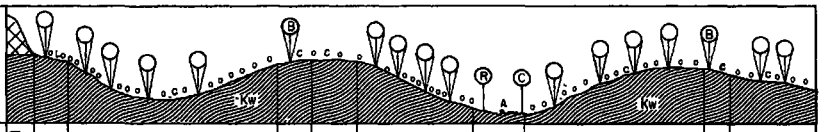
LANDFORM Flat to gently undulating plains, with slopes usually <1%. Weak gilgai microrelief is common.

GEOLOGY· Cretaceous Winton Formation sediments with scattered stone and gravel cover resulting from erosion of previous land surfaces. Kw.

SOILS Mainly deep to very deep, alkaline brown, grey and reddish brown cracking clays UG 5 21, UG 5.24, UG 5 31, UG 5.32, UG 5.34, UG 5 36 with weakly crusting, self-mulching surfaces usually scattered with stone. $CaCO_3$ and gypsum are usually present. Brown and grey clays and alluvial soils occur in the drainage lines.

VEGETATION: Predominantly gidgee low woodland to tall shrubland, occasionally gidgee low open woodland to tall open shrubland. Limited areas of boree, Mitchell grass, low open woodland to Mitchell grass, boree open tussock grassland and Mitchell grass wooded open tussock grassland occur. In the east brigalow, gidgee low open woodland may be present. Alluvia support coolibah, river red gum open woodland and associated herbfield.

G2 Kiama (3930 km²)



Land Unit and/or Associated Land System	R Land Zone	33, 45	40	51	F5, F7	40	W3, rarely W7	40	T1	41
Site and/or special comment		B9, 10						B122, 150, 226, 227		B160, 221
Est. % of Land System		<5			5		5	60	5-10	20

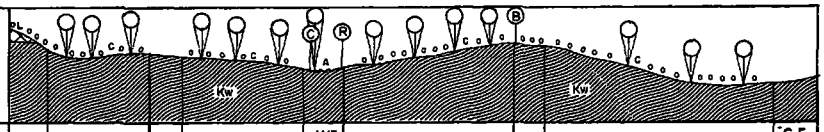
LANDFORM: Gently undulating to undulating plains. Slopes 1-3%. Moderate to strong gilgai microrelief is common.

GEOLOGY Weathered sediments of the Cretaceous Winton Formation with dense stone cover produced as a result of erosion of the Tertiary land surface which previously covered these areas. Kw.

SOILS. Deep to very deep, alkaline reddish brown cracking clays UG 5.28, UG 5.34, UG 5.38, UG 5.39. Surfaces are self-mulching with dense stone and gravel pavements. Minor areas of grey clays occur in depressions. $CaCo_3$ and gypsum are present.

VEGETATION. Predominantly gidgee tall open shrubland to low open woodland occasionally tall shrubland with areas of boree, Mitchell grass low open woodland to Mitchell grass, boree open tussock grassland. Limited areas of gidgee, sandalwood low open woodland and Mitchell grass open tussock grassland, rarely herbfield occur. Associated alluvia support coolibah / river red gum low open woodland or occasionally gidgee tall open shrubland with herbfields on the interchannel plains.

G3 Opal (2210 km²)



Land Unit and/or Associated Land System	R3	42	F7	42	W7, A5, A6	42	rare 18, 7	42	G,F Land Zones
Site and/or special comment						B65, 165, 178, 200	e B225		
Est. % of Land System	<5		<5		5	90			<5

*B225 Remnants of late Tertiary Alluvials

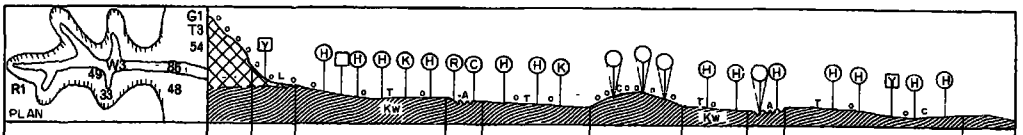
LANDFORM Very gently undulating to undulating plains, slopes usually 1-2%, up to 5%. Weak gilgai microrelief is common.

GEOLOGY Weathered sediments of the Cretaceous Winton Formation with stone and gravel cover produced as a result of erosion of the Tertiary land surface.

SOILS· Red and brown cracking clays with stone and gravel pavements predominate UG 5.37, with minor areas of desert loams DR 2.12. Rarely areas of shallow stony red earths occur on the crests of hills along the Barcoo River. UM 5 31.

VEGETATION Predominantly gidgee tall open shrubland with associated areas devoid of vegetation. Limited areas of mulga, western bloodwood tall open shrubland to mulga tall open shrubland occur. Alluvia support gidgee tall open shrubland or herbfield to sparse herbfield with river red gum, coolibah low open woodland or in the west minenitchie low open woodland fringing the major drainage lines.

G4 Idalia (610 km²)



Land Unit and/or Associated Land System	R1	33	49	A3, W3	49	G2	48	86	48	G1, T3, 54
Site and/or special comment		B10, R11	B270, R1258	B13				B8, 148	B215, 217, 218	
Est. % of Land System		5	20	10		10		<5	40-50	5-10

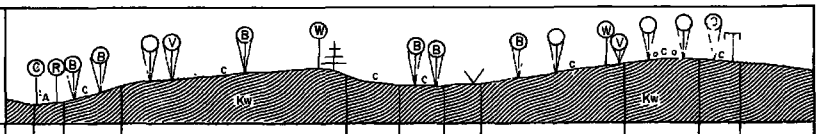
LANDFORM Undulating to gently undulating plains, low hills and lower slopes of scarps. Incised valleys of old upland surfaces are included. Slopes range from 1 - 3% on plains to 15% on upper slopes.

GEOLOGY Quaternary deposits over altered Winton Formation sediments are exposed in scarp retreat zones, usually with thin veneers of Quaternary stone and gravel. Q / Kw.

SOILS Moderately deep to deep, red cracking clays UG 5 38 and desert loams DR 2 12, with scattered stone and gravel cover predominate. Massive surfaced reddish - brown texture contrast soils occur on the valley floors.

VEGETATION Predominantly brigalow low open woodland to low woodland and brigalow, gidgee low open woodland with areas of gidgee tall open shrubland and brigalow, mountain yapunyah low open woodland. Limited areas of mulga, Dawson gum tall open shrubland to Dawson gum open woodland and poplar box open woodland occur in incised valleys. The lower slopes of dissected residuals support mountain yapunyah, bowyakka low open woodland in places. Sparse herbfield to open herbfield and coolibah, river red gum open woodland are associated with the alluvia.

T1 Hobson (1580 km²)



Land Unit and/or Associated Land System	50	W3	53	50	F5, F6, F7	T2	80	50	Clumps of 38	52	F, G or T Land Zones
Site and/or special comment		B125	B153, 157, 223	B11, 45, 57, 141, 147, 161	B141		B133		B32, 33		
Est. % of Land System		5	5	60-70	2-10	5-10	<2		10-15	<5	

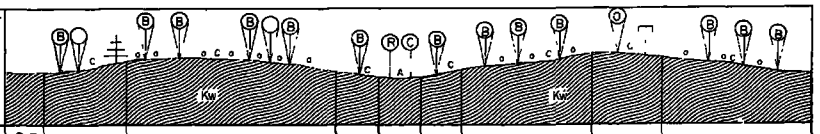
LANDFORM Flat to gently undulating plains, slopes < 1%, drained by well defined braided channels.

GEOLOGY Weathered sediments of Cretaceous Winton Formation. Kw.

SOILS Predominantly moderately deep, alkaline brown cracking clays UG 5 22, UG 5.32, UG 5.37, UG 5 38. Areas of deep to very deep, alkaline brown cracking clays with scattered stone on the surface occur. UG 5.2, UG 5 3. Surfaces are self - mulching. Grey and brown clays are associated with local alluvia.

VEGETATION. Predominantly Mitchell grass wooded open tussock grassland with gidgee conspicuous and areas of boree, Mitchell grass low open wood - land to Mitchell grass, boree wooded open tussock grassland. Limited areas of gidgee tall shrubland to low woodland, occasionally tall open shrubland to low open woodland and Mitchell grass open tussock grassland occur. The alluvia support coolibah, river red gum fringing open woodland with associated herbfields.

T2 Greenwood (2250 km²)



Land Unit and/or Associated Land System	G,F Land Zones	T1	51	53	W3, 80	53	51	52	51
Site and/or special comment			B49, 123, 149, 157, 159	B153	B133			B34, 35, 143	
Est. % of Land System		10-20	60	5	- 5			10-25	

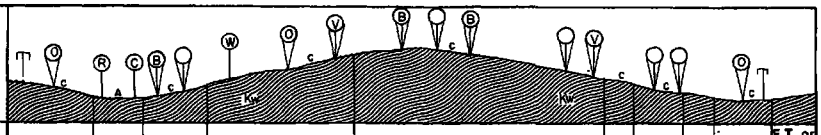
LANDFORM Flat to very gently undulating plains, slopes < 1%.

GEOLOGY Weathered sediments of Cretaceous Winton Formation. Kw.

SOILS Moderately deep to deep, alkaline brown cracking clays are dominant throughout UG 5 24, UG 5 32, UG 5 34. Surfaces are self - mulching. Small areas of grey and brown clays and alluvial soils are associated with local drainage lines.

VEGETATION Predominantly Mitchell grass, boree wooded open tussock grassland to boree, Mitchell grass low open woodland and areas of Mitchell grass open tussock grassland. Alluvia support coolibah, river red gum low open woodland to open woodland on major drainage channels and mimosa low open shrubland on minor drainage lines.

T3 Terrick (1160 km²)



Land Unit and/or Associated Land System	52	W3	51, 52, 53	65	51, 52	51	38	80	52	F,T, or G Land Zones
Site and/or special comment		B13, 38		B14, 15, 29	B34, 35, 143		B30, 31	B133		
Est. % of Land System		5	5-10	30	50-60		5-10	<5		

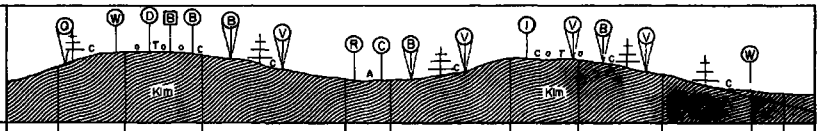
LANDFORM Flat to gently undulating plains. Slopes <1%. Towards the western limits of its distribution this land system becomes restricted to upper slopes and crests of the undulations.

GEOLOGY Weathered sediments of Cretaceous Winton Formation. Kw.

SOILS Deep, brown, alkaline cracking clays occur throughout UG 5.24, UG 5.34. Surfaces are self-mulching with weak crusts. On the crests, textures become lighter with increasing sand content and scattered sandstone 'floaters' may be present.

VEGETATION Predominantly Mitchell grass wooded open tussock grassland with scattered boree, whitewood, vine-tree, gidgee and myall forming low open woodlands in places and Mitchell grass open tussock grassland, occasionally other short grass open tussock grassland and rarely Mitchell grass, mimosa open tussock grassland. Clumps of gidgee forming tall shrubland to low woodland occasionally tall open shrubland occur. Alluvia support coolibah, river red gum fringing open woodland on major drainage channels and mimosa low open shrubland on minor drainage lines.

T4 Mooney (500 km²)



Land Unit and/or Associated Land System	G1	65	56	55	W3	55	56	55	65	80	F Land Zone
Site and/or special comment	R55			B40, 144	B38		B39, 42, 250		B41	R56	
Est. % of Land System	<5			40	<5		20-30		25-30	<2	

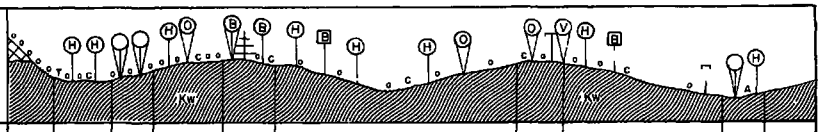
LANDFORM Gently undulating plains with slopes <2%, becoming steeper on the lower slopes. Linear gilgais are common on the slopes.

GEOLOGY Weathered sediments of Cretaceous Mackunda Formation. Klm.

SOILS Moderately deep to deep, alkaline, brown cracking clays occur on the slopes UG 5.23, UG 5.31. On the crests very shallow, reddish-brown clays UG 5.37, and some shallow texture contrast soils DR 2.13 occur. Weathered rock outcrops in places.

VEGETATION Predominantly Mitchell grass wooded open tussock grassland to low open woodland of vine-tree / eastern dead finish / whitewood / bauhinia and western bloodwood and areas of Mitchell grass open tussock grassland occasionally other short grass open tussock grassland. Limited areas of gidgee tall shrubland to low woodland, occasionally tall open shrubland to low open woodland occur. Alluvia support coolibah, river red gum fringing open woodland on major drainage channels and mimosa low open shrubland on minor drainage lines.

T5 Mt. Harden (160 km²)



Land Unit and/or Associated Land System	R1, G4	48	40	54	52	54	52	54	86, W3	T3, G1
Site and/or special comment		B216, 217, 218	R1257		R863	B254, 255, R1258			R861	
Est. % of Land System		10-20	5		<5	65			5	70

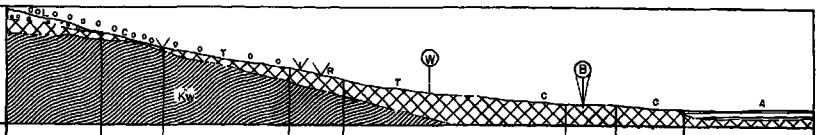
LANDFORM Flat to undulating plains with slopes to 3%.

GEOLOGY Weathered sediments of exposed Cretaceous Winton Formation. Kw.

SOILS Deep, red alkaline cracking clays are dominant, UG 5 34. In places moderately deep to deep, reddish-brown and brown clays are present. Surfaces usually have stone and gravel cover. Incipient gilgais are characteristic on local alluvia where brown clays with sandy or silty crusts occur.

VEGETATION Predominantly Mitchell grass open tussock grassland with clumps of brigalow low open woodland. Areas of Mitchell grass wooded open tussock grassland occur. Vine-tree, eastern dead finish, boonaree and myall may be conspicuous in places forming tall open shrublands to low open woodlands. Alluvia support coolibah, river red gum open woodland, brigalow sandalwood shrubby low open woodland.

F1 Palparara (1260 km²)



Land Unit and/or Associated Land System	H1 and R Land Zones	F4	61	20	61	80, A5	61	A2, C3
Site and/or special comment		R797		B196	B181, 185	R798		B182, R795, R805
Est. % of Land System		10		<2	60-70	<5		10-15

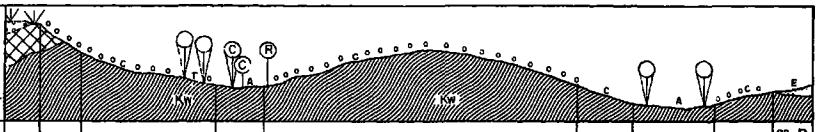
LANDFORM Flat to gently undulating plains with long slopes less than 1%.

GEOLOGY Quaternary colluvial fans.

SOILS Mainly deep to very deep, red desert loams on the slopes, becoming shallower towards the top of the slopes DR 2.12, DR 3.13. Ironstone shot and gravel pavements are characteristic. Soils may be weakly gilgaied. On the lower slopes desert loams grade into red and brown clays of the alluvial plains. Small areas of shallow red earths with ferruginous hardpans occur.

VEGETATION Seasonally dependent. Predominantly a fluctuating climax between saltbush, bassia forbland and tussock grassland composed of Mitchell grasses and other short grasses. Very sparse herbfield to herbfield are associated with the red and brown clays of the alluvial plains. Scalding is conspicuous in places. Major drainage channels support coolibah, river red gum fringing low open woodland to open woodland or in the west mineritchie fringing low open woodland. Limited areas of witchetty, cassia low open shrubland occur on the shallow red earths with ferruginous hardpans.

F2 Plevna (2010 km²)



Land Unit and/or Associated Land System	R4	43	69	85	69	F1, F3	A2, A5	69	S6 D Land Zones
Site and/or special comment		B102, 103		R1232, 1236	A120, 162, 164, R1238		B109		
Est. % of Land System	5-10	<5		<2	70	10	5		

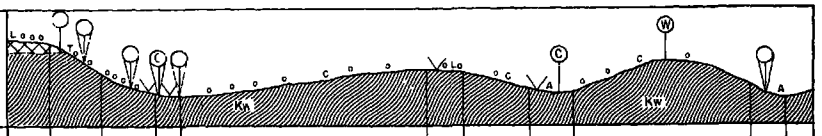
LANDFORM Gently undulating to undulating plains. Slopes 1 - 5%.

GEOLOGY Weathered sediments of Cretaceous Winton Formation mantled with a dense cover of silcrete derived by erosion of the previous Tertiary land surfaces. Tg / Kw.

SOILS Deep to very deep, gilgaied, stony red and brown clays, UG 5 35, UG 5 38. Silcrete cover is very dense, ranging from boulders to stone and gravel, sometimes with desert varnish. A moderately deep phase of this soil and shallow to moderately deep desert loams DR 1.13, DR 2 13 are present on the crests.

VEGETATION Seasonally dependent. Predominantly a fluctuating climax between tussock grassland including Mitchell grasses and other short grasses and saltbush, bassia forbland. Very sparse herbfield to herbfield are associated with the clays of the alluvial plains. Scalding is conspicuous in places. Coolibah and or river red gum fringing low open woodland occur on the major alluvia. Drainage lines and small creeks west of Cooper Creek support mineritchie low open woodland to tall open shrubland. Limited areas of gidgee tall open shrubland occur.

F3 Davenport (3390 km²)



Land Unit and/or Associated Land System	R7, R8	G3	43	B1, 85	62	37	62	A5	66	82	63
Site and/or special comment		B178	B102,103	B180	B179, 260 R773	B189			B192, 262	B191, R811	B190
Est. % of Land System		<5	5	2	60-70	< 1		< 5	10-30	<5	5-10

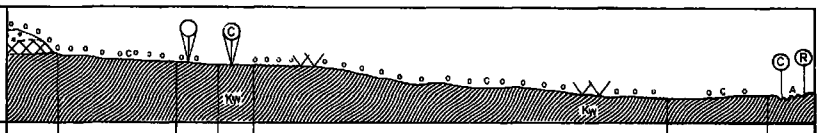
LANDFORM Flat to gently undulating plains with slopes to 2% in places.

GEOLOGY Weathered sediments of Cretaceous Winton Formation. Kw.

SOILS Shallow to moderately deep, alkaline brown cracking clays, UG 5 36, UG 5 32, predominate. Surfaces are soft and self-mulching and may be scattered with silcrete gravel. Brown clays and alluvial soils occur on the drainage lines.

VEGETATION Seasonally dependent. Predominantly a fluctuating climax between open tussock grassland composed of Mitchell grasses and other short grasses and saltbush, bassia forbland. Very sparse herbfields or areas devoid of vegetation occur. Drainage lines support gidgee tall open shrubland, mineritchie tall open shrubland or sparse herbfield to herbfield. Limited areas of gidgee tall open shrubland occur on some slopes.

F4 Morney (1200 km²)



Land Unit and/or Associated Land System	R Land Zone	F2	43	85	60	62	A5
Site and/or special comment	R787	R1238	B101, 102		B261	B260	R785
Est. % of Land System	<5	10-20	5	<2	60	10	5

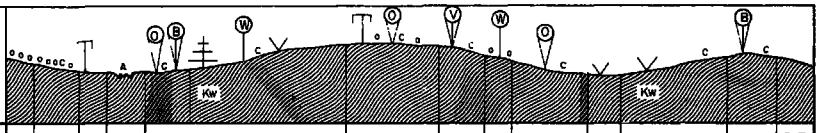
LANDFORM Flat to gently undulating plains with long slopes of 1% or less.

GEOLOGY Weathered sediments of the Cretaceous Winton Formation with mantle of stone and gravel derived from the erosion of the Tertiary land surface.

SOILS: Moderately deep to deep, stony, neutral, red and brown cracking clays UG 5.36. Dense silcrete stone pavements are characteristic, becoming more scattered on the lower slopes. On the upper slopes shallow gravelly red desert loams with stone cover are common.

VEGETATION: Seasonally dependent. Predominantly a fluctuating climax between saltbush, bassia forbland and tussock grassland composed of Mitchell grasses and other short grasses. Very sparse herbfield to herbfield are associated with the alluvia. Major alluvia support coolibah and/or river red gum fringing low open woodland with minerlitchie low open woodland to tall open shrubland occurring on drainage lines or creeks in the west. Limited areas of gidgee tall open shrubland occur on some slopes.

F5 Blackall (3320 km²)



Land Unit and/or Associated Land System	G1	67	52, 53	W3, A1	52, 53	65	52	65	57	65	80	65	T2	G,T Land Zones
Site and/or special comment		(Issford area only) B155		B13, 36, 53, 125, 137	B153	B14, 15, 29, 41, 43, 44, 46, 47, 145	B34, 35, 143		R64		B133, R674	B151, 152		
Est. % of Land System	<5	<5		5	5	50	20-30		<1		5		<5	

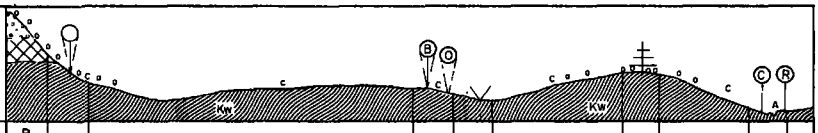
LANDFORM Flat to gently undulating (rolling) plains with slopes less than 1%, commonly with incipient gilgais.

GEOLOGY: Weathered sediments of Cretaceous Winton Formation. Kw.

SOILS Moderately deep, alkaline, self-mulching, grey and brown cracking clays UG 5.22, UG 5.35, UG 5.37, predominate. Surfaces may have some scattered pebble, becoming dense in certain areas. Brown clays with silty crusts and some grey clays occur in the drainage lines.

VEGETATION Predominantly Mitchell grass open tussock grassland to tussock grassland with other short grasses, and saltbush, bassia herbfield. Areas of Mitchell grass, mimosa open tussock grassland to mimosa low open shrubland occur frequently. Limited areas of boree, Mitchell grass low open woodland to Mitchell grass, boree open tussock grassland and Mitchell grass wooded open tussock grassland with whitewood vine-tree, boonaree, gidgee and myall conspicuous occur. Alluvia support coolibah, river red gum fringing open woodland on major drainage channels and mimosa low open shrubland on minor drainage lines. Clumps of gidgee tall open shrubland to low woodland occur frequently.

F6 Warbreccan (2710 km²)



Land Unit and/or Associated Land System	R Land Zone	G3	58	51, 52	80	59	63	59	A5	58
Site and/or special comment		B200	B64, R1248			B210, 202	B63			
Est. % of Land System		5	< 70	<2	<2	10-20	5		<5	

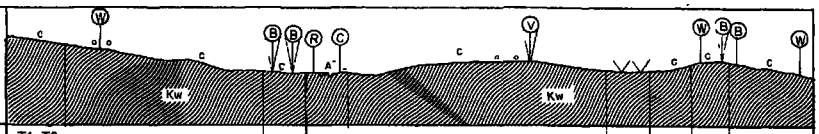
LANDFORM Flat to undulating (rolling) plains, with slopes ranging from 0.5% on long slopes to 2% in more undulating areas.

GEOLOGY Fresh sediments of Cretaceous Winton Formation. Kw.

SOILS: Shallow to moderately deep, alkaline, self-mulching, brown cracking clays, UG 5 32 predominate. Incipient gilgais are common and surfaces have scattered gravel cover in places. Brown cracking clays with silty crusts occur in the drainage lines.

VEGETATION: Predominantly Mitchell grass open tussock grassland with areas of other short grasses, bassias, saltbush herbfield. Limited areas of sparse herbfield and areas devoid of vegetation occur. Mitchell grass wooded open tussock grassland is conspicuous in places. Alluvia support coolibah, river red gum fringing open woodland on major drainage channels and mimosa low open shrubland with associated herbfield on minor drainage lines. Gidgee tall open shrubland may occur on slopes adjacent to the fringing residuals.

F7 Bimerah (3230 km²)



Land Unit and/or Associated Land System	T1, T2 and G Land Zones	64	50, 51	A5	64	80	64	51,52	64
Site and/or special comment			R734	R605	B58, 59, 130, 131, 134, 135, 162	B133		R81, 731	
Est. % of Land System			10	5	>80	<2		<2	

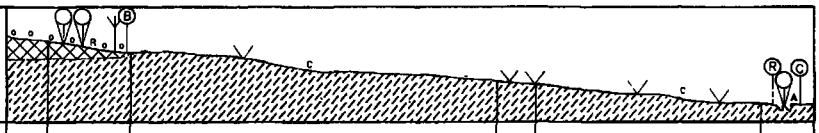
LANDFORM. Flat to very gently undulating (rolling) plains with slopes less than 2%, commonly 0.5% on long slopes.

GEOLOGY Weathered sediments of Cretaceous Winton Formation. A small area of weathered sediments of the Cretaceous Mackunda Formation is associated with the Stormhill Fault.

SOILS Moderately deep, self-mulching, alkaline, brown cracking clays throughout. UG 5.22, UG 5 32. Brown cracking clays with silty crusts occur in the drainage lines. Very minor areas with scalded surfaces occur. Scattered pebble and lumps of sandstone occur on the surface in places.

VEGETATION. Predominantly Mitchell grass open tussock grassland with other short grasses, bassia and saltbush herbfield rarely bassia, soda bush open forbland. Limited areas of Mitchell grass wooded open tussock grassland with scattered boree, gidgee, western bloodwood, whitewood and vine-tree occur. In places, these trees may form a low open woodland. Alluvia support coolibah and or river red gum fringing low open woodland on the major channels and creeks with mimosa low open shrubland and associated herbfields on minor drainage lines.

F8 Corrikie (530 km²)



Land Unit and/or Associated Land System	R3	H3, G3	68	80, 81	68	W7, A5
Site and/or special comment		R820, 821, 840	B195, 203, 211	R 839		
Est. % of Land System		10	80	5		5

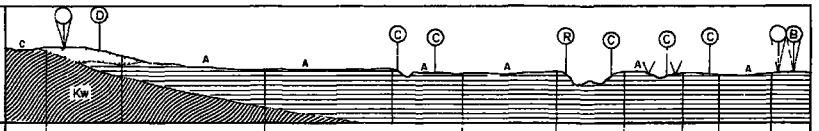
LANDFORM Flat to very gently sloping plains, with long slopes of less than 1%.

GEOLOGY· Weathered sediments of lower beds in Tertiary Glendower Formation. Tg.

SOILS Moderately deep, alkaline, red cracking clays occur throughout, usually with incipient gilgais, UG 5.37. Scattered gravel occurs on the surface. Red cracking clays with silty crusts occur in the drainage lines.

VEGETATION Seasonally dependent. Predominantly short grass open tussock grassland to Mitchell grass, short grass open tussock grassland, occasionally Mitchell grass tussock grassland. Alluvia support Cassia phyllodinea low open shrubland and herbfield with mimosa low open shrubland occurring on drainage lines. Limited areas of mulga, western bloodwood tall open shrubland, mulga sparse tall open shrubland and gidgee tall open shrubland may occur where the plains adjoin other land systems.

W1 Barcoo (1150 km²)



Land Unit and/or Associated Land System	F,G,T Land Zones	S5	77	78	71	78	70	72	76	7P	53
Site and/or special comment		B51, 52, 270	B37, 55	B36	B38		B126		B246	B222	B223
Est. % of Land System		10	Seasonal 10-40	40	10		10		<2	<2	<5

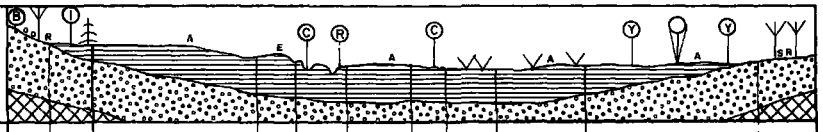
LANDFORM Flooded alluvial plains with a main and some braided channels in the lower reaches becomes restricted to a large main channel with deep waterholes.

GEOLOGY Recent alluvia. Qa.

SOILS Mainly very deep, brown and grey clays and alluvial soils with silt and sands bands common. UG 5.28, UG 5.24, UG 5.34, UG 5 38. Scalded areas are common. Sandy texture contrast soils occur in places. DY 5.43,DB 4.13, DB 3.12. Small areas of massive, poorly drained grey clays occur.

VEGETATION Predominantly coolibah, river red gum fringing open woodland occasionally coolibah low open woodland and rarely gidgee, coolibah low open woodland along major channels. Sparse herbfield to Mitchell grass open tussock grassland occur on the inter-channel plains and associated alluvia. The alluvia also support limited areas of gidgee tall open shrubland and boree, Mitchell grass low open woodland. In places a complex of gidgee low open woodland to open woodland and eastern dead finish / beefwood / bauhinia shrubby low open woodland to open woodland occurs.

W2 Millo (440 km²)



Land Unit and/or Associated Land System	H4, M3	91	94	92	70	77	71	73	78	84	S1
Site and/or special comment		B19	B118	R684	R917	R685	B13	R1253, 1254	R1252	R420, 916	
Est. % of Land System		<5	25-30	<5	5	Seasonal 5-20	5	5	Seasonal 10-20	30-35	

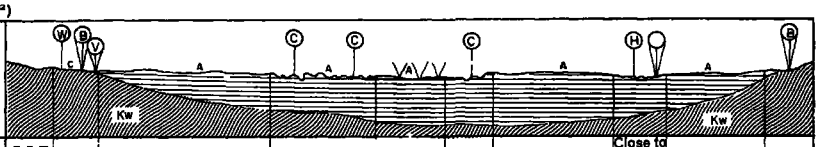
LANDFORM. Flooded alluvial plains with well defined main channels and some associated braided channels.

GEOLOGY· Quaternary alluvia. Qa.

SOILS Mainly very deep, alluvial brown and grey clays with crusts of silt and sand. UG 5.24, UG 5.28, UG 5 34. These soils are commonly subject to scalding. Areas of massive, poorly drained grey clays occur in depressions UG 5.28. Alluvial texture contrast soils occur in places as levee banks.

VEGETATION. Predominantly river red gum, coolibah fringing open woodland on major channels with yapunyah open woodland in places and gidgee low open woodland on the braided channels. Sparse herbfield to Mitchell grass open tussock grassland occur on the inter-channel plains and associated alluvia. Limited areas of coolibah low open woodland and ironwood, poplar box, sandalwood tall open shrubland to low open woodland also occur. The swamps support bluebush low open shrubland, channel millet open tussock grassland and rarely bluebush, lignum low open shrubland.

W3 Ravensbourne (1910 km²)



Land Unit and/or Associated Land System	F,G,T Land Zones	T2, T3	A1	71	73	71	Seasonal 77, 78	Close to residual land Zones 86	A1	53
Site and/or special comment			B12, 27, 36	B13, 38	B23		B28, 37, 55	B8		B153
Est. % of Land System		<5	35	25	5		20-30	<5		5-10

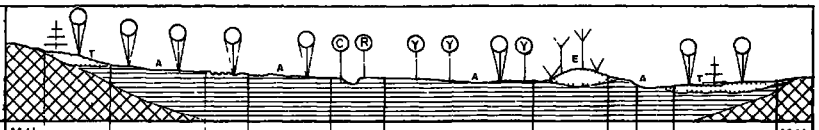
LANDFORM: Seasonally flooded, flat alluvial plains with numerous braided channels, occasionally with low ridge and swale relief between the channels.

GEOLOGY Recent alluvia. Qa.

SOILS. Deep to very deep, alkaline brown clays with silt and sand throughout, UG 5.24, UG 5.25, UG 5.31, UG 5.34, UG 5.38. Most inter-channel surfaces are self-mulching with crusts of silt and sand. Minor areas are subject to seasonal scalding. Areas of alluvial soils and some poorly drained grey clays occur.

VEGETATION: Predominantly Mitchell grass open tussock grassland on the alluvial plains with coolibah, river red gum fringing low open woodland to open woodland on channels. Limited areas of coolibah low open woodland, brigalow low open woodland, boree, Mitchell grass low open woodland to Mitchell grass, boree open tussock grassland and gidgee low open woodland to tall open shrubland occur. Swamps and depressions support bluebush low open shrubland or bluebush, lignum low open shrubland. Sparse herbfield may occur on slightly scalded areas.

W4 Springfield (1050 km²)



Land Unit and/or Associated Land System	M,H Land Zones	93	79, 81	82	79, 84	70	79, 84	D3	99	87	93	M,H Land Zones
Site and/or special comment			R902	B210		R899	B75, R897, 898	R896	R904	R901	B239, R897, 903	
Est. % of Land System			5-15	<5		2	40-50	10-15	<2	<5	20-30	

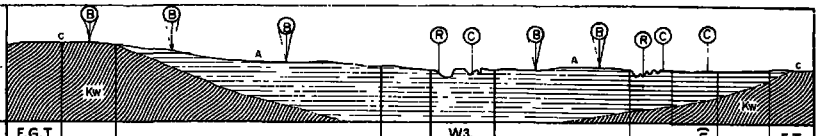
LANDFORM Alluvial plains with main channels and occasional braided channels, eroded low dunes less than 1 5 m high are common.

GEOLOGY· Recent alluvia. Qa.

SOILS Mainly very deep, brown clays UG 5.34, UG 5.38, commonly with scalded surfaces. Toward the outer margins some sandy-surfaced, red hardpan soils,GN 1.12 and texture contrast soils occur. Hardpans are often visible around the bases of low sandhills on the alluvial plains.

VEGETATION Predominantly gidgee, yapunyah low open woodland to open woodland or gidgee shrubby tall open shrubland to tall shrubland with areas of yapunyah open woodland. Coolibah, river red gum fringing open woodland to low open woodland occurs on the major channels. Swamps and depressions support swamp canegrass open tussock grassland and less frequently coolibah, lignum low open woodland. Limited areas of Cassia phyllodinea low open shrubland and open herbfield occur. Scalded areas support sparse herbfield. Sparse forbland, or low open shrubland with various species predominant, rarely mulga tall open shrubland occurs on the isolated sandhills.

W5 Fanning (180 km²)



Land Unit and/or Associated Land System	F,G,T Land Zones		53	77	W3, occasional W1	53, A1	W3	76 (Eastern)	A1	F,T Land Zones
Site and/or special comment			B45, 153, 157, 223	R724	B38			B246, R1202, 1226	R724	
Est. % of Land System	<5	5	>60	<5	5-10			5-10	10-20	

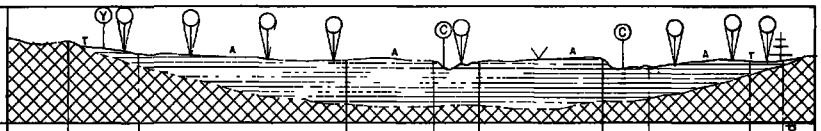
LANDFORM· Infrequently flooded flat plains associated with local alluvia and outer alluvial plains.

GEOLOGY Recent alluvia, sometimes grading into weathered sediments of the Cretaceous Winton Formation, Qa.

SOILS On the frontage country deep to very deep, alkaline brown cracking clays UG 5.31, UG 5.34 predominate. Surfaces are crusting and usually display incipient gilgais. On the eastern coolibah unit very deep, alkaline, grey cracking clays with sand bands, UG 5.29, and alluvial soils occur.

VEGETATION Predominantly boree grassy low open woodland to open woodland or Mitchell grass, boree wooded open tussock grassland with areas of Mitchell grass open tussock grassland. Coolibah, river red gum open woodland to low open woodland fringe the main channels. In the east, coolibah low open woodland occurs. Scalds support sparse herbfields.

W6 Durella (840 km²)



Land Unit and/or Associated Land System	H,M Land Zones	84	79	77	71, 82	83	71, 82	79	93	H,M Land Zones
Site and/or special comment		R897, 898	B75, 224, 235	B124	B210, R219, 489, 490	B234, 267			B115, 239	
Est. % of Land System		5-10	>60	Seasonal 10-20	5-10	10-20			5	

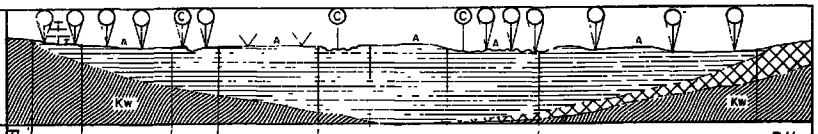
LANDFORM Flat alluvial plains with occasional minor channels.

GEOLOGY Recent alluvia. Qa.

SOILS: Very deep, red and brown alkaline cracking clays, UG 5.34, UG 5.39 predominate. Grey clays occur in depressions UG 5.24. Sand bands and silt may be present in these soils. Surfaces may exhibit moderate gilgai development. Limited areas of alluvial texture contrast soils occur.

VEGETATION Predominantly gidgee tall open shrubland to low woodland with associated herbfield. Limited areas of coolibah low open woodland and gidgee, yapunyah low open woodland to yapunyah open woodland occur. Coolibah, river red gum low open woodland to open woodland fringe the major channels. Scalds support sparse herbfields with large areas devoid of vegetation.

W7 Edkins (2060 km²)



Land Unit and/or Associated Land System	F,R Land Zones	93	79	85	83	71	Seasonal 77	82	79	R,H Land Zones
Site and/or special comment		B205		upper reaches	B267	B53		B191, 210, R811	B75, 235	
Est. % of Land System		5		<5	20	5	>5	30	30	

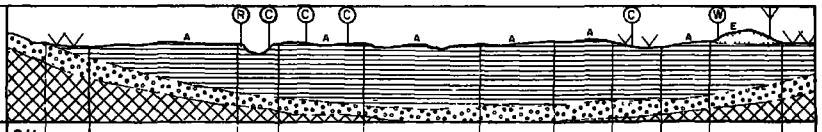
LANDFORM Seasonally flooded alluvial plains with numerous braided channels.

GEOLOGY Recent alluvia. Qa.

SOILS Mainly very deep, red and brown cracking clays UG 5.34, with silt and sand intermixed and forming thin crusts. Inter-channel areas are subject to scalding. Small areas of alluvial soils and grey clays occur.

VEGETATION Predominantly gidgee tall open shrubland rarely tall shrubland with areas of sparse herbfield to Mitchell grass open tussock grassland. Limted areas of coolibah low open woodland occur. Coolibah, river red gum open woodland to low open woodland fringe the major channels with mineritchie low open woodland to tall open shrubland on the minor channels and drainage lines. Seasonally scalded areas support sparse forblands with large areas devoid of vegetation.

C1 Cooper (3180 km²)



Land Unit and/or Associated Land System	S,H Land Zones	C3	74	70	75	C3, 71	74, 75	95	71, C3	74	D3	C2
Site and/or special comment			B174, 183, 188	B93	B173	B80, 172		B79, 163			B170	
Est. % of Land System			40	5	20	25		5-10			5	

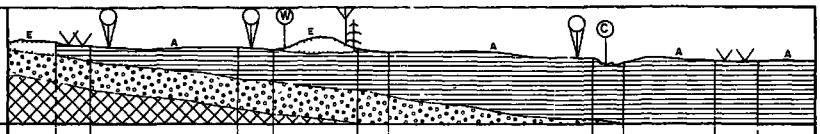
LANDFORM: Flooded alluvial plains with very low gradients of less than 1 in 5000, and numerous anastomosing channels (<1m relief), shallow flooded depressions and one or more major channels (<10m relief).

GEOLOGY. Recent alluvia. Qa.

SOILS· Predominantly very deep, alkaline, heavy grey clays which crack widely on drying. UG 5.24, UG 5.28. Silt and sand bands are common throughout. $CaCO_3$ is common in the lower parts of the profile. Very deep, poorly drained grey clays occur in swamps, while grey and brown clays (occasionally scalded) occur on the outer alluvial plains.

VEGETATION. Predominantly herbfield of various composition on flat plains and inter-channel flats with river red gum, coolibah fringing open woodland on main channels and coolibah low open woodland fringing minor channels and waterholes. Swamps and depressions support bluebush, lignum low open shrubland to bluebush low open shrubland rarely swamp canegrass open tussock grassland. Limited areas of coolibah grassy low open woodland and oldman saltbush low shrubland to low open shrubland also occur on the alluvial plains. Isolated dunes carrying sparse forbland to tall open shrubland may occur.

C2 Cunnawilla (2870 km²)



Land Unit and/or Associated Land System	S4, S6	81	95	79	D3	99	95	71	Seasonal 77	98	C1, C3	
Site and/or special comment		B111		B94	B170, 171	A197	B62, 79, 163	B125	B127	R 555		
Est. % of Land System		<2		<2	10	<2	65	5	10	<2	5-10	

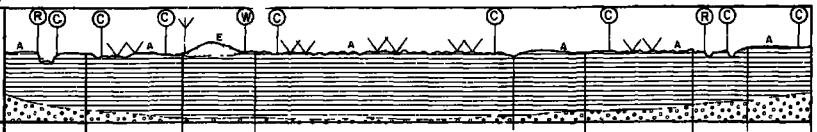
LANDFORM. Occasionally flooded, outer alluvial plains of the channel country rivers. Associated are small areas with networks of minor channels.

GEOLOGY. Recent alluvia. Qa.

SOILS. Predominantly very deep, grey and brown clays subject to seasonal scalding in places. UG 5.24, UG 5.34. Surfaces are usually crusting. Gypsum commonly occurs at depth in the profile. Associated are very deep, grey clays on the channels and poorly drained grey clays in depressions.

VEGETATION. Predominantly herbfield of various composition with swamps and depressions supporting bluebush, lignum low open shrubland, bluebush low open shrubland or rarely swamp canegrass open tussock grassland. Limited areas of coolibah low open woodland, Cassia phyllodinea low open shrubland and oldman saltbush low open shrubland occur. Drainage channels support coolibah, river red gum fringing low open woodland or coolibah low open woodland. Sparse herbfield or areas devoid of vegetation are associated with the scalds. Isolated dunes supporting sparse to open forbland or low open shrubland may occur.

C3 Woonsbootra (2850 km²)



Land Unit and/or Associated Land System	C1	72	D3	72, 73	C2	73	70, 71	74, 75
Site and/or special comment		B80, 172	B81			B61, 97	B93	B174
Est. % of Land System	>10	20	5		5-10	40	10	5-10

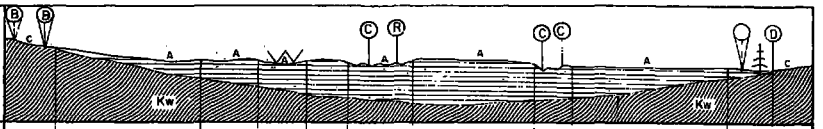
LANDFORM· Poorly drained swamps on alluvial plains, commonly with numerous minor channels less than 1m deep.

GEOLOGY. Recent alluvia. Qa.

SOILS. Very deep, grey clays with widely cracking thick crusts, usually showing polygonal cracking patterns. UG 5.24, UG 5.25, UG 5.28. Minor occurrences of alluvial soils are associated with the channels.

VEGETATION· Predominantly bluebush, lignum low open shrubland or swamp canegrass open hummock grassland. Bluebush and lignum may form pure stands in places. Areas of sparse herbfield to herbfield occur. Coolibah, lignum low open woodland and less frequently coolibah, river red gum fringing low open woodland are associated with drainage channels.

A1 Listowel (1400 km²)



Land Unit and/or Associated Land System	51, 53	78	77	73	78	71	78	76	78	79, S5	F.G,T Land Zones
Site and/or special comment	B153	B28, 37, 55	B23, 56	B23	B13, 38	B38, 53	B12, 27, 36	B246			
Est. % of Land System	5		Seasonal >10	<5		5-10	>70	<5		5-10	

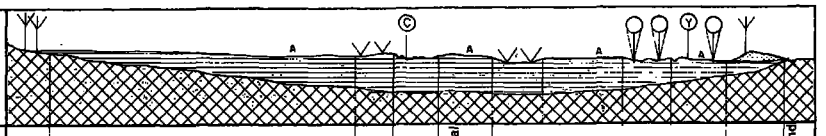
LANDFORM: Occasionally flooded alluvial plains associated with areas of braided channels in local alluvia.

GEOLOGY: Recent alluvia. Qa.

SOILS: Mainly very deep, brown, alkaline cracking clays with sand and silt throughout, UG 5.24, UG 5.25, UG 5.31, UG 5.34, UG 5.38. Limited seasonal scalding occurs. Alluvial soils may occur, and poorly drained grey clays are associated with swamp depressions.

VEGETATION: Seasonally dependent. Predominantly Mitchell grass open tussock grassland to tussock grassland with sparse herbfield to herbfield in places. Swamps and depressions support bluebush low open shrubland occasionally channel millet open tussock grassland and rarely bluebush, lignum low open shrubland. Limited areas of coolibah low open woodland, gidgee tall open shrubland and Mitchell grass, boree wooded open tussock grassland occur. Drainage channels support coolibah fringing low open woodland or coolibah, river red gum fringing low open woodland. Limited areas of eastern dead finish / beefwood / bauhinia shrubby low open woodland occur.

A2 Eromanga (1170 km²)



Land Unit and/or Associated Land System	M3, F1	94	81	71	Seasonal	77	72, 73	94	82	W4, W6	D3	M,H Land Zones
Site and/or special comment	B118, 244, 268		B180	R137, 911	B240, 242		B23, 222		B210	R909		
Est. % of Land System		>60	<2	5	>10		5		5	5-10	5-10	

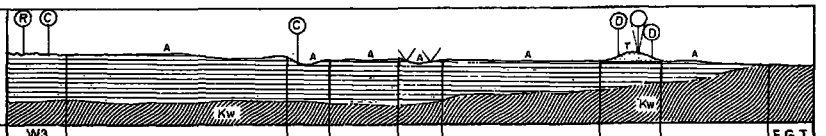
LANDFORM: Occasionally flooded flat alluvial plains with more frequently flooded areas of braided channels and 'channel country' swamps.

GEOLOGY: Recent alluvia. Qa.

SOILS: Very deep, alkaline, brown, grey and red cracking clays, UG 5.34, UG 5.38. Areas of seasonally scalded brown clays occur on the outer alluvial plains. Grey clays are associated with the frequently flooded channels and swamps. UG 5.24, UG 5.25.

VEGETATION: Seasonally dependent. Predominantly a herbfield of various composition with bassia, saltbush, short grasses and infrequently Mitchell grass predominating. Bluebush, lignum low open shrubland occur on swamps and poorly drained areas. Scalded areas support sparse forbland or are devoid of vegetation. Limited areas of coolibah low open woodland, gidgee tall open shrubland and Cassia phyllodinea low open shrubland occur. Coolibah fringing low open woodland to coolibah, river red gum fringing low open woodland are associated with the drainage channels.

A3 Nooyeah (530 km²)



Land Unit and/or Associated Land System	W3, other alluvial Land Zones	77	76	77	80	78, 83	S5	77	F.G,T Land Zones
Site and/or special comment		B28, 37, 55, 242	B246		B133	B36	B51, 52, 245, 271		
Est. % of Land System		>80	<5		<2	10	5		

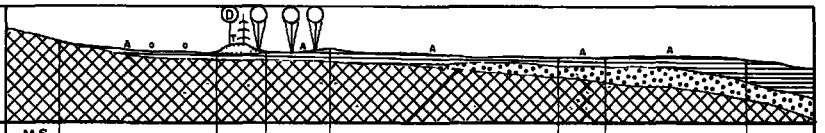
LANDFORM: Flat alluvial plains, most commonly associated with outer margins of alluvial areas. Deflation may be evident.

GEOLOGY: Recent alluvia. Qa.

SOILS: Predominantly brown and grey clays and alluvial soils with scalded surfaces and strong crusts (up to 2cm thick), which may be vesicular or platy. Reaction trend is neutral to alkaline. Strongly structured subsoils occur under these crusts. UG 5.24, UG 5.38. Varying degrees of scalding occur depending on present and previous seasonal conditions.

VEGETATION: Seasonally dependent. Predominantly sparse herbfield infrequently tussock grassland and rarely Mitchell grass open tussock grassland with large areas devoid of vegetation. Limited areas of coolibah low open woodland occur. Some minor drainage lines support mimosa low open shrubland. In places eastern dead finish / beefwood / bauhinia shrubby low open woodland and gidgee tall open shrubland are conspicuous.

A4 Jundah (260 km²)



Land Unit and/or Associated Land System	M,S Land Zones	96	93	79	96	78	96	C2
Site and/or special comment			B214	B75	B90, 167	B74		B215
Est. % of Land System			<5	5-10	70	<5		10

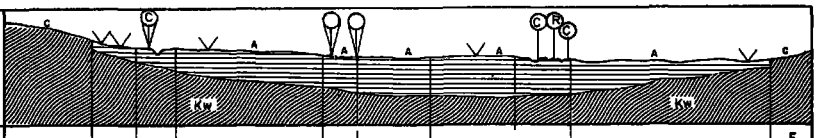
LANDFORM: Rarely flooded flat alluvial plains fringing the Thomson River.

GEOLOGY: Cainozoic alluvia.

SOILS: Predominantly very deep, red and brown cracking clays with crusting surfaces, sometimes scattered with gravel. UG 5.38. On the outer margins areas of texture contrast soils with hardsetting sandy surfaces occur. DR 2.13.

VEGETATION: Seasonally dependent. Predominantly open herbfield to herbfield of various composition or Mitchell grass open tussock grassland to tussock grassland. Limited areas of gidgee tall open shrubland occur. Saltbush / bassia / short grass herbfield to sparse herbfield are associated with scalds. In places eastern dead finish / beefwood / bauhinia shrubby low open woodland to open woodland occur.

A5 Dingera (1570 km²)



Land Unit and/or Associated Land System	F2, F3, F4, F6	81	85	83	82	Seasonal 77	83	71	83	F Land Zone
Site and/or special comment		B180	R1232, 1233	B109, 166, 234, 267	B191	B84		R86, 827, 828		
Est. % of Land System		5	<5	60	<5	>10		5-10		

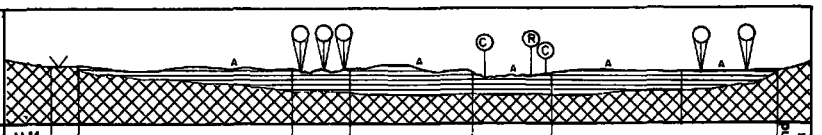
LANDFORM: Flat alluvial plains with single or braided channels.

GEOLOGY: Recent alluvia. Qa.

SOILS: Predominantly deep to very deep, brown clays, with crusting surfaces, commonly with silt and sand intermixed. UG 5.34. Small areas of red and grey clays occur. Associated with the drainage lines are some alluvial texture contrast soils. Scalded areas may occur on the outer alluvia.

VEGETATION: Seasonally dependent. Mainly open herbfield to tussock grassland with bassia, saltbush and short grass conspicuous occasionally Mitchell grass open tussock grassland. Limited areas of coolibah low open woodland or gidgee tall open shrubland occur. Minor drainage channels support Cassia spp. low open shrubland or mineritchie tall open shrubland. Coolibah fringing low open woodland, coolibah, river red gum fringing low open woodland or mineritchie low open woodland occur on major channels or creeks. Sparse forblands or areas devoid of vegetation are associated with the scalds.

A6 Warry (1470 km²)



Land Unit and/or Associated Land System	H,M Land Zones	90	94	83	Seasonal 77	71	94	W6	H,M Land Zones
Site and/or special comment		B120	B118, 244, 268	R142	B240, 242	B13			
Est. % of Land System		<5	70	<5		5-10		10-20	

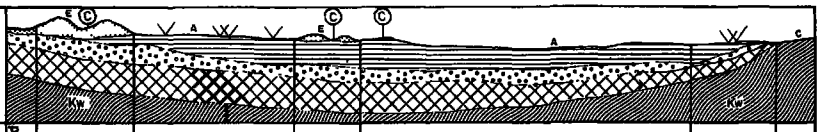
LANDFORM: Alluvial plains of minor streams with well defined main channel and / or minor channels.

GEOLOGY Recent alluvia. Qa.

SOILS: Predominantly alluvial soils, commonly with texture contrasts, DR 1.12, DR 1.13, DR 2.12, DR 2.13, DY 2.12 on the channels and adjacent plains, with red and brown clays and texture contrast soils on the outer alluvial plains. Associated are claypans and scalded areas. Minor occurrences of red earths.

VEGETATION: Predominantly open herbfield to Mitchell grass open tussock grassland with areas of mulga, western bloodwood tall open shrubland and mulga tall open shrubland rarely mulga, poplar box tall open shrubland. Limited areas of gidgee tall open shrubland, western bloodwood low open woodland, coolibah low open woodland and Cassia phyllodinea low open shrubland occur. Coolibah, river red gum fringing low open woodland occurs on the maior channels. Scalded areas support sparse forbland or areas devoid of vegetation.

L1 Cuddapan (70 km²)



	D.S.Land Zones						
Land Unit and/or Associated Land System		D4	88	D4	87, 23	88	F2
Site and/or special comment			B106, 107		B108, R570		
Est. % of Land System		5-10	35		60		

LANDFORM: Occasionally flooded shallow depressions, forming major lakes when flooded, usually surrounded by dunes of various sizes.

GEOLOGY: Quaternary alluvia. Qa.

SOILS: Predominantly grey and brown cracking clays commonly mottled at depth with sand throughout UG 5.28, UG 5.34. Surfaces are crusting and crack widely. Associated on the outer margins are texture contrast soils on low wind-blown rises, DY 3.12.

VEGETATION: Predominantly swamp canegrass open hummock grassland with areas of bluebush low open shrubland and sparse herbfields to open tussock grasslands of various composition. Limited areas of coolibah low open woodland or coolibah, lignum low open woodland occur at the edge of the lakes. Low windblown sand rises support various forblands to tussock grassland.

LAND UNITS

By J.R. Mills and D.E. Boyland.

LAND UNIT 1

LANDFORM:

Mobile crests and upper flanks of longitudinal dunes. Slopes 6 - 80%. Crests are commonly rounded on the western side and steeper on the eastern side.

GEOLOGY:

Aeolian Quaternary sands.

SOILS:

Very deep, loose, slightly acid to neutral, red siliceous sands. Textures range from coarse sand to sand. Surfaces are loose. Uc1.23 *Ullenburry.*

VEGETATION:

(A) Bluebush pea, grassy open forbland rarely *Grevillea stenobotrya* tall open shrubland. Usually the vegetation is sparse with *Crotalaria eremaea* (bluebush pea) predominating forming a distinct ground layer with a very discontinuous canopy. Frequently areas devoid of vegetation are associated. Scattered tall shrubs or low trees may emerge and in places may form a tall open shrubland with *Grevillea stenobotrya* predominating. Isolated low shrubs may occur. The ground cover is sparse composed of forbs and grasses.

STRUCTURAL FORMATION: Open forbland.

TREE/TALL SHRUB LAYER: Ht 3 ± 1m; PFC usually < 1% in places up to 5%; density usually < 30 shrubs/ha, rarely 350 shrubs/ha.

FREQUENT SPP: *Grevillea stenobotrya.*

INFREQUENT SPP: *Acacia aneura* (rare), *Atalaya hemiglauca, Hakea divaricata, Owenia acidula.*

LOW SHRUB LAYER: Ht 1.5 ± 0.5m; PFC < 1%; density < 25 shrubs/ha.

INFREQUENT SPP: *Acacia dictyophleba, A. ligulata, A. tetragonophylla, Cassia notabilis, C. pleurocarpa.*

GROUND LAYER: Ht < 0.75m; PFC (variable) usually 2.5 ± 2% in places 20%.

FORBS:

FREQUENT SPP: *Calotis erinacea, C. inermis, Crotalaria cunninghamii, C. eremaea, Ptilotus polystachyus, Salsola kali, Senecio gregorii, Trachymene glaucifolia, Tribulus hystrix, T. occidentalis.*

INFREQUENT SPP: *Bassia paradoxa, Blennodia pterosperma, Boerhavia diffusa, Brachyscome ciliocarpa, Calandrinia balonensis, C. ptychosperma, C. volubilis, Calocephalus multiflorus, Cleome viscosa, Cucumis myriocarpus, Erodium crinitum, Euphorbia drummondii, E. tannensis* ssp. *eremophila* var. *eremophila, E. wheeleri, Glinus lotoides, Haloragis gossei, Helichrysum semifertile, Helipterum floribundum, H. moschatum, Hibiscus krichauffianus, Indigofera colutea, Ipomoea polymorpha, Lepidium rotundum, Myriocephalus stuartii, Newcastelia cephalantha, Nicotiana velutina, Phyllanthus fuernrohrii, Portulaca* sp. aff. *P. oleracea, Psoralea* sp. aff. *P. eriantha, Ptilotus latifolius, Scaevola depauperata, S. ovalifolia, Swainsona campylantha, S. phacioides, Tephrosia benthamii, T. sphaerospera.*

GRAMINOIDS:

FREQUENT SPP: *Aristida armata, A. browniana, Eragrostis eriopoda, Eriachne aristidea, Plagiosetum refractum.*

INFREQUENT SPP: *Bulbinopsis semibarbata, Dactyloctenium radulans, Eragrostis basedowii, Triodia basedowii* (rare), *Triraphis mollis, Xerochloa laniflora*

VEGETATION:

(B) Sandhill canegrass open hummock grassland. The shrublike grass *Zygochloa paradoxa* (sandhill canegrass) predominates forming scattered clumps with bare areas between the clumps. *Crotalaria eremaea* is frequently conspicuous. Forbs are usually present. In places stunted *Acacia dictyophleba* occurs on the crest.

STRUCTURAL FORMATION: Open hummock grassland.

LOW SHRUB LAYER: Ht < 1.5m; PFC < 1%; density < 10 shrubs/ha.

INFREQUENT SPP: *Acacia dictyophleba.*

GROUND LAYER: Ht < 1.3m; PFC < 2%.

PREDOMINANT SPP: *Zygochloa paradoxa,* Ht < 1.3m; PFC < 1%.

FORBS:

FREQUENT SPP: *Crotalaria eremaea, Salsola kali, Tribulus hystrix.*

INFREQUENT SPP: *Blennodia pterosperma, Crotalaria cunninghamii, cunninghamii, Daucus glochidiatus.*

GRAMINOIDS:

FREQUENT SPP: *Plagiosetum refractum.*

LAND USE:

Low and unreliable rainfall limiting, useful for grazing at very low stocking rates only, vegetation present sparse, but responds well to light falls of rain; negligible standover feed; topfeed virtually absent; poisonous plants conspicuous; drought grazing capacity nil; very low AWC; very low fertility, naturally unstable. Condition mediocre; trend stable.

SITES: B83, 104, 186. R119, 560, 759, 1231.

LAND UNIT 2

LANDFORM:

Dunes with blown out crests and upper flanks forming a reticulate network of sand ridges less than 10m in height, with slopes from 7 - 25% on the flanks.

GEOLOGY:

Aeolian Quaternary sands.

SOILS:

Very deep, slightly acid red siliceous sands with textures ranging from sand to loamy sand. Surfaces are loose. Uc 1.23, Uc 5.21 *Ullenburry.*

VEGETATION:

Spinifex wooded open hummock grassland to hummock grassland. *Triodia basedowii* (spinifex) predominates forming a well defined layer with a continuous canopy. Scattered trees and low shrubs occur emerging above the grass canopy. Ground flora is variable composed of grasses and forbs depending on seasonal conditions.

STRUCTURAL FORMATION: Open hummock grassland to hummock grassland.

TREE/TALL SHRUB LAYER: Ht 3 ± 1m; PFC < 1%, density < 25 shrubs/ha.

INFREQUENT SPP: *Eucalyptus kingsmillii* (rare), *Grevillea stenobotrya.*

LOW SHRUB LAYER: Ht 1 ± 0.5m, PFC < 1%, density 80 ± 70 shrubs/ha.

FREQUENT SPP: *Dodonaea angustissima.*

GROUND LAYER: Ht < 1.5m; PFC 20 ± 10%.

PREDOMINANT SPP: *Triodia basedowii.*

FORBS:

FREQUENT SPP: *Calandrinia balonensis, Crotalaria cunninghamii, C. eremaea, Euphorbia drummondii, E. tannensis* spp. *eremophila* var. *eremophila, Helipterum roseum, Ptilotus polystachyus, Salsola kali, Tribulus occidentalis, T. terrestris.*

INFREQUENT SPP: *Bassia convexula, Blennodia pterosperma, Helichrysum semifertile, Hibiscus krichauffianus, Ipomoea polymorpha, Scaevola depauperata, S. ovalifolia, Tephrosia benthamii, T. supina.*

GRAMINOIDS:

FREQUENT SPP: *Aristida armata, A. browniana, Dactyloctenium radulans, Eragrostis basedowii, E. eriopoda, Eriachne aristidea, Triraphis mollis.*

INFREQUENT SPP: *Chloris pectinata, Eragrostis tenellula, Parotis rara, Tragus australianus.*

LAND USE:

Low and unreliable rainfall limiting; production insignificant; vegetation responds well to light falls of rain; limited standover feed; poisonous plants conspicuous; topfeed virtually absent; drought grazing capacity nil; very low AWC; very low fertility; naturally unstable. Condition fair; trend stable.

SITES: B176.

LAND UNIT 3

LANDFORM:

Rounded upper flanks of low dunes, formed on alluvial plains.

GEOLOGY:

Aeolian sands overlying Quaternary alluvium.

SOILS:

Very deep, slightly acid to neutral, red and occasionally yellow, siliceous sands and earthy sands. Surfaces are loose and weakly crusting. Uc 1.23. Very low C and N; fair K; low to very low AP and BP; very low CEC and cation values.

VEGETATION:

Woollybutt, bluebush pea wooded open tussock grassland to mulga, hopbush tall open shrubland. The structure and floristic composition of this unit is variable and is dependent on local environmental conditions. Grasses mainly *Eragrostis eriopoda* (woollybutt) and forbs such as *Crotalaria eremaea* (bluebush pea) form a well defined lower layer with emerging trees and tall shrubs. In places the shrubs, mainly *Acacia aneura* (mulga), form a well defined tall shrub layer with a discontinuous canopy. Scattered low shrubs occur but *Dodonaea angustissima* (hopbush) may form a well defined low shrub layer in some situations. Ground flora is variable and depends on seasonal conditions. Large areas devoid of vegetation may be associated with this unit.

STRUCTURAL FORMATION: Usually open tussock grassland rarely tall open shrubland.

TREE/TALL SHRUB LAYER: Ht 4.5 ± 1.5m; PFC usually < 1% in places up to 5%; density usually < 25 shrubs/ha, in places up to 200 shrubs/ha.

FREQUENT SPP: *Lysiphyllum gilvum.*

INFREQUENT SPP: *Acacia aneura* (in the region of Kyabra Creek, *A. aneura* forms tall open shrublands), *Hakea chordophylla, H. divaricata.*

LOW SHRUB LAYER: Ht 1.25 ± 0.75m; PFC usually < 1% in places 10%, density usually < 25 shrubs/ha in places 1000 shrubs/ha.

FREQUENT SPP- *Acacia tetragonophylla, Dodonaea angustissima.*

INFREQUENT SPP. *Acacia farnesiana* (rare), *Cassia nemophila* var. *zygophylla.*

GROUND LAYER: Ht < 0.75m; PFC (variable) 12.5 ± 7.5%.

FORBS:

FREQUENT SPP: *Crotalaria eremaea, Ipomoea polymorpha, Ptilotus obovatus, P. polystachyus, Salsola kali, Tribulus occidentalis.*

INFREQUENT SPP: *Abutilon otocarpum, Boerhavia diffusa, Brachyscome ciliocarpa, Calandrinia balonensis, Hibiscus kirchauffianus, Helichrysum semifertile, Helipterum floribundum, H. moschatum, Indigofera linnaei, Myriocephalus stuartii, Nicotiana velutina, Portulaca sp. aff. P. oleracea, Scaevola depauperata, S. ovalifolia, Tephrosia supina.*

GRAMINOIDS:

FREQUENT SPP: *Eragrostis basedowii, E. eriopoda.*

INFREQUENT SPP: *Aristida armata, A. browniana, A. ingrata, Brachiaria miliiformis, Dactyloctenium radulans, Triodia basedowii, Tragus australianus.*

LAND USE:

Rainfall low and unreliable; responds well to light falls of rain; considerable variation in productivity occurs throughout the distribution of this unit; limited standover feed and sparse topfeed in areas east of Cooper Creek; in western areas supports limited ephemeral pastures; serves as a refuge for animals in floodtime; subject to overgrazing and subsequent erosion; drought grazing capacity limited; low AWC; very low fertility.
Condition: poor to mediocre. Trend: slightly upward.

SITES: B81, 170.

LAND UNIT 4

LANDFORM:

Extended lower flanks of dunes on alluvia. Slopes 1-2%.

GEOLOGY:

Aeolian sands over Quaternary alluvium.

SOILS:

Very deep, red and brown, texture contrast soils with loamy coarse sands overlying alkaline, sandy, mottled clays. Hardpans may be present. Surfaces are loose to weakly crusting. DY 5.52, DR4.12. Very low C and N; very fair to high K; AP and BP, ranging from low on the Barcoo River to very fair on the Cooper Creek flood plain.

VEGETATION:

Mixed low open woodland rarely budda bush low open shrubland. Scattered trees of *Grevillea striata* (beefwood), *Eucalyptus terminalis* (western bloodwood), *Atalaya hemiglauca* (whitewood) and *Lysiphyllum gilvum* (bauhinia) form a low open woodland with a very discontinuous canopy. Isolated low shrubs may occur and in places form a well defined layer. Ground cover is variable composed of grasses and forbs.

A variant of this unit occurs in places. *Eremophila sturtii* (budda bush) forms a well defined low shrub layer with emergent trees. Ground flora is variable.

STRUCTURAL FORMATION: Low open woodland.

TREE/TALL SHRUB LAYER: Ht 8 ± 2m; PFC < 1%; density 30 ± 20 trees/ha.

FREQUENT SPP: *Atalaya hemiglauca, Eucalyptus terminalis, Grevillea striata.*

INFREQUENT SPP: *Lysiphyllum gilvum, Codonocarpus cotinifolius, Ventilago viminalis.*

LOW SHRUB LAYER: Ht 1.25 ± 0.75m; PFC usually < 1%, in places 15%; density usually < 150 shrubs/ha, in places up to 1500 shrubs/ha.

FREQUENT SPP: *Acacia tetragonophylla, Eremophila sturtii.*

INFREQUENT SPP: *Eremophila duttonii.*

GROUND LAYER: Ht < 0.7m; PFC < 10%, up to 20% in places.

FORBS:

FREQUENT SPP: *Abutilon otocarpum, Boerhavia diffusa.*

INFREQUENT SPP: *Atriplex* spp., *Bassia* spp.

GRAMINOIDS:

FREQUENT SPP: *Aristida browniana, Eragrostis eriopoda.*

INFREQUENT SPP: *Aristida anthoxanthoides, A. armata, Dactyloctenium radulans, Enneapogon polyphyllus.*

LAND USE:

Unit makes insignificant contribution to total pasture; rainfall low and unreliable; responds to light falls of rain: limited standover feed, very scattered edible shrubs; potential woody weed problem; drought grazing capacity negligible; subject to overgrazing and subsequent erosion; very low AWC; fertility variable, usually low.
Condition: poor to mediocre. Trend: stable to slightly downwards.

SITES: B 95, 128.

LAND UNIT 5

LANDFORM:

Flat to very gently undulating sandplains. Slopes < 1%.

GEOLOGY:

Aeolian Quaternary sands.

SOILS:

Deep to very deep, slightly acid to neutral, red earthy sands and occasional red, siliceous sands. Textures usually increase from coarse sands and loamy coarse sands to coarse sandy loams. Surfaces are loose to weakly crusting. UC5.11, UC1.43, UC1.23. Neutral to very strongly acid pH; very low to fair K; very low C, N, AP, BP, CEC and cation values (K, Ca and Mg may be limiting in some cases). *Michells, Ullenburry.* Representative soil analysis B78, 82, 113.

VEGETATION:

Spinifex wooded open hummock grassland to hummock grassland. *Triodia basedowii* (spinifex) predominates forming a distinct ground layer with a very discontinuous canopy. Scattered trees and tall shrubs are usually present emerging above the canopy and in places approach a tall open shrubland with an understorey of *T. basedowii*. Usually isolated low shrubs occur and may form a well defined layer in some situations. Ground cover is variable with the areas between the hummock of *T. basedowii* devoid of vegetation or supporting short grasses and forbs.

STRUCTURAL FORMATION: Open hummock grassland to hummock grassland.

TREE/TALL SHRUB LAYER: Ht 7 ± 3m; PFC usually < 1% (in places 5 ± 2.5%) density < 70 trees/ha.

FREQUENT SPP: *Acacia aneura, A. coriacea, Atalaya hemiglauca, Eucalyptus papuana, E. terminalis, Grevillea juncifolia, Hakea chordophylla, H. divaricata, H. leucoptera.*

INFREQUENT SPP: *Acacia cowleana, A. melleodora* (rare), *A. ramulosa, Clerodendrum floribundum, Codonocarpus cotinifolius, Grevillea stenobotrya, G. striata, Owenia acidula, Ventilago viminalis* (rare).

LOW SHRUB LAYER: Ht 1.25 ± 0.75m; PFC (variable) 5 ± 5%; density 600 ± 550 shrubs/ha.

FREQUENT SPP: *Acacia ligulata, A. murrayana, A. tetragonophylla, Cassia artemisioides, C. desolata, C. nemophila* var. *zygophylla, C. oligophylla, C. notabilis, C. pleurocarpa, Dodonaea angustissima, Enchylaena tomentosa, Eremophila duttonii, E. obovata.*

INFREQUENT SPP: *Acacia adsurgens, A. maitlandii* (rare), *Calytrix longiflora, Eremophila goodwinii, E. maculata. E. latrobei, Gyrostemon ramulosus.*

GROUND LAYER: Ht < 1m; PFC 25 ± 15%

PREDOMINANT SPP: *Triodia basedowii;* Ht < 1m; PFC 20 ± 10%.

FORBS:

FREQUENT SPP: *Brunonia australis, Calandrinia balonensis, Calocephalus multiflorus, Calotis erinacea, C. multicaulis, C. porphyroglossa, Crotalaria eremaea, Euphorbia drummondii, E. wheeleri, Evolvulus alsinoides, Goodenia mitchellii, Helipterum floribundum, H. moschatum, Ipomoea polymorpha, Lepidium rotundum, Kennedia prorepens, Maeogregoria racemigera, Nicotiana velutina, Portulaca sp. aff. P. oleracea, Ptilotus obovatus, P. polystachyus, Salsola kali, Scaevola depauperata, S. ovalifolia, Senecio gregorii, Trachymene glaucifolia, Tribulus terrestris.*

INFREQUENT SPP: *Bassia bicornis, B. convexula, B. ventricosa, Bonamia media, Calandrinia ptychosperma, Brachyscome ciliocarpa, B. curvicarpa, Centipeda thespidioides, Gossypium australe, Halgania cyanea, Haloragis gossei, Helichrysum odorum* var. *arachnoideum, H. ramosissimum, Heliotropium tenuifolium, Helipterum molle, Hibiscus kirchauffianus, H. sturtii, Maireana tomentosa, Myriocephalus stuartii, Newcastelia cephalantha* var. *cephalantha, N. cephalantha* var. *oblonga, Phyllanthus fuernrohrii, P. rhytidospermus, Pimelea trichostachya, Rutidosis helichrysoides, Scaevola collina, Sida platycalyx, Solanum esuriale, Swainsona microphylla* ssp. *affinis, S. oroboides, Tephrosia benthamii, Trichodesma zeylanicum.*

GRAMINOIDS:

FREQUENT SPP: *Aristida browniana, A. inaequiglumis, A. ingrata, Dactyloctenium radulans, Enneapogon polyphyllus, Eragrostis basedowii, E. cumingii, E. eriopoda, Eriachne aristidea, E. helmsii, E. mucronata.*

INFREQUENT SPP: *Aristida armata, Bulbostylis barbata, Fimbristylis dichotoma, Paraneurachne mvelleri, Panicum australiense, Perotis rara, Sehoenus subaphyllus, Thyridolepis xerophila, Tragus australianus, Tripogon loliiformis, Triraphis mollis.*

LAND USE:

Provides valuable and durable low grazing capability pastures; low and unreliable rainfall limiting; responds well to light falls of rain and resultant ephemeral pastures lift grazing capacity; limited standover feed; sparse topfeed in places; very low drought grazing capacity; very low to low AWC (infiltration rates high); very low fertility; susceptible to erosion if burnt or overgrazed, particularly round watering points. Condition: fair. Trend: stable.

SITES: B77, 78, 82, 91, 113, 232, 259.

LAND UNIT 6

LANDFORM:

Flat to very gently undulating plains. Slopes < 1%.

GEOLOGY:

Quaternary deposits overlying the Tertiary land surface.

SOILS:

Deep to very deep, acid, sandy red earths. In the intergrove textures are coarse sandy loams grading into sandy clay loams. Grove areas have sandy clay loams grading into sandy clays at depth. Surfaces are generally hard setting. GN2.11, GN2.12. Medium to very strongly acid pH; very low C and N; low to very fair K; very low to low AP and BP; very low CEC and cation values (Ca and Mg may be limiting).
Bulgroo (grove) Representative soil analysis. B69.
Woomelang (intergrove) Representative soil analysis. B 70.

VEGETATION:

Mulga tall open shrubland to mulga, western bloodwood tall open shrubland, distinctly groved. In the groves *Acacia aneura* (mulga) predominates with *Eucalyptus terminalis* (western bloodwood) emerging

above the distinct but discontinuous canopy. Other scattered trees may occur. Low shrubs are usually present and in places form a distinct low shrub layer. Ground cover is variable composed of grasses and forbs. The intergroves support open herbfield with very scattered low shrubs, tall shrubs and trees.

GROVE:

STRUCTURAL FORMATION: Tall open shrubland.

TREE/TALL SHRUB LAYER: Ht 5 ± 1m; PFC 7.5 ± 2.5%; density 425 ± 300 shrubs/ha.

PREDOMINANT SPP: *Acacia aneura** Ht 4.5 ± 0.5m; PFC 7.5 ± 2.5%.

FREQUENT SPP: *Eucalyptus terminalis**.

INFREQUENT SPP: *Acacia coriacea** (rare), *Grevillea striata*, *Hakea chordophylla** (rare).

LOW SHRUB LAYER: Ht 1.25 ± 0.25m; PFC (variable) 5 ± 4.5%; density 550 ± 500 shrubs/ha.

FREQUENT SPP. *Eremophila bowmanii**.

INFREQUENT SPP: *Cassia desolata**, *C. notabilis**, *Eremophila gilesii**.

GROUND LAYER: Ht < 1m; PFC 10 ± 9%.

FORBS:

FREQUENT SPP: *Bassia cornishiana**, *Evolvulus alsinoides**, *Mairecna villosa**, *Sida platycalyx**.

INFREQUENT SPP: *Calotis xanthosioidoa**, *Goodenia subintegra**, *Helipterum floribundum**, *Polycarpaea microphylla*, *Portulaca filifolia**, P. sp. aff. *P. oleracea*.

GRAMINOIDS:

FREQUENT SPP: *Aristida armata*, *A. contorta**, *A. ingrata**, *Digitaria brownii*, *Eragrostis eriopoda**, *Tripogon loliiformis**.

INFREQUENT SPP: *Aristida browniana**, *Enneapogon polyphyllus**, *Eriachne aristidea**, *E. mucronata**, *E. pulchella**, *Monachather paradoxa*.

INTERGROVE:

STRUCTURAL FORMATION: Open Herbfield. Ht < 1m; PFC 15 ± 10%.

TREE/TALL SHRUB LAYER: Ht 5 ± 1m; PFC < 1%; density < 5 shrubs/ha.

LOW SHRUB LAYER: Ht < 1m; PFC < 1%; density usually < 25 shrubs/ha., in places PFC 10%; density 1000 shrubs/ha.

GROUND LAYER: Ht < 1m; PFC 15 ± 10%.

LAND USE:

Capable of producing good pastures but is susceptible to overuse in droughts with subsequent degradation; distinctly groved; intergrove contributes little to total pasture; useful standover feed and good topfeed in groves; valuable drought reserve with medium grazing capacity; AWC low in groves, very low in intergroves; fertility very low throughout but better in grove areas.
Condition: fair to good. Trend: slightly upward.

SITES: B 69, 70, 213.

* Species which occur in the intergrove.

LAND UNIT 7

LANDFORM:

Flat to very gently undulating plains. Slopes < 1%.

GEOLOGY:

Quaternary deposits overlying the Tertiary land surface.

SOILS:

Deep, acid to neutral, sandy red earths. Textures range from sandy loams and clay loams to sandy clays. Most surfaces are hardsetting. Ironstone shot occurs on the surface and throughout the profile in limited areas. GN2.11, GN2.12. Strongly to extremely acid pH; low to very low C and N; very low AP and BP; Mg may be limiting. *Woomelang*. Representative soil analysis B 20.

VEGETATION:

Mulga grassy tall shrubland to tall open shrubland. *Acacia aneura* (mulga) predominates usually with scattered trees emerging above the distinct but discontinuous canopy. A low shrub layer is not well defined but scattered low shrubs may occur. Ground cover is variable composed of grasses and forbs.

STRUCTURAL FORMATION: Tall shrubland to tall open shrubland.

TREE/TALL SHRUB LAYER: Ht 5 ± 1m; PFC 10 ± 5%; density 800 ± 400 shrubs/ha.

PREDOMINANT SPP: *Acacia aneura*, Ht 5 ± 1m; PFC 10 ± 5%.

FREQUENT SPP: *Codonocarpus cotinifolius* (more prevelant in disturbed sites).

INFREQUENT SPP: *Brachychiton populneum*, *Eucalyptus populnea*.

LOW SHRUB LAYER: Ht < 1.25m; PFC usually < 1%; density < 25 shrubs/ha.

INFREQUENT SPP: *Acacia aneura*, *Cassia artemisioides*, *C. sturtii*, *Eremophila bowmanii*.

GROUND LAYER: Ht < 0.75m; PFC (variable) 20 ± 15%.

FORBS:

FREQUENT SPP: *Abutilon otocarpum*, *Euphorbia tannensis* ssp. *eremophila* var. *eremophila*, *Maireana villosa*, *Ptilotus polystachyus*, *Sida filiformis*, *S. platycalyx*, *Trachymene ochracea*.

INFREQUENT SPP: *Euphorbia drummondii*, *Evolvulus alsinoides*, *Sida cunninghamii*, *Solanum ellipticum*, *S. ferocissimum*, *Swainsona microphylla* spp. *affinis*.

GRAMINOIDS:

FREQUENT SPP: *Aristida ingrata*, *Digitaria ammophila*, *D. brownii*, *Eragrostis eriopoda*, *Monachather paradoxa*, *Neurachne mitchelliana*, *Thyridolepis mitchelliana*, *Tripogon loliiformis*.

INFREQUENT SPP: *Aristida armata*, *A. contorta*, *A. inaequiglumis*, *Eriachne helmsii*, *E. mucronata*, *Themeda australis*.

LAND USE:

Capable of providing valuable and moderately durable perennial grass pasture; productivity can be increased by selective thinning; woody weeds may be a problem particularly after fire or excessive clearing; good topfeed; valuable drought reserve; low AWC; low fertility.
Condition: fair. Trend: stable to slightly downwards.

SITES: B20, 21, 22.

LAND UNIT 8

LANDFORM:

Flat to very gently undulating plains. Slopes < 1%.

GEOLOGY:

Tertiary *Glendower Formation*.

SOILS:

Moderately deep to deep, sandy red earths. Textures range from coarse sandy loams to light clays at depth. Surfaces are sandy and hardsetting. GN2.11. Strongly to extremely acid pH; very low C, N, AP and BP. *Woomelang*. Representative soil analysis B17.

VEGETATION:

Mulga tall open shrubland. *Acacia aneura* (mulga) predominates with scattered *Eucalyptus terminalis* (western bloodwood) emerging. Low shrubs, mainly *Eremophila* spp., occur forming a well defined layer in places. Where *A. aneura* has been disturbed, suppressed *A. aneura* seedlings may form a dense low shrub layer. Ground cover is variable but in undisturbed areas rarely exceeds 10%.

STRUCTURAL FORMATION: Tall open shrubland to infrequently tall shrubland.

TREE/TALL SHRUB LAYER: Ht 7 ± 1m; PFC 6 ± 4%; density 300 ± 200 shrubs/ha.

PREDOMINANT SPP: *Acacia aneura*, Ht 7 ± 1m; PFC 6 ± 4%.

FREQUENT SPP: *Eucalyptus terminalis*.

LOW SHRUB LAYER: Ht 1.5 ± 0.5m; PFC (variable) 10 ± 10%; density 1000 ± 1000 shrubs/ha.

FREQUENT SPP: *Acacia aneura*, *Eremophila bowmanii*, *E. gilesii*.

INFREQUENT SPP: *Cassia artemisioides*, *C. nemophila* var. *nemophila*.

GROUND LAYER: Ht < 0.75m; PFC 5 ± 5% (up to 30% in disturbed areas).

FORBS:

FREQUENT SPP: *Sida filiformis*, *S. platycalyx*.

INFREQUENT SPP: *Bassia convexula*, *Solanum ellipticum*.

GRAMINOIDS:

FREQUENT SPP: *Aristida armata*, *A. contorta*, *A. ingrata*, *Digitaria ammophila*, *Eragrostis eriopoda*, *Eriachne mucronata*, *Monachather paradoxa*, *Tripogon loliiformis*.

INFREQUENT SPP: *Digitaria brownii*.

LAND USE:

Provides useful but limited ground pastures with good topfeed; productivity can be increased by cautious thinning; woody weeds are a problem; a valuable low stocking rate drought reserve; subject to degradation if overgrazed; very low AWC; very low fertility.
Condition: fair to mediocre. Trend: stable to downwards in places.

SITES: B 17, 18.

LAND UNIT 9

LANDFORM:

Gently undulating to flat plains. Slopes 0.5 to 2%.

GEOLOGY:

Quaternary sand sheet over the Tertiary land surface.

SOILS:

Deep to very deep, acid to neutral, sandy red earths and earthy sands. Textures range from coarse sandy loam to sandy clay loam. Soils are loose when moist, but slightly hardsetting and massive when dry. Gn 2.12, UC 5.21, UM 5.52. *Napoleon** small areas of *Kotri**. Representative soils analysis A12, A30, A77, A106.

VEGETATION:

Woollybutt, mulga open tussock grassland. Short tussock grasses, mainly *Eragrostis eriopoda* (woollybutt), predominate with *Acacia aneura* (mulga) emerging. Frequently other scattered trees are present. A low shrubby layer is usually not well defined but in places dense stands of low shrubs may occur. Ground cover is variable, composed mainly of grasses.

STRUCTURAL FORMATION: Open tussock grassland.

TREE/TALL SHRUB LAYER: Ht 4 ± 1m; PFC < 1%; density < 25 shrubs/ha.

FREQUENT SPP: *Acacia aneura, Eucalyptus terminalis.*

INFREQUENT SPP: *Codonocarpus cotinifolius, Eremophila longifolia, Grevillea striata.*

LOW SHRUB LAYER: Ht 1.5 ± 0.75m; PFC < 1% (in places up to 10%); density 600 ± 550 shrubs/ha.

FREQUENT SPP: *Dodonaea angustissima, Eremophila bowmanii.*

INFREQUENT SPP: *Cassia artemisioides, C. nemophila, Eremophila duttonii, E. sturtii.*

GROUND LAYER: Ht < 0.5m; PFC (variable) 15 ± 10%.

FORBS:

FREQUENT SPP: *Evolvulus alsinoides, Maireana villosa, Ptilotus polystachyus, Sida platycalyx.*

INFREQUENT SPP: *Boerhavia diffusa, Brachyscome ciliaris* var. *lanuginosa, B. curvicarpa, Chenopodium rhadinostachyum, Cleome viscosa, Euphoria coghlanii, E. drummondii, E. tannensis* ssp. *eremophila* var. *eremophila, E. wheeleri, Helichrysum rarosissimum, Heliotropium strigosum, Indigofera linnaei, Ptilotus leucocoma, Sida ammophila, S. cunninghamii, Trachymene cyanantha, T. ochracea, Velleia glabrata.*

GRAMINOIDS:

PREDOMINANT SPP: *Eragrostis eriopoda.*

FREQUENT SPP: *Aristida contorta, A. armata, A. ingrata, Eriachne helmsii, E. mucronata, Monachather paradoxa, Thyridolepis mitchelliana.*

INFREQUENT SPP: *Dactyloctenium radulans, Digitaria ammophila, Digitaria divaricatissima, D. brownii, D. hystrichoides, Enneapogon polyphyllus, Panicum decompositum, Perotis rara, Tragus australianus.*

LAND USE:

Limited in extent but can provide valuable ground pasture with scattered topfeed; over-use has depleted the palatable perennial grass component in places; woody weeds may be a problem; limited value as a drought reserve; low AWC; low fertility; susceptible to wind and water erosion when bare or after fire.
Condition: fair to good. Trend: stable to downward.

LAND UNIT 10

LANDFORM:

Flat to very gently undulating plains, usually in run-on situations.

GEOLOGY:

Quaternary deposits over alluvium or Tertiary land surfaces.

SOILS:

Moderately deep to deep red earths, occasionally with accumulations of loose sand on the surface. Soil reaction is slightly acid at the surface tending neutral at depth. Textures are gradational, ranging from coarse sandy loams to light clays at depth. Surfaces are normally hardsetting; some areas with loose surfaces occur in the drainage lines. GN 2.12, GN 2.11. Slightly to strongly acid pH; very low to very low to low AP and BP. *Bulgroo, Lynwood.* Representative soil analysis B 177.

VEGETATION:

Mulga, western bloodwood tall open shrubland to mulga tall open shrubland infrequently mulga, *Acacia kempeana* tall open shrubland. *Acacia aneura* (mulga) predominates forming a distinct but discontinuous canopy and *Eucalyptus terminalis* (western bloodwood) usually occurs as an emergent. In places *Acacia kempeana* is conspicuous and is codominant with *A. aneura.* Other scattered trees may occur. Scattered low shrubs are usually present and in places form a well defined low shrub layer. Ground cover is variable composed of grasses and forbs.

STRUCTURAL FORMATION: Tall open shrubland.

TREE/TALL SHRUB LAYER: Ht 7 ± 3m; PFC 5 ± 4%; density 400 ± 350 shrubs/ha.

PREDOMINANT SPP: *Acacia aneura,* Ht 5 ± 1m; PFC 5 ± 4%.

FREQUENT SPP: *Acacia kempeana, Eucalyptus terminalis.*

INFREQUENT SPP: *Eucalyptus papuana, Grevillea striata, Hakea chordophylla.*

LOW SHRUB LAYER: Ht 1.25 ± 0.25m; PFC (variable) usually < 2.5% in places up to 7.5%; density usually < 250/ha up to < 1000 shrubs/ha.

FREQUENT SPP: *Acacia tetragonophylla, Cassia oligophylla, Eremophila bowmanii.*

INFREQUENT SPP: *Acacia clivicola* (rare), *Eremophila gilesii, E. goodwinii, E. latrobei.*

GROUND LAYER: Ht < 0.5m; PFC (variable) 15 ± 15%.

FORBS:

FREQUENT SPP: *Bassia cornishiana, Chenopodium rhadinostachyum, Convolvulus erubescens, Euphorbia drummondii, E. tannensis* ssp. *eremophila* var. *eremophila, Evolvulus alsinoides, Goodenia lunata, Heliotropium tenuifolium, Ptilotus polystachyus, Sida platycalyx, Velleia glabrata.*

INFREQUENT SPP: *Bassia bicornis, B. convexula, Indigofera linnaei, Josephinia eugeniae, Maagregoria racemigera, Portulaca* sp. aff. *P. oleracea, Pterocaulon sphacelatum, Ptilotus gaudichaudii, P. macrocephalus, Sida cunninghamii, S. filiformis, Stenopetalum nutans, Trachymene cyanantha.*

GRAMINOIDS:

FREQUENT SPP: *Aristida browniana, A. contorta, A. ingrata, Dactyloctenium radulans, Enneapogon polyphyllus, Eragrostis eriopoda, Eriachne aristidea, E. pulchella.*

INFREQUENT SPP: *Aristida armata, Cymbopogon obtectus, Paspalidium clementii, P. rarum, Themeda australis, Tripogon loliiformis.*

LAND USE:

Low and unreliable rainfall limiting; occurs in run-on situations, and responds well to light falls of rain; produces valuable ephemeral ground pastures with low perennial grass component; abundant topfood; valuable low grazing capacity drought reserve; over-use leads to degradation with a decrease in perennial pasture grasses and an increase in woody species; very low to low AWC; very low fertility.
Condition: fair to mediocre. Trend: stable to slightly downwards.

SITES: B 96, 105, 110, 112, 177, 236, 237.

LAND UNIT 11

LANDFORM:

Flat to gently undulating plains of low relief (slopes < 1%) with gilgai microrelief in grove areas.

GEOLOGY:

Quaternary sands and other colluvial material over Tertiary land surfaces.

SOILS:

(a) Grove: Deep to very deep, red clays and red texture contrast soils with neutral soil reaction UG 5.38, DR 2.12. Varying degrees of gilgai development occur. *Hayfields.*

(b) Intergrove: Moderately deep to deep red earths with neutral soil reaction. Textures commonly range from loam to clay loam. Surfaces are hardsetting and are usually scattered with silcrete gravel. GN 2.12. Medium to strongly acid pH; low C, N, AP and BP; high K. *Lynwood.*

VEGETATION:

Mulga grassy tall to tall open shrubland with distinct groves. *Acacia aneura* (mulga) predominates the groves with scattered grasses and low forbs conspicuous in the intergrove.

A. GROVE:

Eucalyptus terminalis is common. Usually a low shrubby layer is not conspicuous but may be well developed in places. Ground cover is variable composed mainly of grasses but forbs do occur.

STRUCTURAL FORMATION: Tall shrubland to tall open shrubland.

TREE/TALL SHRUB LAYER Ht 8 ± 2m; PFC 7.5 ± 2.5%; density 225 ± 100 tall shrubs/ha.

PREDOMINANT SPP: *Acacia aneura*# Ht 8 ± 2m; PFC 7.5 ± 2.5%.

FREQUENT SPP: *Eucalyptus terminalis* #

INFREQUENT SPP: *Acacia tetragonophylla* #.

LOW SHRUB LAYER: Ht < 1m (rarely 1 ± 1.5m); PFC 2.5 ± 2.5%; density 60 ± 60 low shrubs/ha.

FREQUENT SPP: *Eremophila gilesii* #.

INFREQUENT SPP: *Cassia artemisioides, Eremophila bowmanii, Spartothamnella puberula.*

GROUND LAYER: Ht 1 ± 0.3m; PFC 25 ± 5%.

FORBS:

FREQUENT SPP: *Alternathera denticulata, A. nodiflora, Bassia cornishiana* #, *B. bicornis* #, *B. divaricata* #, *Calotis multicaulis* #, *Convolvulus erubescens, Goodenia lunata* #, *Marsilea* ssp., *Ptilotus macrocephalus, P. polystachyus, Salsola kali, Sida platycalyx* #, *Velleia glabrata.*

INFREQUENT SPP: *Abutilon otocarpum* #, *Centipeda thespidioides, Chenopodium rhadinostachyum, Indigofera linnaei, Portulaca* sp. aff. *P. oleracea* #, *Rhynchosia minima, Solanum ellipticum, Xanthium pungens.*

GRAMINOIDS:

FREQUENT SPP: *Aristida contorta* #, *Chloris pectinata, Cyperus iria, Dactyloctenium radulans, Dichanthium sericeum, Digitaria ammophila, D. brownii, Enneapogon polyphyllus* #, *Eragrostis ciliatensis, E. leptocarpa, E. pergracilis* #, *E. setifolia, E. tenellula, Eriochloa pseudoacrotricha, Eulalia fulva, Fimbristylis dichotoma* #, *Iseilema membranaceum, Paspalidium rarum, Themeda avenacea, T. australis, Tragus australianus* #, *Tripogon loliiformis* #.

INFREQUENT SPP: *Aristida anthoxanthiodes* #, *A. armata* #, *Brachyachne convergens, Austrochloris dichanthoides, Perotis rara* #, *Sporobolus actinocladus* #, *S. australasicus* #.

B. INTERGROVE:

STRUCTURAL FORMATION: Open herbfields to herbfield (grasses or forbs predominating depending on seasonal influence).

TREE/TALL SHRUB LAYER: Ht 8 ± 2m; PFC < 1%.

LOW SHRUB LAYER: Ht < 1m; PFC < 1%; Not well defined, scattered individuals.

GROUND LAYER: Ht < 0.75m; PFC 10 ± 5%.

LAND USE:

Capable of producing valuable ground pastures with a high component of edible perennial grasses and adequate topfeed; intergroves contribute little to overall pasture; valuable drought reserve with high drought grazing capacity; proximity to alluvia commonly leads to overuse and subsequent degradation; low to medium AWC in groves; low fertility.
Condition: fair to mediocre in intergrove, good in groves;
Trend: stable to slightly downwards.

SITES: B 88, 89, 168, 169.

Species which occur in the intergrove area.

LAND UNIT 12

LANDFORM:

Flat plains of very low relief, forming run-on areas.

GEOLOGY:

Quaternary deposits derived from weathering of the Tertiary land surfaces.

SOILS:

Deep to very deep, red and brown texture contrast soils, with acid, loamy surface soils overlying clay subsoils. Occassional gravel inclusions are present in the profile. Surfaces are crusting. DR 2.43, DY 2.12. Strongly acid pH in the surface; low C and N; very high K; very low AP and BP; strongly sodic subsoils with high salt levels at the base of the profile.

VEGETATION:

Mulga, poplar box shrubby low open woodland to woodland. *Acacia aneura* (mulga) predominates with *Eucalyptus populnea* (poplar box) emerging. Shrubs are usually present and in places *Eremophila mitchellii* (sandalwood) form well defined layers. Ground cover is variable composed of grasses and forbs.

STRUCTURAL FORMATION: Low open woodland to woodland.

TREE LAYER: Ht 10 ± 2m; PFC 10 ± 5%; density *Acacia aneura*, 275 ± 100 trees/ha, *Eucalyptus populnea* 60 ± 40 trees/ha.

PREDOMINANT SPP: *Acacia aneura* Ht 10 ± 2m; PFC 9 ± 4%.

FREQUENT SPP: *Eucalyptus populnea.*

INFREQUENT SPP: *Santalum lanceolatum.*

TALL SHRUB LAYER: Ht 3 ± 1m; PFC 4 ± 3%; density 350 ± 300 shrubs/ha.

FREQUENT SPP: *Eremophila mitchellii.*

LOW SHRUB LAYER: Ht < 1m; PFC < 1%; 25 ± 20 shrubs/ha.

FREQUENT SPP: *Eremophila gilesii.*

INFREQUENT SPP: *Eremophila maculata.*

GROUND COVER: Ht 0.7 ± 0.3m; PFC 15 ± 5%.

FORBS:

FREQUENT SPP: *Bassia bicornis, B. quinquecuspis, Boerhavia diffusa, Cheilanthes sieberi, Convolvulus erubescens, Dolvulus alsinoides, Goodenia lunata, Ptilotus macrocephalus, Solanum esuriale, Vittadinia sulcata.*

INFREQUENT SPP: *Abutilon leucopetalum, Bassia birchii, B. convexula, Chenopodium rhytidostachyum, Dianella laevis* vel. aff., *Goodenia subintegra Malvastrum americanum, Phyllanthus maderaspatensis, Ptilotus exaltatus, P. gaudichaudii, P. polystachyus, Vittadinia pterochaeta.*

GRAMINOIDS:

FREQUENT SPP: *Aristida armata, A. ingrata, Digitaria ammophila, D. brownii, Enteropogon acicularis, Eragrostis kennedyae, E. setifolia, Fimbristylis dichotoma, Monachather paradoxa, Panicum decompositum, Tripogon loliiformis.*

INFREQUENT SPP: *Aristida helicophylla, A. jerichoensis, Brachiaria gilesii, Digitaria divaricatissima, Eragrostis dielsii, E. elongata, Neurachne munroi, Thyridolepis mitchelliana, Sporobolus caroli.*

LAND USE:

Extensive run-on areas capable of producing valuable ground pastures with a high component of edible grasses and forbs; adequate topfeed; valuable drought reserve with high grazing capacity; woody weeds a problem; margins susceptible to degradation; low to medium AWC; low to very low fertility and sodic subsoils limit possible development. Conditions: fair to good. Trend: stable, slightly upwards.

SITES: B 1, 2.

LAND UNIT 13

LANDFORM:

Run-on areas and drainage lines on gently undulating plains of low relief.

GEOLOGY:

Quaternary deposits.

SOILS:

Deep to very deep, red, texture contrast soils. Neutral, red, clay loams with a bleached A_2 horizon overlie alkaline, red, sandy clay loam to sandy clay subsoils. Surfaces are hardsetting. Structure is massive throughout. Dr 2.83. Low C and N; high K; very low AP and BP; strongly sodic subsoils. *Essex.*

VEGETATION:

Poplar box grassy open woodland. *Eucalyptus populnea* (poplar box) predominates. A tall shrubby layer may be conspicuous in places but usually only scattered shrubs occur. Isolated low shrubs may be found. Ground cover is variable composed mainly of grasses but forbs also occur.

STRUCTURAL FORMATION: Open woodland.

TREE LAYER: Ht 12 ± 2m; PFC 3 ± 2%; 40 ± 20 trees/ha.

PREDOMINANT SPP: *Eucalyptus populnea.* Ht 12 ± 2m; PFC 3 ± 2%.

INFREQUENT SPP: *Grevillea striata. Ventilago viminalis.*

TALL SHRUB LAYER: Ht 3 ± 1m; PFC 3 ± 2%; 150 ± 100 shrubs/ha.

FREQUENT SPP: *Eremophila mitchellii.*

INFREQUENT SPP: *Acacia tetragonophylla.*

LOW SHRUB LAYER: Ht < 1m; PFC usually < 1%; rarely 10%; density usually < 10 shrubs/ha in places up to 1000 shrubs/ha.

FREQUENT SPP: *Cassia artemisioides.*

INFREQUENT SPP: *Eremophila bowmanii.*

GROUND LAYER: Ht 1 ± 0.5m; PFC 30 ± 10%

FORBS:

FREQUENT SPP: *Alternanthera nodiflora, Bassia birchii, Evolvulus alsinoides, Malvastrum americanum, Solanum ellipticum.*

INFREQUENT SPP: *Calotis multicaulis, Goodenia subintegra, Helipterum floribundum, Sida filiformis.*

GRAMINOIDS:

FREQUENT SPP: *Aristida armata, A. ingrata, Bothriochloa ewartiana, Chloris pectinata, Eragrostis kennedyae, Themeda australis.*

INFREQUENT SPP: *Aristida inaequiglumis, Eragrostis elongata, Ennaepogon polyphyllus, Eriachne mucronata.*

LAND USE:

Limited in extent, but responds well to light falls of rain because of run-on situation; yields useful pasture with high portion of edible perennial grasses; useful standover feed; limited topfeed; limited drought grazing capacity; woody weeds may be a problem; potentially unstable sodic subsoils subject to gully erosion if run-on water excessive; low to medium AWC; low fertility with some build up of nutrients in the surface layer.
Condition: fair to good. Trend: slightly downwards.

SITES: B 16.

LAND UNIT 14

LANDFORM:

Run-on areas in gently undulating to flat plains.

GEOLOGY:

Quaternary deposits over the Tertiary land surface.

SOILS:

Deep to very deep, uniform, red and brown clays with slightly acid to neutral soil reaction and clay loam to light clay textures, surfaces are hardsetting. UF 4.43 UF 4.41. Strongly acid pH; low C and N; very low AP and BP.

VEGETATION:

Mulga tall shrubland to poplar box mulga low open woodland *Acacia aneura* (mulga) and *Eucalyptus populnea* (poplar box) occur with either species predominating. Other emerging *Eucalyptus* spp. are rarely present. Scattered low shrubs may occur but usually they do not form a well defined layer. Ground flora is variable composed of mainly grasses but forbs do occur.

STRUCTURAL FORMATION: Tall shrubland to low open woodland.

TREE/TALL SHRUB LAYER: Ht 8 ± 2m (rarely 5m); PFC 10 ± 5%; density 450 ± 200 *A. aneura*, shrubs/ha. 75 ± 50 *Eucalyptus populnea* trees/ha.

PREDOMINANT SPP: *Acacia aneura*, Ht 6 ± 1m; PFC 7.5 ± 5%. *Eucalyptus populnea.* Ht 8 ± 2m; PFC 3 ± 2%

INFREQUENT SPP: *Eremophila bignoniiflora, Eucalyptus papuana, E. terminalis.*

LOW SHRUB LAYER: Ht 0.75 ± 0.25m; PFC variable < 3%; 50 ± 50 shrubs/ha.

FREQUENT SPP: *Eremophila gilesii.*

INFREQUENT SPP: *Cassia nemophila, Spartothamnella puberula.*

GROUND LAYER: Ht 1 ± 0.5m; PFC 50 ± 20%.

FORBS:

FREQUENT SPP: *Malvastrum americanum, Solanum ellipticum.*

INFREQUENT SPP: *Abutilon otocarpum, Bassia bicornis, Bassia paradoxa, Solanum ferocissimum.*

GRAMINOIDS:

FREQUENT SPP: *Aristida inaequiglumis, A. jerichoensis, Dichanthium sericeum, Digitaria brownii, Enteropogon acicularis, Panicum decompositum, Themeda australis.*

INFREQUENT SPP: *Digitaria ammophila, Eragrostis leptocarpa, Eulalia fulva, Themeda avenacea.*

LAND USE:

Run-on situation responds well to light rains; capable of producing valuable pastures with a high perennial grass component and abundant topfeed; selective thinning will increase productivity; valuable drought reserve; over-use leads to degradation and increase in woody weeds; low AWC; low to very low fertility.
Condition: good. Trend: slightly upwards.

SITES: B 119, 256.

LAND UNIT 15

LANDFORM:

Flat to gently undulating plains of low relief (slopes < 2%).

GEOLOGY:

Superficial Quaternary deposits over the Tertiary land surface.

SOILS:

Moderately deep to deep, loamy red earths with slightly acid clay loams grading into neutral light clays containing ironstone shot at depth. Surfaces are hardsetting, characteristically with veneers of ironstone shot. GN 2.11 GN 2.12. *Bularoo.* Medium to strongly acid pH; C and N low; high K; very low AP and BP, very low Mg values.

VEGETATION:

Groved mulga grassy tall shrubland to tall open shrubland. In the grove *Acacia aneura* (mulga) predominates with *Eucalyptus populnea* (poplar box) emerging. Scattered low shrubs occur but do not form a well defined layer. Ground cover is variable composed mainly of grasses. The intergrove supports an open tussock grassland with isolated shrubs.

STRUCTURAL FORMATION: Tall open shrubland to tall shrubland.

TREE/TALL SHRUB LAYER: Ht 7 ± 2m; PFC 7.5 ± 2.5%; density 300 ± 100 shrubs/ha, 25 ± 20 trees/ha.

PREDOMINANT SPP: *Acacia aneura.* Ht 7 ± 2m; PFC 7.5 ± 2.5%

FREQUENT SPP: *Eucalyptus populnea.*

LOW SHRUB LAYER: Ht 1 ± 0.3m; PFC < 1%; density < 25 shrubs/ha.

FREQUENT SPP: *Eremophila gilesii.*

INFREQUENT SPP: *Eremophila bowmanii.*

GROUND LAYER: Ht 1 ± 0.3m; PFC 40 ± 10%

FORBS:

FREQUENT SPP: *Abutilon oxycarpum, Malvastrum americanum, Sida filiformis, Solanum ellipticum.*

INFREQUENT SPP: *Abutilon otocarpum, Sida aprica.*

GRAMINOIDS:

FREQUENT SPP: *Aristida arnata, A. jerichoensis, Bulbostylis barbata, Digitaria brownii, Panicum decompositum, Themeda australis, T. avenacea.*

INFREQUENT SPP: *Digitaria ammophila, Enneapogon polyphyllus, Sporobolus caroli, Thyridolepis mitchelliana, Tragus australianus.*

LAND USE:

Capable of producing useful pastures with a high perennial grass component and adequate topfeed; cautious selective thinning may increase productivity; valuable drought reserve; over-use leads to degradation, woody weeds a potential problem; low AWC; low to very low fertility.
Condition: fair to good. Trend: stable.

SITES: B 257.

LAND UNIT 16

LANDFORM:

Gently undulating plains of low relief (slopes < 2%).

GEOLOGY:

Superficial Quaternary deposits over altered *Winton Formation.*

SOILS:

Moderately deep, red texture contrast soils with neutral sandy loams overlying neutral to slightly alkaline sandy clays. Surfaces are hardsetting. DR 2.12. *Greers.*

VEGETATION:

Horse mulga, mulga tall shrubland to tall open shrubland. Either *Acacia ramulosa* (horse mulga), or *A. aneura* (mulga) may predominate and in places *A. ramulosa* forms almost pure stands. Emerging trees may occur. A lower shrub layer is usually well developed but in some situations only isolated shrubs are found. Ground cover is variable composed of grasses and forbs.

STRUCTURAL FORMATION: Tall open shrubland to tall shrubland.

TREE/TALL SHRUB LAYER: Ht 5 ± 1m; PFC 7.5 ± 5%; density 425 ± 300 shrubs/ha.

PREDOMINANT SPP: *Acacia aneura,* Ht 5 ± 1m; PFC 5 ± 5%,
A. ramulosa, Ht 4.5 ± 0.5m; PFC 5 ± 5%.

FREQUENT SPP: *Grevillea striata.*

INFREQUENT SPP: *Acacia tetragonophylla, Eucalyptus terminalis.*

LOW SHRUB LAYER: Ht 1 ± 0.3m; PFC 5 ± 4%; density 600 ± 700 shrubs/ha.

FREQUENT SPP: *Cassia desolata, C. oligophylla, C. sturtii.*

INFREQUENT SPP: *Cassia phyllodinea, Eremophila gilesii* (rare), *E. latrobei, Gossypium australe.*

GROUND LAYER: Ht 0.6 ± 0.3m; PFC 20 ± 15%.

FORBS:

FREQUENT SPP: *Evolvulus alsinoides, Chenopodium rhadinostachyum, Heliotropium tenuifolium, Pterigeron adscendens, Ptilotus macrocephalus, Sida filiformis, S. platycalyx.*

INFREQUENT SPP: *Alternanthera nodiflora, Bassia cornishiana, B. lanicuspis, Boerhavia diffusa, Cleome viscosa, Goodenia subintegra, Ptilotus helipteroides.*

GRAMINOIDS:

FREQUENT SPP: *Aristida contorta, A. ingrata, A. jerichoensis, Chloris pectinata, Dactyloctenium radulans, Eragrostis eriopoda.*

INFREQUENT SPP: *Chloris scariosa, Enneapogon polyphyllus, Tragus australianus.*

LAND USE:

Limited in extent; capable of producing useful ephemeral pastures with a limited component of perennial grasses; topfeed present but not abundant; limited value as a drought reserve; woody weeds a problem.
Condition: fair to mediocre. Trend: stable to downward.

SITES: B 206.

LAND UNIT 17

LANDFORM:

Slightly undulating plains with slopes < 2%.

GEOLOGY:

Tertiary *Glendower Formation* covered by superficial Quaternary deposits.

SOILS:

Shallow to very shallow, red earths and lithosols with neutral to slightly acid soil reaction. Silcrete stone cover is common on the surface and throughout the profile. GN 2.12, UM 1.43, UM 5.51, UC 1.43. Medium to very strongly acid pH; very low C and N; high K; very low to low AP and BP. *Woolga, Newhaven.* Representative soil analysis B99.

VEGETATION:

Mulga, bastard mulga tall open shrubland to bastard mulga, mulga low open shrubland rarely bastard mulga low shrubland. *Acacia aneura* (mulga) and *A. clivicola* (bastard mulga) usually occur with either predominating, but in some situations only one may be present. Other trees may be conspicuous emerging above the canopy. Scattered low shrubs mainly *Cassia* spp. and *Eremophila* spp. occur and in places form a well defined layer. Ground cover is usually sparse composed of grasses and forbs.

STRUCTURAL FORMATION: Tall open shrubland
or
Low open shrubland.

TREE/TALL SHRUB LAYER: Ht 7 ± 3m; PFC 3 ± 2%; density 65 ± 60 shrub/ha.

PREDOMINANT SPP: *Acacia aneura,* Ht 5 ± 1m; PFC 3 ± 2%.

FREQUENT SPP: *Eucalyptus terminalis.*

INFREQUENT SPP: *Acacia tetragonophylla, Atalaya hemiglauca, Clerodendrum floribundum, Codonocarpus cotinifolius.*

LOW SHRUB LAYER: Ht 1.75 ± 0.5m; PFC 6 ± 5%; density 500 ± 450 shrubs/ha.

PREDOMINANT SPP: *Acacia clivicola,* Ht 1.75 ± 0.5m; PFC 6 ± 5%.

FREQUENT SPP: *Cassia helmsii, Eremophila latrobei.*

INFREQUENT SPP: *Acacia adoxa rgens, Cassia desolata, C. phyllodinea, Eremophila bowmanii, E. cordatisepala, E. gilesii.*

GROUND LAYER: Ht 0.7 ± 0.3m; PFC 3 ± 2% rarely 15%.

FORBS:

FREQUENT SPP: *Bassia cornishiana, B. convexula, B. lanicuspis, Chenopodium rhadinostachyum, Evolvulus alsinoides, Euphorbia drummondii, E. boophthona, Portulaca* sp. aff. *P. oleracea, Salsola kali, Sida cunninghamii, S. filiformis, S. platycalyx, Velleia glabrata.*

INFREQUENT SPP: *Bassia bicornis, B. tricuspis, Convolvulus erubescens, Heliotropium tenuifolium, Ptilotus gaudichaudii, P. polystachyus, Solanum ellipticum.*

GRAMINOIDS:

FREQUENT SPP: *Aristida contorta, A. ingrata, Eragrostis eriopoda, Eriachne pulchella, Fimbristylis dichotoma, Paspalidium rarum, Tripogon loliiformis.*

INFREQUENT SPP: *Aristida jerichoensis, A. jerichoensis* var. *subspinulifera, Digitaria ammophila, Enneapogon polyphyllus, Monachather paradoxa, Sporobolus actinocladus, Thyridolepis mitchelliana.*

LAND USE:

Provides low value pasture with a low component of perennial fodder grasses and limited topfeed; limited drought grazing capacity; over-use leads to degradation; low AWC; very low fertility.
Condition: poor to mediocre. Trend: stable to downwards.

SITES: B 73, 92, 98, 99, 193, 199, 231, 238.

LAND UNIT 18

LANDFORM:

Flat to gently undulating plains of low relief with slopes < 1%.

GEOLOGY:

Superficial Quaternary deposits overlying *Glendower* and altered *Winton Formation.*

SOILS:

(a) Grove: Shallow to moderately deep, red earths with slightly acid to neutral surfaces. Textures are gradational with sandy loam to sandy clay loams overlying light to medium clays. Slump holes are common. Surfaces are hardsetting and are occasionally covered with accumulations of organic matter. GN 2.12, DR 2.12. *Wichilo.* Representative soil analysis B 116.

(b) Intergrove: Shallow red earths with slightly acid surfaces. Textures are gradational with loam to sandy clay loam surfaces grading into sandy clay loams to medium clays. Surfaces are hardsetting, occasionally with scattered gravel. GN 2.12, UM 1.23, GN 2.11. *Lynwood.* Representative soil analysis B 117. Medium to very strongly acid pH; very low to low C and N; SP and BP; high K.

VEGETATION:

Distinctly groved mulga, western bloodwood tall open shrubland *Acacia aneura* (mulga) predominates forming distinct groves with *Eucalyptus terminalis* (western bloodwood) usually emerging. Other emergent trees may be present. Low shrubs mainly *Cassia* spp. and *Eremophila* spp. also occur and form well defined layers in places. The ground flora is variable depending on seasonal conditions and may be composed of grasses and forbs. The depressions and slump holes support *Marsilea* spp. (Nardoo), grasses and sedges.

GROVE:

STRUCTURAL FORMATION. Tall open shrubland

TREE/TALL SHRUB LAYER: Ht 6 ± 2m; PFC 5 ± 4%; density 300 ± 250 shrubs/ha.

PREDOMINANT SPP: *Acacia aneura*[4], Ht 5.5 ± 1.5m; PFC 5 ± 4%.

FREQUENT SPP: *Eucalyptus terminalis*[4].

INFREQUENT SPP: *Albizia basaltica* (rare), *Codonocarpus cotinifolius*[4], *Eremophila longifolia*[4], *Eucalyptus populnea* (in the east), *Owenia acidula*, *Ventilago viminalis*.

LOW SHRUB LAYER: Ht 1 ± 0.25m; PFC (variable) 8 ± 7%; density 1250 ± 1200 shrubs/ha.

FREQUENT SPP: *Cassia artemisioides*[4], *C. desolata*[4], *C. oligophylla*[4].

INFREQUENT SPP: *Acacia tetragonophylla*[4], *Cassia nemophila*[4], *Eremophila bowmani*, *E. duttonii*[4], *E. gilesii*, *E. latrobei*[4], *Scaevola spinescens*.

GROUND LAYER: Ht 0.75 ± 0.25m; PFC 20 ± 20%.

FORBS:

FREQUENT SPP: *Bassia cornishiana*[4], *B. divaricata*[4], *Chenopodium rhadinostachyum*[4], *Evolvulus alsinoides*[4], *Heliotropium strigosum*[4], *Maireana villosa*[4], *Portulaca* sp. aff. *P. oleracea*[4], *Ptilotus polystachyus*[4], *Salsola kali*[4], *Sida filiformis*[4], *S. platycalyx*[4], *Velleia glabrata*[4].

INFREQUENT SPP: *Abutilon otocarpum*[4], *Alternanthera nodiflora* (depression), *Bassia paradoxa*[4], *Boerhavia diffusa*[4], *Cheilanthes sieberi*, *Euphorbia drummondii*[4], *Marsilea drummondii* (depression), *Phyllanthus maderaspatensis*, *Poranthera (microphylla,)Ptilotus macrocephalus*, *Sida cunninghamii*[4], *Solanum esuriale*[4].

GRAMINOIDS:

FREQUENT SPP: *Aristida contorta*[4], *Dactyloctenium radulans*[4], *Digitaria ammophila*, *Enneapogon polyphyllus*, *Eragrostis eriopoda*[4], *E. lacunaria*, *E. pergracilis*, *Fimbristylis dichotoma*[4], *Monachather paradoxa*, *Sporobolus caroli*, *Thyridolepis mitchelliana*, *Tragus australianus*[4], *Tripogon loliiformis*[4].

INFREQUENT SPP: *Amphipogon caricinus*[4], *Aristida jerichoensis* var. *subspinulifera*[4], *Bothriochloa ewartiana*, *Brachiara miliiformis*, *Digitaria brownii*, *Dichanthium affine*, *D. sericeum*, *Eragrostis setifolia* (depressions), *Eriachne pulchella*[4], *Iseilema membranaceum*[4], *Perotis rara*, *Sporobolus mitchellii* (depressions), *Themeda australis* (depressions), *Uranthoecium truncatum*.

INTERGROVE:

STRUCTURAL FORMATION: Sparse open herbfield to open tussock grassland.

TREE/TALL SHRUB LAYER: Ht 5 ± 1m; PFC < 1%, isolated.

LOW SHRUB LAYER: Ht 1.0m; PFC (variable up to 10% in places) usually < 1%.

GROUND LAYER: Ht < 0.75m; PFC 12.5 ± 12.5%.

LAND USE:

In the non-degraded state, capable of providing good perennial grass pastures with adequate topfeed; groves are more productive because of run-on situation but intergrove contributes significantly to the pasture; a useful drought reserve at low stocking rates; over-use leads to degradation; woody weeds may be a problem; low AWC, very low fertility. Condition: mediocre to fair. Trend: stable to downwards.

SITES: B 116, 117, 225, 228, 229, 230, 241, 243.

LAND UNIT 19

LANDFORM:

Tablelands with flat to slightly undulating plains of low relief (slopes < 1%).

GEOLOGY:

Thin Quaternary deposits over silicified Tertiary *Glendower Formation*.

SOILS:

Shallow to very shallow, red earths and lithosols with slightly acid soil reaction and clay loam to sandy clay loam textures, overlying weathered rock. Surfaces are hardsetting with scattered silcrete stone in intergrove areas. UM 5.21, UM 5.51. Very strongly acid pH; low C and N; very fair to high K; very low to low AP and BP; Mg may be limiting.

VEGETATION:

Distinctly groved mulga tall open shrubland. *Acacia aneura* (mulga) predominates forming distinct groves with scattered *Eucalyptus papuana* (desert gum) emerging. Other trees may be present. Low shrubs occur forming well defined layers in places. Ground flora is composed of grasses and forbs forming a variable ground cover depending on seasonal conditions.

GROVE:

STRUCTURAL FORMATION: Tall open shrubland rarely tall shrubland.

TREE/TALL SHRUB LAYER: Ht 4.5 ± 1.5m; PFC 7 ± 5%; density 500 ± 400 shrubs/ha.

PREDOMINANT SPP: *Acacia aneura*[4], Ht 4.5 ± 1.5m; PFC 7 ± 5%.

FREQUENT SPP: *Eucalyptus papuana*[4].

INFREQUENT SPP: *Clerodendrum floribundum*, *Eucalyptus terminalis* (rare).

LOW SHRUB LAYER: Ht 1 ± 0.25m; PFC (variable) 5 ± 5%; density 500 ± 500 shrubs/ha.

FREQUENT SPP: *Cassia helmsii*[4], *C. oligophylla*, *Eremophila bowmanii*[4].

INFREQUENT SPP: *Cassia nemophila*.

GROUND LAYER: Ht 0.75 ± 0.5m, PFC (variable) 20 ± 10%.

FORBS:

FREQUENT SPP: *Bassia cornishiana*[4], *Evolvulus alsinoides*[4], *Portulaca* sp. aff. *P. oleracea*[4], *Sida cunninghamii*[4], *S. platycalyx*[4].

INFREQUENT SPP: *Cheilanthes sieberi*, *Goodenia subintegra*, *Malvastrum americanum*, *Polycarpaea microphylla*[4], *Sida filiformis*[4], *Solanum ellipticum*[4], *Velleia glabrata*.

GRAMINOIDS:

FREQUENT SPP: *Aristida contorta*[4], *A. jerichoensis* var. *subspinulifera*[4], *Bulbostylis barbata*[4], *Digitaria brownii*, *Eragrostis eriopoda*[4], *E. lacunaria*[4], *E. pergracilis*[4], *Eriachne pulchella*[4], *Monachather paradoxa*, *Themeda australis*.

INFREQUENT SPP: *Aristida helicophylla*[4], *A. inaequiglumis*[4], *Dichanthium affine*, *D. sericeum*, *Digitaria ammophila*[4], *Enneapogon polyphyllus*[4], *Panicum decompositum*[4], *Paspalidium rarum*, *Perotis rara*[4].

INTERGROVE:

STRUCTURAL FORMATION: Sparse herbfield to open tussock grassland. Ht 0.75 ± 0.5m; PFC (variable) 10 ± 10%.

TREE/TALL SHRUB LAYER: Isolated. Ht 4 ± 1m; PFC 1%.

LOW SHRUB LAYER: Isolated. Ht < 1m; PFC < 1%.

GROUND LAYER: Ht 0.75 ± 0.25m; PFC (variable) 5 ± 5%.

LAND USE:

Limited in extent; usually only capable of limited productivity; groves more productive than intergroves; useful perennial grasses scarce; adequate topfeed; limited use as a drought reserve; must be stocked lightly as over-use leads to a decrease in more acceptable species; low AWC; very low fertility. Condition: poor to mediocre. Trend: stable to slightly downward.

SITES: B 17, 72.

* Species which occur in the intergrove.

LAND UNIT 20

LANDFORM:

Flat to very gently sloping plains (slopes 1% or less).

GEOLOGY:

Quaternary deposits overlying the Tertiary land surface.

SOILS:

Shallow red earths, with sandy clay loam to sandy clay textures. Soil reaction is neutral. Ferruginous hardpans occur. Surfaces are hardsetting usually with gravel cover. GN 2.12. Slightly acid lab pH; very low C and N; high K; low AP and BP. *Lynwood*.

VEGETATION:

Witchetty, Cassia low open shrubland. *Acacia kempeana* (witchetty) predominates with other low shrubs mainly *Cassia* spp. conspicuous. Ground cover is variable but usually sparse composed of grasses and forbs. Trees are rare.

STRUCTURAL FORMATION: Low open shrubland.

TREE/TALL SHRUB LAYER: Ht 4m; PFC (isolated) < 1%; density < 5 trees/ha.

INFREQUENT SPP: *Alstonia constricta*.

LOW SHRUB LAYER: Ht 1.5 ± 0.5m; PFC < 5%; density 175 ± 100 shrubs/ha.

PREDOMINANT SPP: *Acacia kempeana*, Ht 1.5 ± 0.5m; PFC < 5%.

FREQUENT SPP: *Cassia desolata*, *C. oligophylla*.

INFREQUENT SPP: *Acacia clivicola*, *Cassia helmsii*.

GROUND LAYER: Ht < 0.5m; PFC (variable) 10 ± 5% (rarely 20%).

FORBS:

FREQUENT SPP: *Bassia cornishiana*, *Portulaca* sp. aff. *P. oleracea*.

INFREQUENT SPP: *Bassia lanicuspis*, *Salsola kali*, *Sida filiformis*.

GRAMINOIDS:

FREQUENT SPP: *Aristida contorta*, *Dactyloctenium radulans*, *Fimbristylis dichotoma*.

INFREQUENT SPP: *Brachyachne convergens*, *Chloris pectinata*, *Enneapogon polyphyllus*, *Tragus australianus*.

LAND USE:

An unproductive unit; very limited in extent; provides a depauporate ephemeral pasture of low value; medium AWC; low fertility. Condition: poor to mediocre. Trend: stable.

SITES: B 196.

LAND UNIT 21

LANDFORM:

Flat to gently undulating plains of low relief with slopes < 2%.

GEOLOGY:

Quaternary deposits over altered *Winton Formation*.

SOILS:

Shallow red earths predominate throughout, UM 1.43. Associated with well developed grove areas are minor occurrences of red texture contrast soils and red clays, commonly with sinkhole depressions evident. Very strongly acid pH, low to very low C and N; very low AP and BP; low K; very low Ca and Mg.

VEGETATION:

Distinctly groved mulga tall open shrubland. *Acacia aneura* (mulga) predominates forming a distinct but discontinuous canopy. Other scattered tall shrubs and low shrubs occur; the latter rarely forming a well defined layer. The ground flora is composed of grasses and forbs forming a variable cover depending on seasonal conditions.

GROVE:

STRUCTURAL FORMATION: Tall open shrubland.

TREE/TALL SHRUB LAYER: Ht 4.5 ± 1.5m; PFC 3 ± 2%; density 300 ± 200 shrubs/ha.

PREDOMINANT SPP: *Acacia aneura**, Ht 4.5 ± 1.5m; PFC 3 ± 2%.

FREQUENT SPP: *Acacia tetragonophylla**.

LOW SHRUB LAYER: Ht 0.75 ± 0.25m; PFC < 1% (in places up to 5%); density 300 ± 200 shrubs/ha.

FREQUENT SPP: *Cassia helmsii**.

INFREQUENT SPP: *Eremophila gilesii.*

GROUND LAYER: Ht 0.75 ± 0.25m; PFC 10 ± 10%.

FORBS:

FREQUENT SPP: *Bassia cornishiana**, *Calandrinia balonensis*, *Goodenia subintegra**, *Portulaca* sp. aff. *P. oleracea**, *Salsola kali**, *Sida platycalyx.*

INFREQUENT SPP: *Abutilon otocarpum**, *Ptilotus macrocephalus**, *Rutidosis helichrysoides.*

GRAMINOIDS:

FREQUENT SPP: *Aristida contorta**, *Dactyloctenium radulans**, *Digitaria brownii**, *Themeda australis*, *Tragus australianus**.

INFREQUENT SPP: *Aristida jerichoensis* var. *subspinulifera**, *Chloris pectinata*, *Dichanthium affine*, *D. sericeum.*

INTERGROVE:

STRUCTURAL FORMATION: (seasonally dependent) sparse herbfield to open tussock grassland. Ht 0.75 ± 0.25m; PFC 10 ± 10%.

TREE/TALL SHRUB LAYER: Isolated. Ht 4 ± 2m; PFC < 1%.

LOW SHRUB LAYER: Isolated. Ht 0.75 ± 0.25m; PFC < 1%.

GROUND LAYER: Ht 0.75 ± 0.25m; PFC (variable) 10 ± 10%.

* Species which occur in the intergrove.

LAND USE:

A distinctly groved unit of limited productivity; low and unreliable rainfall a limiting factor; groves capable of producing useful ephemeral pastures with perennial grasses only a minor component; intergroves usually contribute little to overall pasture; adequate topfeed; limited use as a drought reserve; overstocking results in degradation; low AWC; very low fertility.
Condition: mediocre to fair. Trend: stable to slightly downwards.

SITES: B 265, R1248, 1249.

LAND UNIT 22

LANDFORM:

Gently undulating plains, usually convex, on higher parts of the landscape.

GEOLOGY:

Tertiary *Glendower Formation* with thin Quaternary deposits.

SOILS:

Very shallow to shallow, acid red earths with dense stone cover. Textures range from loams to clay loams at the surface to clay loam and light clays at depth. Structure is massive with stone and gravel throughout. UM 5.51, GN 2.12. *Corona**. Representative soil analysis A3, 25, 54.

VEGETATION:

Rock grass, mulga/western bloodwood wooded open tussock grassland. *Eriachne mucronata* (rock grass) predominates usually with scattered trees of *Eucalyptus terminalis* (western bloodwood) and shrubs of *Acacia aneura* (mulga) conspicuous. Other isolated shrubs may occur. Ground cover is variable composed mainly of grasses but forbs do occur.

STRUCTURAL FORMATION: Open tussock grassland (rarely tall open shrubland).

TREE/TALL SHRUB LAYER: Ht 4 ± 1m; PFC < 1%; density < 40 shrubs/ha.

FREQUENT SPP: *Acacia aneura, Eucalyptus terminalis.*

INFREQUENT SPP: *Acacia tetragonophylla, Codonocarpus cotinifolius.*

LOW SHRUB LAYER: Ht 1.0 ± 0.25m; PFC < 1%; density 150 ± 100 shrubs/ha.

FREQUENT SPP: *Cassia artemisioides.*

INFREQUENT SPP: *Cassia desolata, C. helmsii, C. nemophila, Eremophila gilesii.*

GROUND LAYER: Ht < 0.5m; PFC 5 ± 4%.

PREDOMINANT SPP: *Eriachne mucronata.* Ht < 0.5m; PFC < 5%.

FORBS:

FREQUENT SPP: *Brunonia australis, Euphorbia drummondii, Maireana villosa, Ptilotus macrocephalus, Sida filiformis, Velleia glabrata.*

INFREQUENT SPP: *Bassia cornishiana, B. eriacantha, P. laniceps, Calotis hispidula, Chenopodium rhadinostachyum, Chilanthes sieberi, Evolvulus alsinoides, Glossogyne tenuifolia, Portulaca* sp. aff. *P. oleracea, Psoralea cinerea, Ptilotus leucocoma, Salsola kali, Sida platycalyx, Solanum esuriale, S. quadriloculatum, Vittadinia sulcata.*

GRAMINOIDS:

FREQUENT SPP: *Amphipogon caricinus, Aristida contorta, A. jerichoensis, Eragrostis eriopoda, Eriachne pulchella, Thryidolepis mitchelliana.*

INFREQUENT SPP: *Digitaria ammophila, Eriachne helmsii, Fimbristylis dichotoma, Monachather paradoxa, Neurachne mauroi, Tripogon loliiformis.*

LAND USE:

A very distinctive unit; limited in extent; provides a pasture of low acceptability; topfeed scattered; grazing capacity very low; drought grazing capacity negligible; low AWC; very low fertility.
Condition: poor to mediocre. Trend: stable.

SITES: A3, 25, 54. R1213, R1218.

* A full description of this soil profile class may be found in Western Arid Region Land Use Survey - Part 1, Chapter 4.

LAND UNIT 23

LANDFORM

Slightly undulating plains, slopes < 3%.

GEOLOGY:

Quaternary deposits over *Glendower Formation.*

SOILS:

Shallow, gravelly, red earths with acid soil reaction; textures range from sandy loam and sandy clay loam surfaces to light clays at depth with gravel throughout. Surfaces are hardsetting with gravel or ironstone shot cover and occassional organic matter accumulations. GN 2.11, GN 2.84. Very strongly acid pH; fair C, low N; very low AP and BP. *Wichilo, Lynwood.*

VEGETATION:

Mulga tall open shrubland. *Acacia aneura* (mulga) predominates forming a distinct tall shrub layer with a discontinuous canopy. In the east *Eucalyptus populnea* (poplar box) may occur as an emergent. *Acacia brachystachya* may also occur mainly in the west and becomes co-dominant in places. Other scattered trees and tall shrubs may be present. Scattered low shrubs usually occur and in places form a well defined layer. The ground flora, composed of grasses and forbs, gives a variable cover depending on seasonal conditions.

STRUCTURAL FORMATION: Tall open shrubland.

TREE/TALL SHRUB LAYER: Ht 7 ± 3m; PFC 2.5 ± 2%; density 90 ± 60 shrubs/ha.

PREDOMINANT SPP: *Acacia aneura,* Ht 6 ± 2m; PFC 2.5 ± 2%.

FREQUENT SPP: *Eucalyptus populnea* (in the east).

INFREQUENT SPP: *Codonocarpus cotinifolius, Eremophila longifolia.*

LOW SHRUB LAYER: Ht 1.25 ± 0.75m; PFC (variable) < 10%; density < 1000 shrubs/ha.

FREQUENT SPP: *Acacia brachystachya* (in the west), *Eremophila gilesii.*

INFREQUENT SPP: *Eremophila bowmanii.*

GROUND LAYER: Ht < 0.75m; PFC < 5%.

FORBS:

FREQUENT SPP: *Boerhavia diffusa, Cheilanthes sieberi, Chenopodium rhadinostachyum, Evolvulus alsinoides, Sida filiformis.*

INFREQUENT SPP: *Abutilon leucopetalum, Maireana villosa, Sida platycalyx, Solanum ellipticum.*

GRAMINOIDS:

FREQUENT SPP: *Aristida jerichoensis, Digitaria ammophila, Eriachne mucronata, E. pulchella, Fimbristylis dichotoma, Tripogon loliiformis.*

INFREQUENT SPP: *Aristida contorta, Enneapogon polyphyllus, Eragrostis eriopoda.*

LAND USE:

A naturally unstable, low productivity unit of limited extent; provides limited ephemeral pasture with a low perennial grass component; topfeed scattered; low grazing capability; drought grazing capacity very low; limited basal cover should be maintained to reduce the likelihood of further degradation; woody weeds a problem; low AWC, very low fertility.
Condition: poor to mediocre. Trend: downwards.

SITES: B4, 258.

LAND UNIT 24

LANDFORM:

Slightly undulating convex plains with slopes < 2%.

GEOLOGY:

Tertiary *Glendower Formation* with some Quaternary deposits.

SOILS:

Shallow to very shallow, loamy red earths with silcrete, stone and gravel cover and slightly acid soil reaction. Textures range from sandy loam to sandy clay loam. UM 5.51, GN 2.12. Very strongly acid pH; very low C and N, AP and BP; very fair to high K, Ca and Mg may be limiting in some areas. *Corona**. Representative soil analysis A39, 98.

VEGETATION:

Mulga, western bloodwood sparse tall open shrubland. *Acacia aneura* (mulga) predominates forming a distinct but discontinuous canopy. *Eucalyptus terminalis* (western bloodwood) occurs as an emergent. There is no well defined low shrubby layer but scattered shrubs are present. Ground cover is sparse composed mainly of forbs but grasses also occur.

STRUCTURAL FORMATION: Sparse tall open shrubland.

TALL SHRUB LAYER: Ht 3.5 ± 1.5m; PFC < 1%; density 50 ± 30 shrubs/ha.

PREDOMINANT SPP: *Acacia aneura;* Ht 4 ± 1m; PFC < 1%. *Eucalyptus terminalis* Ht 4 ± 1m; PFC < 1%.

FREQUENT SPP: *Acacia tetragonophylla, Eremophila longifolia.*

LOW SHRUB LAYER: Ht 0.75m; PFC < 1%; density 80 ± 40 shrubs/ha.

FREQUENT SPP: *Cassia desolata, Eremophila bowranii.*

INFREQUENT SPP: *Cassia artemisioides, C. helmsii, Eremophila gilesii.*

GROUND LAYER: Ht < 0.5m; PFC (variable) 5 ± 4%.

FORBS:

FREQUENT SPP: *Bassia cornishiana, B. divaricata, B. eriacantha, Erodium crinatum, Euphorbia drummondii, Lepidium rotundum, Mairevana villosa, Portulaca* sp. aff. *P. oleracea, Ptilotus gaudichaudii, P. macrocephalus, Salsola kali, Sida cunninghamii, S. platycalyx, Zygophyllum ammophilum.*

INFREQUENT SPP: *Alotia pterocarpa, A. multicaulis, Evolvulus alsinoides, Heliotropium strigosum, Ptilotus helipteroides, Pimelea trichostachya, Portulaca filifolia, Sida filiformis, Ctenopetalum nutans, Trianthema triquetra, Velleia glabrata,*

GRAMINOIDS:

FREQUENT SPP: *Aristida contorta, A. jerichoensis, Enneapogon polyphyllus, Eriachne mucronata, E. pulchella, Tripogon loliiformis.*

INFREQUENT SPP: *Digitaria ammophila, D. brownii, Eragrostis eriopoda, E. tenellula, Monachather paradoxa, Thyridolepis mitchelliana.*

LAND USE:

Limited in extent; capable of producing useful ephemeral pasture with a low component of perennial fodder grasses; topfeed sparse; very low grazing capacity; should not be used as drought reserve as degradation would be accelerated; susceptible to erosion; low AWC, very low fertility.
Condition: fair to mediocre. Trend: slightly downwards.

SITES: A 39, 98, R 445, R 447.

* A full description of this soil profile class may be found in Western Arid Region Land Use Survey - Part 1, Chapter 4.

LAND UNIT 25

LANDFORM:

Slightly undulating to undulating plains with slopes < 3%.

GEOLOGY:

Quaternary deposits overlying Tertiary *Glendower* and altered *Winton Formations.*

SOILS:

Shallow to moderately deep, red hardpan soils with alkaline soil reaction. Textures are uniform, sandy clay loams. Surfaces have ironstone shot and silcrete gravel cover. UM 5.31. Medium acid pH at the surface; very low C and N, AP and BP. *Newhaven.*

VEGETATION:

Mulga tall open shrubland. *Acacia aneura* (mulga) predominates with isolated emerging trees of *Eucalyptus terminalis* (western bloodwood). A low shrubby layer is not well defined but scattered shrubs occur. Ground cover is sparse composed of grasses and forbs.

STRUCTURAL FORMATION: Tall open shrubland.

TREE/TALL SHRUB LAYER: Ht 4 ± 1m; PFC < 2.5%; density 40 ± 25 shrubs/ha.

PREDOMINANT SPP: *Acacia aneura.* Ht 4 ± 1m; PFC < 2.5%.

FREQUENT SPP: *Eucalyptus terminalis.*

INFREQUENT SPP: *Grevillea striata.*

LOW SHRUB LAYER: Ht 1.25 ± 0.5m; PFC < 2.5%; density 80 ± 40 shrubs/ha.

FREQUENT SPP: *Acacia oliviicola, A. tetragonophylla.*

INFREQUENT SPP *Cassia helmsii, C. oligophylla, Eremophila duttonii.*

GROUND LAYER: Ht < 0.5m; PFC < 5%.

FORBS:

FREQUENT SPP: *Bassia cornishiana, Chenopodium rhydinostachyum, Evolvulus alsinoides, Sida filiformis.*

INFREQUENT SPP: *Portulaca* sp. aff. *P. oleracea, Ptilotus macrocephalus, P. polystachyus, Sida cunninghamii.*

GRAMINOIDS:

FREQUENT SPP: *Aristida contorta, Digitaria brownii, Enneapogon polyphyllus, Eriachne pulchella, Fimbristylis dichotoma, Tripogon loliiformis.*

INFREQUENT SPP: *Dactyloctenium radulans, Eragrostis dielsii, Paspalidium rarum, Sporobolus actinocladus, S. australasicus, Themeda australis.*

LANDUSE:

Naturally unstable; capable of producing only low quality pasture with a negligible perennial grass component; topfeed sparse, very low grazing capacity; should be grazed when ephemeral pasture available and not used as a drought reserve; susceptible to erosion, low AWC, very low fertility.
Condition: poor. Trend: slightly downwards.

SITES: 129, B 198.

LAND UNIT 26

LANDFORM:

Flat to slightly undulating tops and upper scarps of dissected tablelands.

GEOLOGY:

Altered Cretaceous *Winton Formation* and silicified Tertiary *Glendower Formation.* Very thin Quaternary deposits occur in some areas.

SOILS:

Very shallow, acid, loamy, lithosols with large areas of exposed weathered rock. Ironstone and silcrete gravels commonly form surface pavements. UM 1.43, UM 1.23. Very strongly acid pH; very low to low C and N; K may be limiting in some areas; very low AP and BP (higher under dense *Acacia* scrubs); very low cation values.

VEGETATION:

(a) Lancewood low open woodland. *Acacia petraea* (lancewood) predominates forming a well defined layer with a discontinuous canopy. In places *Acacia aneura* (mulga) and *Eucalyptus* spp. may be present. Usually there is a well defined lower shrub layer. Ground cover is sparse composed of grasses and forbs.

STRUCTURAL FORMATION: Low open woodland to low woodland.

TREE/TALL SHRUB LAYER: Ht 6 ± 3m; PFC 12.5 ± 7.5%; density (variable) 500 ± 400 shrubs/ha.

PREDOMINANT SPP: *Acacia petraea.*

FREQUENT SPP: *Acacia aneura.*

INFREQUENT SPP: *Acacia ensifolia, Eucalyptus papuana, E. thozetiana.*

LOWER SHRUB LAYER: Ht 1.5 ± 0.75m; PFC 5 ± 4%; density 500 ± 400 shrubs/ha.

FREQUENT SPP: *Dodonaea adenophora, D. petiolaris, Eremophila cordatisepala, E. latrobei, E. oppositifolia, Scaevola spinescens.*

INFREQUENT SPP: *Capparis lasiantha, Cassia nemophila, C. helmsii.*

GROUND LAYER: Ht < 0.5m; PFC < 5%.

FORBS:

FREQUENT SPP: *Mairevana georgei, M. triptera, M. villosa, Ptilotus gaudichaudii, P. helipteroides, P. leucocoma, P. obovatus, Salsola kali, Sida aprica, S. filiformis.*

INFREQUENT SPP: *Bassia lenticulosa, Chaetanthes sieberi, Chenopodium rhadinostachyum, Hibiscus sturtii, Indigofera* sp. aff. *I. leucotricha, Solanum esuriale, Zygophyllum apiculatum.*

GRAMINOIDS:

FREQUENT SPP: *Aristida contorta, Eriachne mucronata, E. pulchella, Fimbristylis dichotoma, Tripogon loliiformis.*

INFREQUENT SPP: *Digitaria brownii, Enneapogon polyphyllus, Paspalidium basedowii, P. clementii.*

(b) Bastard mulga, *Eucalyptus* spp. low open shrubland, rarely bendo shrubland. Usually *Acacia oliviicola* (bastard mulga) predominates forming a distinct low shrub layer with a discontinuous canopy. *Eucalyptus* spp. are frequently conspicuous emerging above the canopy. Other trees and tall shrubs may occur. Other low shrubs are usually present. Grasses and forbs occur forming a variable ground cover.

In places *Eucalyptus exserta* (bendo) becomes predominant forming a tall shrubland to tall open shrubland with a well developed low shrubby layer.

A variation in this association does occur. Scattered shrubs of *Acacia oliviicola* form almost a pure stand with isolated shrubs of *Hakea collina* (dwarf needlewood) present. Ground cover is sparse with *Eriachne pulchella, Fimbristylis dichotoma* and *Tripogon loliiformis* predominating.

STRUCTURAL FORMATION: Low open shrubland to low shrubland.

TREE/TALL SHRUB LAYER: Ht 5 ± 2m; PFC (variable) usually < 1%, in places 2.5%; density 80 ± 70 shrubs/ha.

FREQUENT SPP: *Eucalyptus exserta, E. papuana.*

INFREQUENT SPP: *Acacia aneura, A. catenulata* (rare), *Alstonia constricta, A. [illegible]* (rare).

LOW SHRUB LAYER: Ht 1.5 ± 0.5m; PFC 8 ± 7%; density 400 ± 400 shrubs/ha.

PREDOMINANT SPP: *Acacia oliviicola,* Ht 1.5 ± 0.5m; PFC 5 ± 4%

FREQUENT SPP: *Canthium latifolium, Dodonaea adenophora, Eremophila latrobei, Hakea collina.*

INFRLQUENT SPP: *Acacia brachystachya* (rare), *Capparis lasiantha, Cassia helmsii, C. nemophila, Prostanthera reganalyx, P. suborbicularis, Sarcostema australe, Thryptomene hexandra, Westringia rupica.*

GROUND LAYER Ht < 0.5m, PFC < 5%.

FORBS:

FREQUENT SPP: *Bassia convexula, Chenopodium rhadinostachyum, Cheilanthes sieberi, Maireana villosa, Salsola kali.*

INFREQUENT SPP: *Abutilon oxycarpum, Brunonia australis, Portulaca* sp. aff. *P. oleracea, Ptilotus gaudichaudii, P. leucocoma, Sida filiformis, Solanum ellipticum.*

GRAMINOIDS:

FREQUENT SPP: *Digitaria ammophila, Eriachne mucronata, E. pulchella, Fimbristylis dichotoma, Tripogon loliiformis.*

INFREQUENT SPP: *Enneapogon polyphyllus, Sporobolus australasicus.*

VEGETATION:

(c) A mixed open woodland. This is rather varied in structure and floristics and is restricted to the slopes and valley floor of Bosses Gorge. It is of phytogeographical interest.

Trees of *Eucalyptus* spp. and *Acacia* spp. predominate. Other trees and tall shrubs occur. Scattered low shrubs are usually present and in places form a well defined layer. Ground flora is variable.

STRUCTURAL FORMATION: Open woodland.

TREE/TALL SHRUB LAYER: Ht 9 ± 6m; PFC (variable) < 5%; density variable < 150 trees/ha.

SPECIES: *Acacia ensifolia, A. petraea, A. sparsiflora, Alstonia constricta, Eucalyptus camaldulensis, E. melanophloia, E. papuana, E. thozetiana, Geijera parviflora, Maytenus cunninghamii.*

LOW SHRUB LAYER: Ht < 2m; PFC (variable) < 10%; density < 300 shrubs/ha.

SPECIES: *Acacia clivicola, Calytrix longiflora, Capparis lasiantha, Carrisa ovata, Cassia artemisioides, Enchylaena tomentosa, Eremophila latrobei, E. mitchellii, Hakea collina, Petalostylis labichoides, Prostanthera megacalyx, P. suborbicularis.*

GROUND LAYER: Ht < 1.3m; PFC (variable) < 10%

FORBS:

SPECIES: *Indigofera australis, I. brevidens, Jasminum lineare, Plectranthus parviflorus.*

GRAMINOIDS:

SPECIES: *Lomandra longifolia, Paspalidium caespitosum, P. jubiflorum* (creek banks) *Sporobolus australasicus.*

LAND USE:

Naturally unstable; unproductive country, capable of producing only limited ephemeral pastures of extremely low grazing capacity; perennial grasses virtually absent, accessibility may be a problem; no topfeed; water for stock limiting; drought grazing capacity nil, minimal AWC; extremely low fertility except where organic matter builds up under lancewood stands.
Condition: poor Trend: downwards.

SITES: B5, 6, 25, 60, 101, 114, R486, 469, 1204, 1218, 1219.

LAND UNIT 27

LANDFORM:

Upper slopes and flat tops of dissected residuals, with slopes 1 - 25%.

GEOLOGY:

Tertiary *Glendower Formation*, silicified in places, with superficial Quaternary deposits.

SOILS:

Very shallow lithosols with surface pavements of silcrete stone and gravel. *Woolga.*

VEGETATION:

Mulga tall open shrubland. *Acacia aneura* (mulga) predominates and with other scattered trees form a distinct tall layer with a discontinuous canopy. Low shrubs occur and usually form a distinct layer. Ground cover is variable composed of grasses and forbs. In places *Triodia pungens* is conspicuous predominating in the ground flora.

STRUCTURAL FORMATION: Tall open shrubland.

TREE/TALL SHRUB LAYER: Ht 6 ± 2m; PFC 7.5 ± 2.5%; density 300 ± 150 shrubs/ha.

PREDOMINANT SPP: *Acacia aneura,* Ht 5.5 ± 1.5m; PFC 7.5 ± 2.5%.

INFREQUENT SPP: *Eucalyptus papuana, Owenia acidula.*

LOW SHRUB LAYER: Ht 1.25 ± 0.5m; PFC 12.5 ± 7.5%; density (variable) 1000 ± 750 shrubs/ha.

FREQUENT SPP: *Cassia pruniosa, Dodonaea petiolaris, Eremophila latrobei.*

INFREQUENT SPP: *Canthium latifolium, Hibiscus* sp.

GROUND LAYER: Ht < 1.25 m; PFC (variable) 10 ± 10%.

FORBS:

FREQUENT SPP: *Boerhavia diffusa, Evolvulus alsinoides, Maireana triptera, M. villosa, Ptilotus exaltatus.*

INFREQUENT SPP: *Bassia lanicuspis, Heliotropium tenuifolium, Sida filiformis, Solanum ellipticum.*

GRAMINOIDS:

FREQUENT SPP: *Digitaria brownii, Enneapogon polyphyllus, Eriachne pulchella, Triodia pungens.*

INFREQUENT SPP: *Thyridolepis xerophila, Triodia longiceps.*

LAND USE:

Naturally unstable, capable of producing only ephemeral pastures of extremely low grazing capacity; acceptable perennial grasses virtually absent; very sparse topfeed; limited drought grazing capacity; access may be limiting; water for stock limiting; minimal AWC; very low fertility.
Condition: poor. Trend: downwards.

SITES: B67, 68.

LAND UNIT 28

LANDFORM:

Undulating plains and lower slopes of dissected residuals with slopes 3 - 15%.

GEOLOGY:

Superficial Quaternary deposits over altered Cretaceous *Winton Formation.*

SOILS:

Very shallow, stony lithosols with areas of weathered rock outcropping; commonly with surface pavements of black ironstone gravel. *Woolga.*

VEGETATION:

(A) Grey lancewood, spinifex low open woodland. *Acacia ensifolia* (grey lancewood) predominates forming a distinct but discontinuous canopy. Other isolated trees or tall shrubs occur. Scattered low shrubs are present and form a well defined layer in places. *Triodia pungens* predominates in the ground layer and together with other grasses and forbs usually forms a mid dense ground cover.

STRUCTURAL FORMATION: Low open woodland.

TREE/TALL SHRUB LAYER: Ht 5.5 ± 1.5m; PFC < 5%; density 110 ± 60 trees/ha.

PREDOMINANT SPP: *Acacia ensifolia,* Ht 5.5 ± 1.5m; PFC < 5%.

INFREQUENT SPP: *Hakea leucoptera, Owenia acidula.*

LOW SHRUB LAYER: Ht 1.25 ± 0.5m; PFC (variable) 5 ± 4%; density (variable) 450 ± 350 shrubs/ha.

FREQUENT SPP: *Cassia helmsii, Dodonaea petiolaris, Eremophila latrobei.*

INFREQUENT SPP: *Cassia artemisioides, C. desolata, Eremophila maculata, E. oppositifolia, Gossypium sturtianum.*

GROUND LAYER: Ht < 1.5m; PFC 15 ± 10%.

FORBS:

FREQUENT SPP: *Bassia lanicuspis, Maireana triptera, M. villosa, Salsola kali.*

INFREQUENT SPP: *Ptilotus schwartzii, Sida* sp.

GRAMINOIDS:

FREQUENT SPP: *Aristida contorta, Enneapogon polyphyllus, Triodia pungens.*

INFREQUENT SPP: *Digitaria brownii, Paspalidium clementii, P. ramum, Thyridolepis xerophila, Tragus australianus, Triodia longiceps.*

VEGETATION:

(B) Bastard mulga, spinifex low open shrubland. *Acacia clivicola* (bastard mulga) usually predominates forming a well defined but discontinuous low shrub layer. Isolated trees may occur. Other scattered low shrubs are usually present. *Triodia pungens* (spinifex) predominates the ground flora but other grasses and forbs do occur.

A variation of this association occurs in some situations. *Eucalyptus normantonensis* predominates forming a tall open shrubland with a well defined ground layer of *Triodia* spp.

In places *Eucalyptus* spp. may fringe this association.

STRUCTURAL FORMATION: Low open shrubland.

TREE/TALL SHRUB LAYER: Ht 4.5 ± 1.5m; PFC < 1%; density < 10 trees/ha.

INFREQUENT SPP: *Acacia aneura, Eucalyptus normantonensis, E. papuana, E. thozetiana.*

LOW SHRUB LAYER: Ht 1.5 ± 0.5m; PFC 7.5 ± 2.5%; density 450 ± 150 shrubs/ha.

PREDOMINANT SPP: *Acacia clivicola,* Ht 1.5 ± 0.5m; PFC 7.5 ± 2.5%.

FREQUENT SPP: *Eremophila latrobei.*

INFREQUENT SPP: *Scaevola spinescens.*

GROUND LAYER: Ht < 1m; PFC 15 ± 10%.

FORBS:

FREQUENT SPP: *Maireana triptera, M. villosa, Salsola kali.*

INFREQUENT SPP: *Sida* sp.

GRAMINOIDS:

FREQUENT SPP: *Aristida contorta, Eriachne pulchella, Triodia pungens.*

INFREQUENT SPP: *Eriachne mucronata, Triodia longiceps.*

LAND USE:

Naturally unstable; not productive; capable of producing only very limited ephemeral pastures of extremely low grazing capacity; acceptable perennial grasses virtually absent; very limited topfeed; access is limited; drought grazing capacity nil; minimal AWC, very low fertility.
Condition: poor. Trend: downwards.

SITES: B66, 209.

LAND UNIT 29

LANDFORM:

Lower slopes of dissected residuals with slopes 3 - 10%.

GEOLOGY:

Superficial Quaternary deposits on altered Cretaceous *Winton Formation.*

SOILS:

Very shallow, stony, lithosols with silcrete and ironstone gravel forming surface pavements. UM 1.23. *Woolga.*

VEGETATION:

Mulga tall open shrubland. *Acacia aneura* (mulga) predominates but other tall shrubs may be present. Low shrubs mainly *Eremophila latrobei* occur forming a well defined layer in places. Ground cover is sparse with grasses and forbs present. Exposed parent rock is common.

STRUCTURAL FORMATION: Tall open shrubland.

TALL SHRUB LAYER: Ht 4 ± 1m; PFC < 5%; density 75 ± 40 shrubs/ha.

PREDOMINANT SPP: *Acacia aneura*, Ht 4 ± 1m; PFC < 5%.

INFREQUENT SPP: *Acacia cambagei.*

LOW SHRUB LAYER: Ht 1 ± 0.25m; PFC usually< 1% rarely 5%; density 250 ± 200 shrubs/ha.

FREQUENT SPP: *Canthium latifolium, Eremophila latrobei.*

INFREQUENT SPP: *Eremophila cordatisepala, Enchylaena tomentosa.*

GROUND LAYER Ht < 0.5m; PFC< 1%.

FORBS:

FREQUENT SPP: *Bassia convexula, B. lanicuepis.*

INFREQUENT SPP: *Maireana villosa, Sida filiformis.*

GRAMINOIDS:

FREQUENT SPP: *Eriachne pulchella, Fimbristylis dichotoma, Sporobolus actinocladus.*

INFREQUENT SPP: *Enneapogon polyphyllus.*

LAND USE:

Naturally unstable; produces only limited amounts of ephemoral pasture; acceptable perennial grasses absent; limited topfeed; very low grazing capacity; only partly accessible to stock; drought grazing capacity nil; very low AWC; very low fertility.
Condition: poor. Trend: downwards.

SITES: B100.

LAND UNIT 30

LANDFORM:

Small areas of low dissected tablelands and mesas, (slopes range from 0-3% on tops to 100% on steep sides).

GEOLOGY:

Tertiary *Moses Sandstone.*

SOILS:

Very shallow, gravelly loams with large areas of exposed weathered rock, high in $CaCO_3$.

VEGETATION:

Mixed sparse low open shrubland. Scattered low shrubs are conspicuous forming a diffuse stratum with isolated tall trees emerging. *Eremophila latrobei* usually predominates but other scattered low shrubs may be codominant or predominant in places. Ground cover is sparse composed of forbs and grasses.

STRUCTURAL FORMATION: Low open shrubland.

TREE/TALL SHRUB LAYER: Ht 5 ± 1m; PFC < 1%; density < 5 trees/ha.

INFREQUENT SPP: *Eucalyptus terminalis.*

LOW SHRUB LAYER: Ht 1.25 ± 0.25m; PFC < 1%; density 90 ± 60 shrubs/ha.

FREQUENT SPP: *Dodonaea adenophora, Eremophila latrobei, Scaevola spinescens.*

INFREQUENT SPP: *Acacia tetragonophylla, Cassia helmsii.*

GROUND LAYER: Ht < 0.5m; PFC < 5%.

FORBS:

FREQUENT SPP: *Maireana dichoptera, M. villosa.*

INFREQUENT SPP: *Abutilon leucopetalum, Trichodesma zeylanicum.*

GRAMINOIDS:

FREQUENT SPP: *Tripogon loliiformis.*

INFREQUENT SPP: *Eriachne pulchella, Fimbristylis dichotoma.*

LAND USE:

Restricted in extent; unproductive; produces depauperate pasture of no significant use.
Condition: very poor. Trend: downwards.

SITES: B 184.

LAND UNIT 31

LANDFORM:

Scarp retreats and flat tops of dissected tablelands, mesas and buttes (slope 1 - 60%).

GEOLOGY:

Superficial Quaternary deposits over altered Cretaceous *Winton Formation* and Tertiary *Glendower Formation.*

SOILS:

Very shallow, red, acid, loamy lithosols with surface cover of stone and rubble. Gravel occurs throughout the profile. Areas of exposed weathered rock are common. *Woolga.*

VEGETATION:

Bendee low open woodland. *Acacia catenulata* (bendee) predominates forming a discontinuous but well defined upper stratum layer. Other *Acacia* spp. may occur and *Eucalyptus thozetiana* may be conspicuous emerging above the canopy. Scattered low shrubs occur but do not form well defined layers. Ground cover is sparse.

In places on the edges of some scarps *Albizia basaltica* is associated with this unit. *A. catenulata* does not predominate in this situation and is poorly represented.

STRUCTURAL FORMATION: Low open woodland.

TREE/TALL SHRUB LAYER: Ht 6 ± 1m; PFC 5 ± 2.5%; density 400 ± 300 shrubs/ha.

PREDOMINANT SPP: *Acacia catenulata*, Ht 6 ± 1m; PFC 5 ± 2.5%.

FREQUENT SPP: *Eucalyptus thozetiana.*

INFREQUENT SPP: *Acacia aneura, A. microsperma* (rare), *Albizia basaltica* (rare).

LOW SHRUB LAYER: Ht 1.25 ± 0.5m; PFC < 2.5%; density 60 ± 30 shrubs/ha.

FREQUENT SPP: *Canthium latifolium, Dodonaea petiolaris, Eremophila latrobei, Hibiscus sp., Ptilotus obovatus.*

INFREQUENT SPP: *Capparis lasiantha, Cassia nemophila, Pandorea doratoxylon.*

GROUND LAYER: Ht < 0.5m; PFC < 1%.

FORBS:

FREQUENT SPP: *Boerhavia diffusa, Chenopodium rhadinostachyum, Cheilanthes vellea, Maireana villosa, Portulaca* sp. aff. *P. oleracea, Salsola kali.*

INFREQUENT SPP: *Atriplex lindleyi, Cleome viscosa, Dipteracanthus primulaceus, Isotoma petraea, Jasminum lineare, Solanum ellipticum, Stenopetalum nutans, Trianthema portulacastrum, T. triquetra.*

GRAMINOIDS:

FREQUENT SPP: *Digitaria ammophila, Enneapogon polyphyllus, Eriachne pulchella, Sporobolus australasicus, Tripogon loliiformis.*

INFREQUENT SPP: *Eriachne mucronata, Panicum decompositum, Paspalidium clementii, P. gracile, P. ramm, Sporobolus caroli.*

LAND USE:

Limited in extent; naturally unstable; capable of producing only limited ephemeral pasture; acceptable perennial grasses virtually absent; scattered topfeed; low carrying capacity; access is limiting; drought grazing capacity nil; high run-off; very low AWC; very low fertility.
Condition: poor. Trend: stable to slightly downwards.

SITES: B7, 138, 139, 140, R461, 169, 473, 474, 471, 1219, 1220.

LAND UNIT 32

LANDFORM:

Gently undulating plains occurring in tracts of dissected terrain.

GEOLOGY:

Quaternary deposits on Tertiary *Glendower Formation* and altered Cretaceous *Winton Formation.*

SOILS:

Shallow, gravelly red earths with slightly acid to neutral soil reaction. Textures grade from loams to light clays. Minor areas of yellowish brown, massive earths occur. Surfaces are hardsetting, commonly with organic matter accumulations and/or stone and gravel cover GN 2.12. Very strongly acid pH; very fair C and fair N (due to organic matter build up); very low AP and BP. *Wichilo.*

VEGETATION:

Mulga, grey lancewood tall shrubland. *Acacia aneura* (mulga) predominates with *A. cyclops* (grey lancewood) conspicuous both forming a mid-dense but discontinuous upper canopy cover. *A. catenulata* occurs on associated scarps. Scattered low shrubs are usually present but do not form a distinct layer. Ground cover is sparse.

STRUCTURAL FORMATION: Tall shrubland.

TREE/TALL SHRUB LAYER: Ht 9 ± 3m; PFC 12.5 ± 5%; density 1000 ± 400 shrubs/ha.

PREDOMINANT SPP: *Acacia aneura.*

FREQUENT SPP: *Acacia cuvifolia.*

INFREQUENT SPP: *Acacia catenulata.*

LOW SHRUB LAYER: Ht 1 ± 0.5m; PFC < 1%; density 60 ± 30 shrubs/ha.

FREQUENT SPP: *Canthium latifolium, Dodonaea petiolaris.*

INFREQUENT SPP: *Capparis lasiantha, Hibiscus* sp., *Pandorea doratoxylon, Sarcostemma australe.*

GROUND LAYER: Ht < 0.5m; PFC < 1%.

FORBS:

FREQUENT SPP: *Cheilanthes sieberi, Sida filiformis.*

INFREQUENT SPP: *Sida cunninghamii.*

GRAMINOIDS:

FREQUENT SPP: *Digitaria brownii, Fimbristylis dichotoma, Tripogon loliiformis.*

LAND USE:

Limited in extent; potentially unstable; in the natural state produces negligible pasture; topfeed abundant; stock water and access both limiting; limited use as a drought reserve; very low AWC; low fertility, dependant on organic matter content.
Condition: fair to mediocre. Trend: stable to slightly downwards.

SITES: B24.

LAND UNIT 33

LANDFORM:

Lower slopes of dissected tablelands, mesas and buttes (slopes 2 - 25%).

GEOLOGY:

Thin cover of Quaternary material over altered Cretaceous *Winton Formation.*

SOILS:

Very shallow, gravelly, red earths with acid soil reaction. Textures range from loam to clay loam. Surface commonly has vesicular structures with silcrete and ironstone cover. GN 2.81. Strongly acid pH; fair C, low N, low AP and BP. *Newhaven.* Representative soil analysis B10.

VEGETATION:

Mountain yapunyah, bowyakka open woodland. *Eucalyptus thosetiana* (mountain yapunyah) and *Acacia microsperma* (bowyakka) predominate with other tall shrubs present. Low shrubs including *Apophyllum anomalum, Cassia* spp. and *Eremophila* spp. form a well defined layer. Ground flora is sparse composed of grasses and forbs.

STRUCTURAL FORMATION: Open woodland.

TREE LAYER: Ht 13 ± 2m; PFC < 5%; density 175 ± 75 trees/ha.

PREDOMINANT SPP: *Eucalyptus thosetiana,* Ht 13 ± 2m; PFC < 5%.

TALL SHRUB LAYER: Ht 6 ± 1m; PFC (variable) usually 7.5 ± 2.5%. (rarely 15%); 300 ± 200 shrubs/ha.

PREDOMINANT SPP: *Acacia microsperma,* Ht 6 ± 1m; PFC 6 ± 2%.

FREQUENT SPP: *Acacia aneura.*

INFREQUENT SPP: *Acacia catenulata, Eremophila mitchellii, Geijera parviflora.*

LOW SHRUB LAYER: Ht < 2m; PFC 7.5 ± 5%; 1000 ± 800 shrubs/ha.

FREQUENT SPP: *Acacia aneura, Apophyllum anomalum, Cassia nemophila, Enchylaena tomentosa, Eremophila mitchellii.*

INFREQUENT SPP: *Cassia artemisioides, Eremophila oppositifolia* var. *rubra, Hyoporum deserti, Scaevola spinescens.*

GROUND LAYER: Ht < 0.75m; PFC < 1%.

FORBS:

INFREQUENT SPP: *Bassia longicuspis, B. ventricosa, Hibiscus sturtii, Maireana triptera, Salsola kali, Solanum esuriale, S. quadriloculatum, Zygophyllum apiculatum.*

GRAMINOIDS:

INFREQUENT SPP: *Digitaria armophila, Enteropogon acicularis, Sporobolus australasicus, Tripogon loliiformis.*

LAND USE:

Naturally unstable, relatively unproductive, capable of producing limited ephemeral pastures of very low grazing capacity; scattered topfeed; woody weeds a potential problem; drought grazing capacity nil; very low AWC; low fertility.
Condition: poor. Trend: downwards.

SITES: B10 .

LAND UNIT 34

LANDFORM:

Gently sloping to undulating plains with slopes 1-4%.

GEOLOGY:

Undifferentiated Quaternary deposits over Tertiary *Glendower Formation.*

SOILS:

Shallow, red earths with acid soil reaction and sandy clay loam textures. Gravel occurs throughout the profile with silcrete stone scattered on the surface. UM 5.51. *Newhaven.*

VEGETATION:

Mulga tall open shrubland. *Acacia aneura* (mulga) predominates forming a well defined tall shrub layer with a discontinuous canopy. Scattered trees may emerge. Low shrubs occur and form a well defined low shrub layer in places. Ground cover is sparse.

STRUCTURAL FORMATION: Tall open shrubland.

TREE/TALL SHRUB LAYER: Ht 5 ± 1m; PFC 7.5 ± 2.5%; density 350 ± 150 shrubs/ha.

PREDOMINANT SPP: *Acacia aneura,* Ht 4.5 ± 0.5m; PFC 7.5 ± 2.5%

FREQUENT SPP: *Eucalyptus papuana, E. terminalis.*

LOW SHRUB LAYER: Ht 1.5m; PFC < 5%; density 250 ± 200 shrubs/ha.

FREQUENT SPP: *Canthium latifolium, Dodonaea petiolaris.*

INFREQUENT SPP: *Cassia artemisioides, C. desolata.*

GROUND LAYER: Ht < 0.5m; PFC < 1%.

FORBS:

INFREQUENT SPP: *Brunonia australis, Heliotropium tenuifolium Maireana villosa.*

GRAMINOIDS:

INFREQUENT SPP: *Eriachne pulchella, Fimbristylis dichotoma, Tripogon loliiformis.*

LAND USE:

Limited in extent; naturally unstable and eroding; produces pastures of limited grazing capacity; topfeed abundant; woody weeds a potential problem, useful as a drought reserve but adequate tree density and ground cover must be maintained to prevent degradation; very low AWC; very low fertility.
Condition: mediocre to poor. Trend: downwards.

SITES: BB6.

LAND UNIT 35

LANDFORM:

Flat to gently undulating plains with slopes < 3%.

GEOLOGY:

Altered Cretaceous *Winton Formation.*

SOILS:

Shallow, red clays with neutral soil reaction and silty to sandy light clay textures. Black ironstone gravel, surface pavements are characteristic. UT 1.42. DR 2.52.

VEGETATION:

Usually devoid of vegetation but scattered forbs may occur.

GROUND LAYER: Ht < 0.3m; PFC < 1%.

FORBS:

INFREQUENT SPP: *Bassia lanicuspis, Boerhavia diffusa, Portulaca* sp. aff. *P. oleracea, Salsola kali, Trianthema triquetra.*

LAND USE:

Low and unreliable rainfall limiting; an unproductive unit capable of producing only very limited, very low grazing capacity ephemeral pastures; low to very low AWC; fair fertility; of no significant use.
Condition: very poor. Trend: downwards.

SITES: B263.

LAND UNIT 36

LANDFORM:

Flat to gently undulating crests of dissected plains. Slopes 1 - 5%.

GEOLOGY:

Eroded remnants of the altered Cretaceous sediments and the Tertiary *Glendower Formation.*

SOILS:

Shallow, acid, red, earthy loams and clay loams. Silcrete gravel and stone occur on the surface and throughout the profile. Rock exposure is common. *Grey*[4]. Representative soil analysis A 134.

VEGETATION:

Bastard mulga, mulga low open shrubland. *Acacia clivicola* (bastard mulga) predominates forming a well defined low shrub layer with a discontinuous canopy. Scattered low trees of *Eucalyptus terminalis* (western bloodwood) and shrubs of *A. aneura* (mulga) emerge. Other low shrubs may be present. Ground cover is sparse composed of forbs and grasses.

STRUCTURAL FORMATION: Low open shrubland.

TREE/TALL SHRUB LAYER: Ht 4.5 ± 1.5m; PFC < 1%; density < 25 shrubs/ha.

FREQUENT SPP: *Acacia aneura, Eucalyptus terminalis.*

LOW SHRUB LAYER. Ht 1.5 ± 0.5m; PFC 2.5 ± 2%, density 250 ± 200 shrubs/ha.

PREDOMINANT SPP: *Acacia clivicola,* Ht 1.5 ± 0.5m, PFC 2.5 ± 2%.

FREQUENT SPP: *Acacia tetragonophylla, Eremophila latrobei.*

INFREQUENT SPP: *Canthium latifolium, Cassia helmsii, C. pruinosa, Phyllanthus rigens.*

GROUND LAYER: Ht < 0.5m; PFC < 5%.

FORBS:

FREQUENT SPP: *Brunonia australis, Maireana villosa, Salsola kali, Sida cunninghamii, Velleia glabrata.*

INFREQUENT SPP: *Bassia cornishiana, B. lanicuspis, Boerhavia diffusa, Calotis inermis, Euphorbia boophthona, E. drummondii, Portulaca* sp. aff.*P. oleracea, Ptilotus exaltatus, P. obovatus, Tribulus terrestris.*

GRAMINOIDS:

FREQUENT SPP: *Aristida contorta, Eragrostis eriopoda, Eriachne pulchella, Tripogon loliiformis.*

INFREQUENT SPP: *Digitaria brownii, Enneapogon polyphyllus Fimbristylis dichotoma.*

LAND USE:

Low and unreliable rainfall limiting; potentially unstable; capable of producing only limited low grazing capacity ephemeral pastures; acceptable perennial grasses virtually absent; topfeed sparse; drought grazing capacity nil; very low AWC; very low fertility.
Condition: very poor. Trend: downwards.

SITES: R 787, A134.

LAND UNIT 37

LANDFORM:

Low stony rises (< 5m) on gently undulating plains of the open downs. Very small areas only.

GEOLOGY:

Weathered remnants of the Tertiary *Moses Sandstone Formation.*

SOILS:

Very shallow, stony loams with alkaline soil reaction and areas of weathered rock outcropping. UM 1.11. *Moses*.

VEGETATION:

Maireana low open shrubland. *Maireana* sp. predominates forming a distinct but very discontinuous low canopy. Other scattered low shrubs are usually conspicuous. Ground cover is sparse composed of grasses and forbs. Trees are absent.

STRUCTURAL FORMATION: Low open shrubland.

LOW SHRUB LAYER: Ht 0.75 ± 0.25m; PFC < 1%; density 60 ± 40 shrubs/ha.

PREDOMINANT SPP: *Maireana* sp.

FREQUENT SPP: *Dodonaea adenophora, Scaevola spinescens.*

GROUND LAYER: Ht< 0.5m; PFC < 5%.

FORBS:

FREQUENT SPP: *Salsola kali.*

INFREQUENT SPP: *Bassia bicornis, Ptilotus obovatus.*

GRAMINOIDS:

FREQUENT SPP: *Dactyloctenium radulans, Enneapogon polyphyllus.*

INFREQUENT SPP: *Sporobolus australasicus, Tripogon loliiformis.*

LAND USE:

Limited in extent; low and unreliable rainfall limiting; an unproductive unit capable of producing only very limited poor quality ephemeral pastures; very low AWC; very low fertility; of no significant use.

SITES: B 189.

LAND UNIT 38

LANDFORM:

Flat to gently undulating plains with slopes < 1%.

GEOLOGY:

Weathered sediments of the Cretaceous *Winton Formation* with scattered stone and gravel cover derived by erosion of the Tertiary land surface.

SOILS

Deep to very deep, brown cracking clays with alkaline reaction and with weak gilgai development. Textures are heavy clays throughout. Surfaces are self-mulching under weak crusts. Scattered gravel cover is characteristic. Ca CO_3 is common throughout the profile with large amounts of gypsum present at depth. UG 5.21, UG 5.24, UG 5.31, UG 5.32, UG 5.34. Mildly to strongly alkaline pH; low to fair C and N; high K; variable AP (mostly high); generally low BP. Considerable accumulation of nutrients occurs in the surface of the profile due to recycling via leaf drop; predominantly montmorillonite type clay. *Sylvester, Carlow.* Representative soil analysis: B30, 31, 32, 50, 146, 156, 247, 248, 251, 253.

VEGETATION:

Gidgee shrubby low open woodland to low woodland infrequently tall open shrubland. *Acacia cambagei* (gidgee) predominates forming with other tree species a distinct but discontinuous canopy. Frequently *Eremophila mitchellii* (sandalwood) is conspicuous and forms a well defined tall shrub understorey. Scattered low shrubs occur but do not form a well defined layer. Ground cover is variable but usually sparse composed of grasses and forbs.

STRUCTURAL FORMATION: Low open woodland to open woodland infrequently tall open shrubland.

TREE LAYER Ht 7 ± 2m; PFC 12.5 ± 7.5%; density 1125 ± 875 trees/ha.

PREDOMINANT SPP: *Acacia cambagei*, Ht 7 ± 2m, PFC 12.5 ± 7.5%

FREQUENT SPP: *Flindersia maculosa, Goijera parviflora, Heterodendrum oleifolium, Santalum lanceolatum.*

INFREQUENT SPP: *Acacia harpophylla, Lysiphyllum gilvum, Ventilago viminalis.*

TALL SHRUB LAYER: Ht 3.5 ± 1m; PFC (variable) < 5%; density 100 ± 100 shrubs/ha.

FREQUENT SPP: *Eremophila mitchellii.*

LOW SHRUB LAYER: Ht 1.25 ± 0.75m; PFC < 1%; density 30 ± 20 shrubs/ha.

FREQUENT SPP: *Apophyllum anomalum, Enchylaena tomentosa, Myoporum deserti.*

INFREQUENT SPP: *Cassia nemophila.*

GROUND LAYER: Ht < 0.75m; PFC (variable) usually < 5% rarely 15%.

FORBS:

FREQUENT SPP: *Abutilon malvifolium, Atriplex muelleri, Bassia divaricata, B. quinquecuspis, Boerhavia diffusa, Commelina cyanea, Euphorbia drummondii, Flaveria australasica, Justicia procumbens, Phyllanthus maderaspatensis, Portulaca* sp. aff. *P. oleracea, Ptilotus exaltatus, Salsola kali, Sida fibulifera, S. trichopoda, Trianthema triquetra.*
INFREQUENT SPP: *Abutilon oxycarpum, Alternanthera nodiflora* Amaranthus mitchellii, Bassia biflorus* var. *cephalocarpa, Bassia bicornis* var. *horrida, B. lanicuspis, Brunoniella australis, Hibiscus trionum, Malvastrum americanum*, Haroldia drummondii*, Ocimum canctum, Ptilotus obovatus, Pterigeron adscendens, Rhagodia nutans, Tribulus terrestris.*

GRAMINOIDS:

FREQUENT SPP: *Astrebla lappacea, Brachyachne convergens, Dactyloctenium radulans, Enneapogon avenaceus, E. pallidus, E. polyphyllus, Enteropogon acicularis, Eragrostis setifolia, Paspalidium constrictum, Sporobolus australasicus, S. caroli.*

INFREQUENT SPP: *Aristida latifolia, Astrebla elymoides, Brachiaria gilesii*, Cenchrus ciliaris, Cyperus bifax, C. iria*, Digitaria divaricatissima, Diplachne muelleri, Eragrostis kennedyae*, E. tenellula*, Eriochloa pseudoacrotricha, Sporobolus caroli, S. mitchellii*, Tragus australianus, Urochloecium truncatum*.*

LAND USE:

Areas have been successfully developed by scrub pulling. Developed areas need wise management to prevent woody weed problems and maintain introduced pastures; in the natural state produces useful low grazing capacity pastures with a moderate component of acceptable perennial grasses. Mitchell grass stands over well; very low but useful drought grazing capacity; high AWC, generally adequate fertility, may be limiting for introduced pastures.
Condition: fair to good. Trend: stable.

SITES: B30, 31, 32, 33, 50, 142, 146, 156, 247, 248, 251, 253.

* Species associated with gilgais.

LAND UNIT 39

LANDFORM:

Gently undulating to undulating plains with slopes < 2% usually forming low rises on surrounding plains. Occasionally weakly gilgaied.

GEOLOGY

Weathered sediments of the Cretaceous *Winton Formation* with scattered stone and gravel cover derived by erosion of the Tertiary land surface.

SOILS:

Deep to very deep, reddish brown cracking clays with alkaline reaction. Surfaces are soft, usually self-mulching, and have surface stone cover. Ca CO_3 occurs throughout the profile with gypsum at depth. UG 5.31, UG 5.36. Moderately alkaline pH; low C and N; high K; fair to high AP; low to fair BP; predominantly montmorillonite types clays; strongly sodic subsoils with high salt levels. *Sylvester.* Representative soil analysis B 26.

VEGETATION:

Gidgee tall open shrubland to tall shrubland. *Acacia cambagei* (gidgee) predominates and together with other tree species form a discontinuous upper stratum layer. Scattered low shrubs occur but rarely form a well defined layer. Ground flora is variable composed of grasses and forbs.

STRUCTURAL FORMATION: Tall open shrubland to tall shrubland.

TREE/TALL SHRUB LAYER: Ht 6 ± 1.5m; PFC 7.5 ± 2.5%; density 425 ± 175 shrubs/ha.

PREDOMINANT SPP: *Acacia cambagei.*
Ht 6 ± 1.5m; PFC 7.5 ± 2.5%.

FREQUENT SPP: *Flindersia maculosa, Santalum lanceolatum.*

INFREQUENT SPP: *Acacia cana, Lysiphyllum gilvum.*

LOW SHRUB LAYER: Ht 1.25 ± 0.75m; PFC < 1% (rarely 5%).

FREQUENT SPP: *Enchylaena tomentosa, Eremophila mitchellii.*

INFREQUENT SPP: *Myoporum deserti.*

GROUND LAYER: Ht < 0.75m; PFC (variable) 15 ± 10%.

FORBS:

FREQUENT SPP: *Abutilon malvifolium, Atriplex muelleri, Boerhavia diffusa, Portulaca* sp. aff. *P. oleracea, Salsola kali, Trianthema triquetra.*

INFREQUENT SPP: *Amaranthus mitchellii, Brassoniella australis, Cheilanthes distans, Commelina cyanea, Hibiscus trionum, Rhagodia parabolica. Ptilotus polystachyus, Sida trichopoda, Solanum ellipticum Tribulus terrestris.*

GRAMINOIDS:

FREQUENT SPP: *Enteropogon acicularis, Sporobolus caroli.*

INFREQUENT SPP: *Astrebla lappacea, Cenchrus ciliaris, Dactyloctenium radulans.*

LAND USE:

Development and wise management needed for maximum productivity; in the natural state produces useful low grazing capacity pastures with a moderate component of acceptable perennial species; clearing or thinning increases grazing capacity; introduced grasses further increase carrying capacity; woody weeds a problem; when developed provides useful standover feed with medium drought grazing capacity; medium to high AWC; generally adequate fertility.
Condition: good. Trend: stable.

SITES: B26, 249.

LAND UNIT 40

LANDFORM:

Undulating plains and low hills with slopes 1 - 3%.

GEOLOGY:

Weathered sediments of the Cretaceous *Winton Formation.* with surface stone cover derived by erosion of Tertiary land surface.

SOILS:

Deep to very deep, very stony, reddish brown cracking clays. Gilgais well developed. Minor occurrences of grey clays (in gilgai depressions). Soil reaction is alkaline, textures are heavy clays. Surfaces have weak crusts,with dense stone pavements. Stone and gravel may occur close to the surface and in the profile. $CaCO_3$ is usually present throughout, with gypsum at depth. UG 5.28 UG 5.34, UG 5.38, UG 5.39. Strong to very strongly alkaline pH; low to very low C and N; fair to high K; variable AP (very low to high); fair to very low BP; predominantly montmorillonite type clays; strongly sodic subsoils with high salt levels; surfaces may be sodic in some landscape positions. *Sylvester.* Representative soil analysis B 122.

VEGETATION:

Gidgee tall open shrubland to tall shrubland. *Acacia cambagei* (gidgee) predominates and together with other tree species form a distinct but discontinuous upper canopy. Scattered low shrubs occur but do not form a well defined layer. Ground cover is variable composed of grasses and forbs.

STRUCTURAL FORMATION: Tall shrubland to tall open shrubland.

TALL SHRUB LAYER: Ht 5.5 ± 1.5m; PFC 10 ± 5%; density 800 ± 300 shrubs/ha.

PREDOMINATE SPP: *Acacia cambagei,* Ht 5.5 ± 1.5m; PFC 10 ± 15%.

FREQUENT SPP: *Santalum lanceolatum.*

INFREQUENT SPP: *Flindersia maculosa.*

LOW SHRUB LAYER: Ht 1.25 ± 0.75m; PFC < 1%; density 30 ± 20 shrubs/ha.

FREQUENT SPP: *Capparis lasiantha, Enchylaena tomentosa, Eremophila mitchellii.*

INFREQUENT SPP: *Cassia oligophylla, C. phyllodinea.*

GROUND LAYER: Ht < 0.75m; PFC 15 ± 10%.

FORBS:

FREQUENT SPP: *Abutilon malvifolium, A. oxycarpum, Bassia divaricata, B. lanicuspis, B. quinqueuspis*[*], *Boerhavia diffusa, Hibiscus trionum, Marsilea drummondii*[*], *Portulaca* sp. aff. *P. oleracea, Ptilotus exaltatus, Salsola kali, Sida fibulifera, S. trichopoda, Solanum esuriale.*

INFREQUENT SPP: *Alternanthera nodiflora*[*], *Atriplex lindleyi, A. muelleri, Bassia biocrnis, B. tricuspis, B. ventricosa, Cleome viscosa, Euphorbia stevenii, Threlkeldia procariflora, Trianthema triquetra, T. portulacastrum.*

GRAMINOIDS:

FREQUENT SPP: *Dactyloctenium radulans, Enneapogon pallidus, E. polyphyllus, Panicum decompositum, Sporobolus actinocladus, S. caroli.*

INFREQUENT SPP: *Aristida anthoxanthoides, Astrebla lappacea, Brachiaria gilesii*[*], *Brachyachne convergens*[*], *Cyperus gilesii*[*], *C. iria*[*], *Enteropogon acicularis. Eragrostis setifolia, E. tenellula*[*], *Eriochloa pseudoacrotricha*[*], *Sporobolus australasicus, Tragus australianus.*

* Species associated with gilgais.

LAND USE:

Sodic surface soils limit development. In the natural state produces useful low grazing capacity pastures with a low component of acceptable perennial grasses; thinning increases carrying capacity; woody weeds a problem; drought grazing capacity very low; high AWC; variable but adequate fertility.
Condition: fair. Trend: stable.

SITES: B122, 150, 226, 227.

LAND UNIT 41

LANDFORM:

Gently undulating plains with slopes < 2%.

GEOLOGY:

Weathered sediments of Cretaceous *Winton Formation* with surface stone cover derived from erosion of the Tertiary land surface.

SOILS:

Deep to very deep, stony, brown to reddish brown, cracking clays with neutral to alkaline reaction, weak gilgai development. Textures range from heavy clays to sandy medium clays. Surface stone and gravel pavements are present. $CaCO_3$ and/or large accumulations of gypsum occur throughout the profile . UG 5.28, UG 5.36. *Sylvester.*

VEGETATION:

Gidgee tall open shrubland. *Acacia cambagei* (gidgee) predominates forming pure stands in places. Scattered low shrubs also occur but do not form a well defined layer. Ground cover is variable composed of grasses and forbs.

STRUCTURAL FORMATION: Tall open shrubland.

TALL SHRUB LAYER: Ht 4.5 ± 0.5m; PFC 7.5 ± 2.5%; density 500 ± 125 shrubs/ha.

PREDOMINANT SPP: *Acacia cambagei.* Ht 4.5 ± 0.5m; PFC 7.5 ± 2.5%.

INFREQUENT SPP: *Santalum lanceolatum.*

LOW SHRUB LAYER: Ht < 0.75m; PFC < 1%; density < 25 shrubs/ha.

FREQUENT SPP: *Enchylaena tomentosa.*

GROUND LAYER: Ht 0.75 ± 0.25m; PFC 12.5 ± 7.5%.

FORBS:

FREQUENT SPP: *Amaranthus mitchellii, Atriplex lindleyi, Bassia divaricata, Portulaca* sp. aff.,*P. oleracea, Sida fibulifera, S. trichopoda, Solanum ellipticum, Salsola kali, Trianthema triquetra.*

INFREQUENT SPP: *Abutilon malvifolium, A. oxycarpum sagittatum, Alternanthera nodiflora*[*], *Aeschynomene indica*[*], *Atriplex muelleri, Cleome viscosa, Marsilea* * *Ocimum sanctum, Portigeron adnarulens, Ptilotus exaltatus.*

GRAMINOIDS:

FREQUENT SPP: *Dactyloctenium radulans, Enneapogon polyphyllus, Enteropogon acicularis, Eragrostis setifolia, Sporobolus actinocladus, S. caroli.*

INFREQUENT SPP: *Astrebla pectinata, Enneapogon pallidus, Eriochloa pseudoacrotricha*[*], *Panicum decompositum, Sporobolus actinocladus, Uranthoecium truncatum*[*].

* Species associated with gilgais.

LAND USE:

A stable, productive unit capable of producing useful low grazing capacity pasture; thinning increases grazing capacity; introduced pasture establishment not recommended; drought grazing capacity very low.
Condition: fair. Trend: stable.

SITES: B 160, 221.

LAND UNIT 42

LANDFORM:

Very gently undulating to undulating plains with slopes < 5% and median slope 1 - 2%.

GEOLOGY:

Weathered sediments of Cretaceous *Winton Formation* with gravel cover derived from erosion of the Tertiary land surface.

SOILS:

Shallow to moderately deep, reddish-brown, cracking clays with minor occurrences of desert loams. Weak gilgai development. Soil reaction is neutral at the surface and neutral to alkaline at depth. Textures are light to medium clays, occasionally with some sand intermixed. UG 5.37, *Sharpham.* Representative soil analysis B 165. Areas with hardsetting sandy loam and clay loam surface textures are classed as desert loams. DR 2.12, *Stewart.* Representative soil analysis B 178. Dense surface stone and gravel pavements are characteristic throughout this unit. $CaCO_3$ and gypsum are often present at depth. Very low C and N; fair to high K; fair to low AP and BP; strongly sodic subsoils with high salts; some sodic surfaces; desert loam soils have Mg as the co-dominant cation with Ca; together with high Na levels this leads to poor physical properties, in particular low infiltration rates.

VEGETATION:

Gidgee tall open shrubland to shrubby tall shrubland. *Acacia cambagei* (gidgee) predominates. Other tall shrubs may be present. Low shrubs mainly *Cassia* spp. and *Eremophila* spp. occur and form well defined layers in places. Ground cover is variable but is usually well developed and composed of grasses and forbs.

STRUCTURAL FORMATION: Tall open shrubland to tall shrubland.

TREE/TALL SHRUB LAYER: Ht 5 ± 2m; PFC 7 ± 5%; density 300 ± 225 shrubs/ha.

PREDOMINATE SPP: *Acacia cambagei.* Ht 5 ± 2m; PFC 7 ± 5%.

INFREQUENT SPP: *Eremophila mitchellii, Santalum lanceolatum.*

LOW SHRUB LAYER: Ht 1.25 ± 0.5m; PFC 5 ± 5%; density 450 ± 450 shrubs/ha.

FREQUENT SPP: *Cassia artemisioides, C. phyllodinea, C. oligophylla, Enchylaena tomentosa, Eremophila oppositifolia* var. *rubra.*

INFREQUENT SPP: *Apophyllum anomalum, Carissa lanceolata.*

GROUND LAYER: Ht < 0.75m; PFC 20 ± 10%.

FORBS:

FREQUENT SPP: *Atriplex lindleyi, Abutilon malvifolium, Bassia divaricata, B. lanicuspis, Boerhavia diffusa, Maireana triptera, Portulaca* sp. aff. *P. oleracea, Ptilotus exaltatus, P. macrocephalus, P. obovatus, Salsola kali, Solanum ellipticum, Threlkeldia proceriflora, Trianthema triquetra.*

INFREQUENT SPP: *Abutilon oxycarpum, Bassia bicornis, B. ventricosa, Cleome viscosa, Euphorbia mitchelliana, Ptilotus polystachyus, Solanum esuriale.*

GRAMINOIDS:

FREQUENT SPP: *Brachyachne convergens, Chloris pectinata, Cyperus gilesii, Dactyloctenium radulans, Enneapogon polyphyllus, Sporobolus actinocladus, S. australasicus, Tripogon loliiformis.*

INFREQUENT SPP: *Astrebla pectinata, Enteropogon acicularis, Iseilema membranaceum, Sporobolus caroli, Tragus australianus.*

LAND USE:

A stable productive unit capable of producing good ephemeral pastures with a low component of acceptable perennial species; useful standover values; low and unreliable rainfall is limiting but unit receives some run-on water; development not recommended; drought grazing capacity very low; medium to high AWC; low to very low fertility. Condition: fair. Trend: stable.

SITES: B65, 165, 178, 200.

LAND UNIT 43

LANDFORM:

Gently undulating to flat plains with slopes 1% or less.

GEOLOGY:

Thin Quaternary deposits over altered Cretaceous *Winton Formation.*

SOILS:

Shallow, gravelly, red desert loams and lithosols with neutral reaction. Occasionally weakly gilgaied. Textures range from silty loam surfaces to sandy clay loam and light clay subsoils with grit or gravel throughout. Surfaces have continuous ironstone shot and gravel cover. DR 2.43, very low C and N; high K; variable AP and BP; strongly sodic subsoils, sodic surfaces; high proportion of Mg cations; generally high salt levels near the surface. *Geiger.* Representative soil analysis B 102.

VEGETATION:

Gidgee grassy to forby tall open shrubland. *Acacia cambagei* (gidgee) predominates. Scattered low shrubs, mainly *Cassia* spp., occur forming a well defined layer in places. Ground cover is variable composed of grasses and forbs. This association is commonly associated with areas devoid of vegetation.

STRUCTURAL FORMATION: Tall open shrubland.

TALL SHRUB LAYER: Ht 4 ± 1m; PFC < 5%; density 100 ± 50 shrubs/ha.

PREDOMINANT SPP: *Acacia cambagei.* Ht 4 ± 1m; PFC < 5%.

LOW SHRUB LAYER: Ht 1.5 ± 0.5m; PFC < 5%; density 300 ± 150 shrubs/ha.

FREQUENT SPP: *Cassia desolata, C. phyllodinea, Eremophila oppositifolia* var. *rubra.*

GROUND LAYER: Ht < 0.5m; PFC (variable) 15 ± 15%.

FORBS:

FREQUENT SPP: *Atriplex lindleyi, Bassia bicornis, B. cornishiana, Chenopodium rhadinostachyum, Portulaca* sp. aff. *P. oleracea, Salsola kali.*

INFREQUENT SPP: *Abutilon leucopetalum, Atriplex elachophylla Bassia lanicuspis, B. tricuspis, Boerhavia diffusa, Trianthema triquetra.*

GRAMINOIDS:

FREQUENT SPP: *Brachyachne convergens, Chloris pectinata, Dactyloctenium radulans, Enneapogon polyphyllus, Sporobolus australasicus, S. actinocladus, Tragus australianus.*

INFREQUENT SPP: *Aristida contorta, Eriachne pulchella, Tripogon loliiformis.*

LAND USE:

A stable unproductive unit capable of producing only limited ephemeral pastures of very low grazing capacity; low and unreliable rainfall, very limited standover feed; drought grazing capacity very low; very low AWC; low to very low fertility. Condition poor to mediocre. Trend: slightly downwards.

SITES: B102, 103, 207.

LAND UNIT 44

LANDFORM:

Flat to gently sloping plains with slopes < 1%.

GEOLOGY:

Undifferentiated Quaternary deposits over altered Cretaceous *Winton Formation.*

SOILS:

Deep to very deep, neutral, brown, cracking clays with heavy clay textures. Surfaces are crusting when dry. $CaCO_3$ and gypsum are present in the lower parts of the profile. UG 5.25. Very low C and N; very low AP and BP. *Conniston.* Representative soil analysis B3.

VEGETATION:

Gidgee, Ellangowan poison bush grassy low open woodland. *Acacia cambagei* (gidgee) predominates. Low shrubs of *Myoporum deserti* (Ellangowan poison bush) occur and form a well defined layer. Tall shrubs and other low shrubs usually are conspicuous. Ground cover is variable but usually sparse composed of grasses and forbs.

STRUCTURAL FORMATION: Low open woodland.

TREE/TALL SHRUB LAYER: Ht 8 ± 2m; PFC < 5%; density 100 ± 50 trees/ha; 50 ± 25 tall shrubs/ha.

PREDOMINANT SPP: *Acacia cambagei.* Ht 8 ± 2m; PFC < 5%.

FREQUENT SPP: *Eremophila mitchellii.*

LOW SHRUB LAYER: Ht 1.25 ± 0.75m; PFC < 5%; density 400 ± 300 shrubs/ha.

FREQUENT SPP: *Cassia nemophila* var. *nemophila, Enchylaena tomentosa, Eremophila polyclada, Myoporum deserti.*

INFREQUENT SPP: *Eremophila maculata.*

GROUND LAYER: Ht < 0.75; PFC (variable) 10 ± 5%.

FORBS:

FREQUENT SPP: *Boerhavia diffusa, Malvastrum americanum Ptilotus exaltatus, P. polystachyus, Salsola kali, Solanum ellipticum.*

INFREQUENT SPP: *Abutilon otocarpum, Bassia paradoxa, Sida fibulifera.*

GRAMINOIDS:

FREQUENT SPP: *Dactyloctenium radulans, Iseilema membranaceum, Sporobolus australasicus, Tripogon loliiformis.*

INFREQUENT SPP: *Enteropogon acicularis, Sporobolus caroli, Tragus australianus.*

LAND USE.

In the natural state produces useful low grazing capacity pastures with a low component of perennial species; thinning increases grazing capacity; woody weeds a problem; benefits from run-on water; drought grazing capacity very low; low to medium AWC and very low fertility are limiting factors.
Condition: poor to mediocre. Trend: slightly downwards.

SITES: B 3.

LAND UNIT 45

LANDFORM:

Sloping to undulating plains at the foot of scarp retreat zones with slopes < 5%.

GEOLOGY:

Quaternary cover over altered Cretaceous *Winton Formation.*

SOILS:

Shallow, gravelly, red clays with slightly alkaline soil reaction and medium to heavy clay textures. $CaCO_3$ and gravel are present in the lower profile, surfaces are crusting and are scattered with stone and gravel. UG 5.37, UF 5.31. Medium acid pH at the surface; low to very low C and N; fair K; low to very low AP and BP; sodic subsoils with high salt levels; Mg co-dominant. *Sharpham.* Representative soil analysis B9.

VEGETATION:

Gidgee, sandalwood low open woodland. *Acacia cambagei* (gidgee) predominates forming a distinct but discontinuous canopy. *Eremophila mitchellii* (sandalwood) is conspicuous and together with other species form a distinct tall shrub understorey. Scattered low shrubs occur but do not form a well defined layer. Ground cover is usually sparse composed of grasses and forbs.

STRUCTURAL FORMATION: Low open woodland.

TREE LAYER: Ht 8 ± 2m; PFC < 5%; density 160 ± 40 trees/ha.

PREDOMINANT SPP: *Acacia cambagei.* Ht 8 ± 2m; PFC < 5%.

FREQUENT SPP *Flindersia maculosa.*

TALL SHRUB LAYER: Ht 3 ± 1m; PFC < 5%; density 80 ± 40 shrubs/ha.

FREQUENT SPP: *Eremophila mitchellii, Cajjera parviflora.*

LOW SHRUB LAYER: Ht 1.5 ± 0.5m; PFC < 1%; density 80 ± 40 shrubs/ha.

FREQUENT SPP: *Apophyllum anomalum, Cassia artemisioides, Myoporum deserti.*

INFREQUENT SPP: *Enchylaena tomentosa.*

GROUND LAYER: Ht < 0.75m; PFC (variable) 5 ± 4%.

FORBS:

FREQUENT SPP: *Portulaca* sp. aff. *P. oleracea, Ptilotus obovatus, Salsola kali.*

INFREQUENT SPP: *Bassia intricata, B. ventricosa.*

GRAMINOIDS:

FREQUENT SPP: *Enteropogon acicularis, Sporobolus australasicus, Tripogon loliiformis.*

INFREQUENT SPP: *Enneapogon pallidus, Panicum decompositum.*

LAND USE:

Capable of producing low grazing capacity pasture with a low component of perennial species; woody weeds a potential problem; drought grazing capacity very low; low AWC; low to very low fertility; susceptible to erosion; development not warranted.
Condition: poor to mediocre. *Trend: slightly downward.*

SITES: B9.

LAND UNIT 46

LANDFORM:

Gently undulating plains with slopes < 3%.

GEOLOGY:

Weathered sediments of Cretaceous *Winton Formation.*

SOILS:

Deep to very deep, brown cracking clays with alkaline reaction and medium to heavy clay textures. Weakly gilgaied. Surfaces are soft, with a thin self-mulching layer over strongly structured subsoils. $CaCO_3$ is present throughout the profile with gypsum at depth. UG 5.34. Low C and N; high K; high AP fair BP; sodic subsoils with high salt levels. *Bonnie.* Representative soil analysis B 252.

VEGETATION:

Brigalow, gidgee shrubby low open woodland. *Acacia harpophylla* (brigalow) and *A. cambagei*(gidgee) predominate and together with scattered trees of other species form a distinct but discontinuous upper stratum canopy. Scattered low shrubs occur and form a well defined layer in places. Ground cover is variable composed of grasses and forbs.

STRUCTURAL FORMATION: Low open woodland.

TREE/TALL SHRUB LAYER: Ht 8 ± 2m; PFC 7.5 ± 2.5%; density 550 ± 100 trees/ha.

PREDOMINANT SPP: *Acacia cambagei*, Ht 7 ± 1m; PFC < 5%; *A. harpophylla*. Ht 8 ± 2m; PFC < 5%.

FREQUENT SPP: *Flindersia maculosa.*

INFREQUENT SPP: *Geijera parviflora.*

LOW SHRUB LAYER: Ht 1.25 ± 0.75m; PFC 7.5 ± 2.5% (rarely 15%); density 700 ± 500 shrubs/ha.

FREQUENT SPP: *Apophyllum anomalum, Enchylaena tomentosa, Eremophila mitchellii.*

INFREQUENT SPP: *Eremophila maculata.*

GROUND LAYER: Ht 0.75 ± 0.25m; PFC 7.5 ± 2.5%.

FORBS:

FREQUENT SPP: *Rhagodia paradoxa, Salsola kali, Sida trichopoda, Trianthema triquetra.*

INFREQUENT SPP: *Abutilon leucopetalum, Bassia tetracuspis, Dipteracanthus primulaceus, Hibiscus trionum, Ptilotus exaltatus, Sida fibulifera.*

GRAMINOIDS:

FREQUENT SPP: *Enneapogon pallidus, Enteropogon acicularis.*

INFREQUENT SPP: *Cenchrus ciliaris, Sporobolus caroli, Tragus australianus.*

LAND USE:

Development and wise management needed for maximum productivity; in the native state produces very limited pasture of low grazing capacity; clearing increases grazing capacity; introduced grasses further increase grazing capacity; woody weeds a potential problem; possible erosion problems during development phase; drought grazing capacity very low; high to very high AWC; adequate fertility.
Condition: good. Trend: stable.

SITES: B252.

LAND UNIT 47

LANDFORM:

Flat to very gently undulating plains with slopes < 2%.

GEOLOGY:

Weathered sediments of Cretaceous *Winton Formation.*

SOILS:

Shallow, brown cracking clays with neutral reaction. Textures are heavy clays. Surfaces are weakly crusting and self-mulching with scattered gravel. Gypsum occurs throughout the profile. UG 5.32. *Carlow.*

VEGETATION:

Gidgee tall open shrubland. *Acacia cambagei* (gidgee) predominates. A low shrubby layer is not present. Ground cover is variable composed of grasses and forbs.

STRUCTURAL FORMATION: Tall open shrubland.

TREE/TALL SHRUB LAYER: Ht 3.5 ± 0.5m; PFC < 5%; density 100 ± 50 shrubs/ha.

PREDOMINANT SPP: *Acacia cambagei* Ht 3.5 ± 0.5m; PFC < 5%.

GROUND LAYER: Ht < 1m; PFC 15 ± 10%.

FORBS:

FREQUENT SPP: *Atriplex lindleyi, A. spongiosa, Bassia divaricata, B. lanicuspis, Portulaca* sp. aff. *P. oleracea, Ptilotus macrocephalus, Salsola kali, Sida trichopoda, Threlkeldia proscriflora,Trianthema triquatra.*

INFREQUENT SPP: *Euphorbia drummondii, Hibiscus trionum, Rhynchosia minima, Sida virgata.*

GRAMINOIDS:

FREQUENT SPP: *Brachyachne convergens, Dactyloctenium radulans, Sporobolus actinocladus, S. australasicus.*

INFREQUENT SPP: *Dichanthium sericeum, Iseilema membranaceum.*

LAND USE:

Low and unreliable rainfall limiting; capable of producing useful low grazing capacity ephemeral pastures with a very low perennial species component; drought grazing capacity very low.
Condition: poor to mediocre. Trend: stable to slightly downwards.

SITES: B 264.

LAND UNIT 48

LANDFORM:

Very gently undulating plains with slopes < 2%; usually at the base of scarp retreat zones.

GEOLOGY:

Weathered sediments of the altered Cretaceous *Winton Formation* occasionally with thin veneer of material derived from erosion of the Tertiary land surface.

SOILS:

Moderately deep to deep, red cracking clays and associated areas of desert loams. Occasional areas with ironstone shot and gravel on the surface occur. The cracking clays have heavy clay textures and alkaline soil reaction, becoming neutral to slightly acid at depth. UG 5.38. The desert loams have hardsetting sandy clay loam surfaces over light to medium clays. Reaction is neutral. DR 2.12. Low C and N; fair K; very low AP and BP; subsoils may be sodic and saline. *Bonnie.* Representative soil analysis B 218. *Stewart.* Representative soil analysis B 216.

VEGETATION:

Brigalow open woodland. *Acacia harpophylla* (brigalow) predominates forming a distinct upper layer with a discontinuous canopy. Other trees may occur emerging above the canopy. Scattered low shrubs and tall shrubs are usually present and in places, particularly where disturbance has occurred, may form a distinct layer. Ground flora is variable composed of grasses and forbs. In many places this association has been greatly disturbed and structural formations vary depending on the stage of re-development.

STRUCTURAL FORMATION: Open woodland.

TREE/TALL SHRUB LAYER: Ht 6 ± 1m; PFC 7.5 ± 2 5%. density (variable) 300 ± 200 shrubs/ha.

PREDOMINANT SPP: *Acacia harpophylla.* Ht 6 ± 1m; PFC 7.5 ± 2.5%.

INFREQUENT SPP: *Eucalyptus thozetiana, Geijera parviflora.*

LOW SHRUB LAYER: Ht 1.25 ± 0.75m; PFC (variable) 5 ± 2.5%, density 600 ± 300 shrubs/ha.

FREQUENT SPP: *Acacia harpophylla* (regrowth), *Apophyllum anomalum, Cassia nemophila, Enchylaena tomentosa, Eremophila mitchellii.*

INFREQUENT SPP: *Atriplex vesicaria, Cassia artemisioides, Eremophila maculata, E. polyclada, Opuntia inermis.*

GROUND LAYER: Ht < 1m; PFC (variable) 20 ± 15%.

FORBS:

FREQUENT SPP: *Abutilon otocarpum, Dipteracanthus primulaceus, Portulaca* sp. aff. *P. oleracea, Ptilotus obovatus, Salsola kali, Sida fibulifera, S. trichopoda.*

INFREQUENT SPP: *Bassia anisacanthoides, B. divaricata, B. lanicuspis, B. paradoxa, B. quinquecuspis, B. tetracuspis, Ptilotus exaltatus, Solanum ellipticum.*

GRAMINOIDS:

FREQUENT SPP: *Dactyloctenium radulans, Enneapogon polyphyllus, Enteropogon acicularis, Sporobolus actinocladus.*

INFREQUENT SPP: *Cenchrus ciliaris, Panicum decompositum, Themeda australis.*

LAND USE:

A relatively unproductive unit producing a pasture of low grazing capacity; woody weeds a problem; drought grazing capacity very low; variable AWC; very low fertility; limited development potential.
Condition: mediocre. Trend: slightly downwards.

SITES: B216, 217, 218.

LAND UNIT 49

LANDFORM:

Flat to gently sloping plains, usually forming valley floors.

GEOLOGY

Undifferentiated Quaternary deposits over altered Cretaceous *Winton Formation.*

SOILS:

Reddish brown, texture contrast soils, with hardsetting sandy clay loam surfaces and clay subsoils.

VEGETATION:

Brigalow, Dawson gum open woodland to low open woodland. *Acacia harpophylla* (brigalow) forms a distinct but discontinuous canopy with *Eucalyptus cambageana* (Dawson gum) emerging. Other scattered trees also occur. There is no well defined tall shrub layer but isolated tall shrubs are usually present. Scattered low shrubs are conspicuous but rarely form a distinct layer. Ground cover is variable composed of grasses and forbs.

STRUCTURAL FORMATION: Open woodland to low open woodland.

TREE LAYER: Ht 10 ± 3m; PFC 7.5 ± 2.5%; density 250 ± 150 trees/ha.

PREDOMINANT SPP: *Acacia harpophylla*, Ht 9 ± 2m; PFC 6.5 ± 1.5%.

FREQUENT SPP: *Eucalyptus cambageana, E. populnea.*

INFREQUENT SPP: *Eucalyptus thozetiana.*

TALL SHRUB LAYER: Ht 4.5 ± 1.5m; PFC < 1%; density < 25 shrubs/ha.

FREQUENT SPP: *Eremophila mitchellii.*

LOW SHRUB LAYER: Ht 1 ± 0.5m; PFC < 1%; density 30 ± 20 shrubs/ha.

FREQUENT SPP: *Capparis lasiantha, Enchylaena tomentosa, Myoporum desorti.*

INFREQUENT SPP: *Carissa ovata, Cassia nemophila.*

GROUND LAYER: Ht < 1m; PFC (variable) 10 ± 5%.

FORBS:

FREQUENT SPP: *Abutilon oxycarpum, Malvastrum americanum, Salsola kali.*

INFREQUENT SPP: *Bassia quinquecuspis, Portulaca* sp. aff. *P. oleracea, Sida fibulifera, S. trichopoda.*

GRAMINOIDS:

FREQUENT SPP: *Astrebla lappacea, Digitaria ammophila, Enteropogon acicularis, Iseilema membranaceum, Sporobolus caroli.*

INFREQUENT SPP: *Aristida latifolia, Dichanthium affine, D. sericeum, Paspalidium caespitosum, Panicum decompositum.*

LAND USE:

Limited in extent; produces low grazing capacity pastures in the natural state; timber treatment may be practical in places and would increase grazing capacity; woody weeds a potential problem; limited topfeed; drought grazing capacity very low; moderate AWC.
Condition: fair. Trend: slightly downwards.

SITES: R1, 258.

LAND UNIT 50

LANDFORM:

Gently undulating plains with slopes < 1%.

GEOLOGY:

Weathered sediments of the Cretaceous *Winton Formation.*

SOILS:

Moderately deep, brown cracking clays with alkaline soil reaction. Textures are heavy clays throughout. Surfaces are usually self-mulching; subsoils are strongly structured. $CaCO_3$ occurs in increasing amounts down the profile; gypsum is occasionally present at depth. UG 5.22, UG 5.32, UG 5.37, UG 5.38. Moderately to very strongly alkaline pH; low to very low C and N; high K; variable AP (very low to very high); very low to low BP; sodic and saline subsoils were recorded in the Arno area. *Thornleigh.* Representative soil analysis B 57.

VEGETATION:

Mitchell grass wooded open tussock grassland to tussock grassland rarely open herbfield. *Astrebla* spp. (Mitchell grasses) predominate with other short grasses and forbs usually present. Ground cover is variable depending on seasonal conditions. Isolated low shrubs occur but in places *Eremophila mitchellii* (sandalwood) forms a well defined low shrub layer. Scattered trees of *Acacia cambagei* (gidgee), *A. cana* (boree), *Atalaya hemiglauca* (whitewood) and *Ventilago viminalis* (wineree) are usually conspicuous. Frequently dense stands of *A. cambagei* (density 1500 ± 500 shrubs/ha) forming distinct clumps are associated with this unit.

STRUCTURAL FORMATION: Open tussock grassland.

TREE/TALL SHRUB LAYER: Ht 9 ± 3m; PFC (variable) usually < 1%; rarely 2.5%; density, 30 ± 20 shrubs/ha.

FREQUENT SPP: *Acacia cambagei, A. cana, Atalaya hemiglauca, Flindersia maculosa, Ventilago viminalis.*

INFREQUENT SPP: *Acacia pendula, Lysiphyllum gilvum, Heterodendrum oleifolium.*

LOW SHRUB LAYER: Ht 1 ± 0.5m; PFC (variable) usually < 1% up to 1.5%; density 50 ± 40 shrubs/ha.

FREQUENT SPP: *Acacia farnesiana, Apophyllum anomalum, Eremophila mitchellii.*

INFREQUENT SPP: *Acacia victoriae, Capparis lasiantha, Enchylaena tomentosa, Eremophila maculata.*

GROUND LAYER: Ht 0.75 ± 0.25m; PFC 25 ± 15%.

PREDOMINANT SPP: *Astrebla elymoides, A. lappacea.* Ht 0.75 ± 0.25m; PFC 20 ± 10%.

FORBS:

FREQUENT SPP: *Abutilon malvifolium, Bassia biocornis* var. *horrida, B. calcarata, B. quinquecuspis, Boerhavia diffusa, Euphorbia drummondii, Ipomoea lonchophylla, Malvastrum americanum, Portulaca* sp. aff. *P. oleracea, Ptilotus exaltatus, Salsola kali, Solanum esuriale, Sida trichopoda, Trianthema triquetra.*

INFREQUENT SPP: *Atriplex muelleri, Cleome viscosa, Hibiscus trionum, Psoralea cinerea, Polymeria longifolia, P. marginata, Pterigeron adscendens, Rhynchosia minima, Sida fibulifera, Threlkeldia proceriflora.*

GRAMINOIDS:

FREQUENT SPP: *Aristida latifolia, Cyperus bifax, Dactyloctenium radulans, Dichanthium sericeum, Iseilema membranaceum, Panicum decompositum, Sporobolus caroli, Tragus australianus.*

INFREQUENT SPP: *Astrebla squarrosa, Digitaria ammophila, Enneapogon polyphyllus, Eragrostis elongata, Iseilema vaginiflorum, Sporobolus actinocladus, S. australasicus.*

LAND USE:

Capable of producing good pastures with a high component of acceptable perennial grasses; standover feed adequate; topfeed sparse; useful but low drought grazing capacity; adequate shade; high AWC, adequate fertility; useful breeding country.
Condition: good to very good. Trend: stable.

SITES: B 11, 57, 141, 147, 161.

LAND UNIT 51

LANDFORM:

Very gently undulating to flat plains with slopes < 1%.

GEOLOGY:

Weathered sediments of the Cretaceous *Winton Formation.*

SOILS:

Moderately deep to deep, brown cracking clays with alkaline soil reaction. Textures are heavy clays throughout. Surfaces are self-mulching. Subsoils are strongly structured. Scattered surface gravel is common. $CaCO_3$ occurs throughout the profile with gypsum at depth. UG 5.24, UG 5.32, UG 5.34. Strongly alkaline pH; very low to low C and N; high K; fair AP; low BP; strongly sodic subsoils with high salt levels. *Cootabynia.* Representative soil analysis B49, 153, 157.

VEGETATION:

Boree grassy low open woodland to open woodland. *Acacia cana* (boree) usually predominates and with other trees especially *A. cambagei* (gidgee) form a distinct but discontinuous upper layer. Scattered low shrubs including *Apophyllum anomalum* (broom brush) and *Eremophila mitchellii* (sandalwood) occur and in places form a well defined low shrub layer. *Astrebla* spp. (Mitchell grasses) usually predominate the ground flora but other short grasses and forbs occur. Ground cover is variable depending on seasonal conditions. In places this association approaches a wooded open tussock grassland.

STRUCTURAL FORMATION: Low open woodland to open woodland.

TREE/TALL SHRUB LAYER: Ht 9 ± 3m; PFC 5 ± 2.5%; density 120 ± 80 trees/ha.

PREDOMINANT SPP: *Acacia cana*, Ht 9.5 ± 2.5m; PFC < 5%.

FREQUENT SPP: *Acacia cambagei, Heterodendrum oleifolium.*

INFREQUENT SPP: *Atalaya hemiglauca, Flindersia maculosa, Ventilago viminalis.*

LOW SHRUB LAYER: Ht 1.5 ± 0.5r; PFC (variable) < 5%; density 80 ± 70 shrubs/ha.

FREQUENT SPP: *Apophyllum anomalum, Eremophila mitchellii.*

INFREQUENT SPP: *Capparis lasiantha, Eremophila maculata, Myoporum desorti.*

GROUND LAYER: Ht < 1m; PFC (variable) 25 ± 15%.

FORBS:

FREQUENT SPP: *Abutilon malvifolium, Atriplex lindleyi, Bassia biocornis, B. biocornis* var. *horrida, B. calcarata, Boerhavia diffusa, Malvastrum americanum, Phyllanthus maderaspatensis, Portulaca* sp. aff. *P. oleracea, Ptilotus exaltatus, Rhynchosia minima, Salsola kali, Sida fibulifera, S. virgata, Threlkeldia proceriflora, Trianthema triquetra.*

INFREQUENT SPP: *Atriplex muelleri, Bassia anisacanthoides, B. ventricosa, Dipteracanthus primulaceus, Desmodium campylocaulon, Hibiscus trionum, Sida trichopoda.*

GRAMINOIDS:

FREQUENT SPP: *Astrebla elymoides, A. lappacea, A. squarrosa, Brachyachne convergens, Dactyloctenium radulans, Dichanthium sericeum, Enneapogon avenaceus, Iseilema membranaceum, Panicum decompositum, P. whitei, Sporobolus australasicus, S. caroli.*

INFREQUENT SPP: *Aristida latifolia, Bothriochloa ewartiana, Dichanthium affine, Digitaria divaricatissima, Enteropogon acicularis, Iseilema vaginiflorum, Panicum effusum, Tripogon loliiformis.*

LAND USE:

Capable of producing useful pastures with a high component of acceptable perennial grasses; standover feed usually adequate; topfeed sparse; drought grazing capacity low but useful; shade adequate; high AWC; adequate fertility; useful breeding country.
Condition: fair to good. Trend: stable.

SITES: B49, 123, 149, 159.

LAND UNIT 52

LANDFORM:

Flat to very gently undulating plains with slopes < 1%.

GEOLOGY:

Weathered sediments of the Cretaceous *Winton Formation.*

SOILS:

Deep, brown cracking clays with alkaline soil reaction. Textures are medium to heavy clays throughout. Surfaces are self-mulching with weak crusts. $CaCO_3$ occurs throughout the profile with gypsum at depth. UG 5.24, UG 5.34. Low C and N; high K; high AP; low BP; strongly sodic subsoils with high salt levels. *Cootabynia.* Representative soil analysis B 34.

VEGETATION:

Mitchell grass wooded tussock grassland to wooded open herbfield. Grasses or forbs predominate depending on seasonal conditions. The principal grasses are *Astrebla* spp. (Mitchell grasses). *Atriplex* spp., *Bassia* spp. and *Sida* spp. the more frequently occurring forbs. Scattered low shrubs occur. Isolated trees are usually conspicuous. *Aristida* spp. are conspicuous in over-grazed pastures.

STRUCTURAL FORMATION: Tussock grassland, open tussock grassland or open herbfield depending on seasonal conditions.

TREE/TALL SHRUB LAYER: Ht 7 ± 4m; PFC < 2.5%; density 25 ± 25 shrubs/ha.

FREQUENT SPP: *Heterodendrum oleifolium.*

INFREQUENT SPP: *Acacia pendula, Eremophila mitchellii, Santalum lanceolatum.*

LOW SHRUB LAYER: Ht 1.25 ± 0.5m; PFC < 1%; density < 10 shrubs/ha.

FREQUENT SPP: *Acacia farnesiana.*

INFREQUENT SPP: *Apophyllum anomalum, Eremophila maculata.*

GROUND LAYER: Ht 0.75 ± 0.25m; PFC 25 ± 15%.

FORBS:

FREQUENT SPP: *Atriplex muelleri, A. spongiosa, Bassia bicornis var. horrida, B. calcarata, B. quinquecuspis, Malvastrum americanum, Portulaca sp. aff. P. oleracea, Ptilotus exaltatus, Salsola kali, Sida trichopoda, S. virgata.*

INFREQUENT SPP: *Atriplex lindleyi, Bassia anisacanthoides, Phyllanthus maderaspatensis, Rhynchosia minima, Sida fibulifera.*

GRAMINOIDS:

FREQUENT SPP: *Aristida latifolia, Astrebla elymoides, A. lappacea, Cyperus bifax, Enneapogon polyphyllus, Panicum decompositum, Sporobolus actinocladus, S. caroli, Tripogon loliiformis.*

INFREQUENT SPP: *Aristida leptopoda, Brachyachne convergens, Dactyloctenium radulans, Digitaria ammophila, Panicum effusum.*

LAND USE:

Capable of producing good pastures with a high component of acceptable perennial grasses and ephemeral forbs; standover feed adequate; topfeed sparse; drought grazing capacity low but useful; adequate shade; medium AWC; adequate fertility; useful breeding country.
Condition: good. Trend: stable.

SITES: B 34, 35, 143.

LAND UNIT 53

LANDFORM:

Rarely flooded flat plains, fringing alluvia.

GEOLOGY:

Weathered sediments of the Cretaceous *Winton Formation,* sometimes with a thin cover of Quaternary alluvium.

SOILS:

Deep to very deep, brown cracking clays with alkaline soil reaction. Textures are heavy clays throughout, occasionally with some sand present in the profile. Surfaces are weakly crusting and self-mulching; small sinkholes are common. UG 5.31, UG 5.34. Moderately to very strongly alkaline pH; low to very low C and N; high K; high AP; low BP; subsoils are strongly sodic, generally with high salt levels. *Blackwater, Cootabynia.* Representative soil analysis B 45, 153, 157.

VEGETATION:

Boree grassy open woodland to Mitchell grass boree open tussock grassland. Usually *Acacia cana* (boree) predominates forming a distinct but discontinuous canopy layer. Other scattered trees are usually present. Scattered low shrubs occur but rarely form a well defined layer. Ground flora is variable composed of grasses and forbs. *Astrebla* spp. (Mitchell grasses) are usually predominant in the ground layer. In places this association grades into open tussock grassland with scattered emerging trees.

STRUCTURAL FORMATION: Open woodland.

TREE/TALL SHRUB LAYER: Ht 9 ± 3m; PFC < 5%; density 120 ± 90 trees/ha.

PREDOMINANT SPP: *Acacia cana,* Ht 9 ± 3m; PFC < 5%.

FREQUENT SPP: *Acacia cambagei, Santalum lanceolatum.*

INFREQUENT SPP: *Flindersia maculosa, Heterodendrum oleifolium.*

LOW SHRUB LAYER: Ht < 2m; PFC usually < 1% but up to 5% in places; density 100 ± 100 shrubs/ha.

FREQUENT SPP: *Apophyllum anomalum, Eremophila bignoniiflora, E. mitchellii.*

INFREQUENT SPP: *Enchylaena tomentosa, Eremophila maculata.*

GROUND LAYER: Ht < 1m; PFC 25 ± 15%.

FORBS:

FREQUENT SPP: *Abutilon malvifolium, Amaranthus mitchellii, Atriplex lindleyi, A. muelleri, Bassia bicornis, B. biflora var. cephalocarpa, B. divaricata, B. quinquecuspis, B. ventricosa, Boerhavia diffusa, Commelina cyanea, Desmodium campylocaulon, Hibiscus trionum, Ipomoea lonchophylla, Malvastrum americanum, Portulaca sp. aff. P. oleracea, Ptilotus exaltatus, Rhynchosia minima, Salsola kali, Sida trichopoda, S. virgata, Trianthema triquetra.*

INFREQUENT SPP: *Bassia anisacanthoides, Cleome viscosa, Corchorus trilocularis, Dipteracanthus primulaceus, Phyllanthus maderaspatensis, Pterigeron adscendens, Sida fibulifera, Tribulus terrestris.*

GRAMINOIDS:

FREQUENT SPP: *Aristida latifolia, Astrebla elymoides, A. lappacea, Dactyloctenium radulans, Dichanthium affine, D. sericeum, Iseilema membranaceum, Panicum decompositum, Sporobolus actinocladus, Tragus australianus.*

INFREQUENT SPP: *Aristida leptopoda, Astrebla squarrosa, Brachyachne convergans, Eriochloa pseudoacrotricha, Panicum effusum, Sporobolus caroli.*

LAND USE:

Capable of producing good pastures with a high component of acceptable perennial grasses and ephemeral species; standover feed adequate; limited topfeed; drought grazing capacity low but useful; shade adequate; high AWC; adequate fertility; because of its situation is subject to overgrazing.
Condition: fair to mediocre. Trend: slightly downwards.

SITES: 45, B 153, 157, 223.

LAND UNIT 54

LANDFORM:

Undulating to very gently undulating plains with slopes < 3%.

GEOLOGY:

Weathered sediments of the Cretaceous *Winton Formation;* Quaternary deposits resulting from erosion of old upland surfaces may occur.

SOILS:

Deep, red clays with alkaline reaction and textures ranging from light to heavy clay. Surfaces are predominantly cracking with weak crusts and incipient gilgai microrelief. UG 5.34. Scattered gravel cover is common. Minor areas with hardsetting surfaces occur in the east. UF 6.31. Low to fair C and N; high AP; very fair to high BP (through lower in the profile levels are low to very low); recycling has resulted in a massive build-up of nutrients in the surface in the vicinity of brigalow trees; medium to high salt levels may occur at the base of the profile. *Bonnie.* Representative soil analysis B 254.

VEGETATION:

A mosaic of Mitchell grass open tussock grassland and clumps of brigalow low open woodland to low woodland.

(A) Grassland. *Astrebla lappacea* (curly Mitchell grass) predominates with other short grasses and forbs occurring. Ground cover is variable depending on seasonal conditions. Scattered low shrubs occur but do not form a well defined layer. Isolated tall shrubs and low trees may be present.

STRUCTURAL FORMATION: Open tussock grassland.

TREE/TALL SHRUB LAYER: Ht 8 ± 2m; PFC < 1%, density < 25 trees/ha.

FREQUENT SPP: *Acacia harpophylla.*

INFREQUENT SPP: *Acacia pendula, Lysiphyllum gilvum, Heterodendrum oleifolium.*

LOW SHRUB LAYER: Ht 1.25 ± 0.25m; PFC < 1%; density 30 ± 20 shrubs/ha.

FREQUENT SPP: *Acacia farnesiana.*

INFREQUENT SPP: *Eremophila mitchellii.*

GROUND LAYER: Ht < 1m; PFC 20 ± 10%.

FREQUENT SPP: *Abutilon malvifolium, Bassia quinquecuspis, B. tetracuspis, Boerhavia diffusa, Malvastrum americanum, Oxalis corniculata, Sida trichopoda, S. virgata.*

INFREQUENT SPP: *Bassia birchii, Brachyscome ciliaris* var. *lanuginosa, Sida fibulifera, Tribulus terrestris.*

GRAMINOIDS:

PREDOMINANT SPP: *Astrebla lappacea*, Ht < 1m; PFC 15 ± 5%.

FREQUENT SPP: *Aristida latifolia, Enneapogon avenaceus, Panicum whitei, Sporobolus caroli.*

INFREQUENT SPP: *Astrebla elymoides, Bothriochloa ewartiana, Dichanthium sericeum, Enteropogon acicularis, Eriochloa pseudoacrotricha.*

(B) Woodland. *Acacia harpophylla* (brigalow) predominates and usually forms pure stands. Isolated low shrubs may occur but do not form a well defined layer. Ground cover is variable but usually sparse composed of grasses and forbs.

STRUCTURAL FORMATION: Low open woodland to low woodland.

TREE/TALL SHRUB LAYER: Ht 8 ± 2m; PFC (variable) 7.5 ± 5%; density (variable) 80 ± 40 shrubs/ha.

PREDOMINANT SPP: *Acacia harpophylla*, Ht 9 ± 1m; PFC 7.5 ± 5%.

INFREQUENT SPP: *Heterodendrum oleifolium.*

LOW SHRUB LAYER: Ht 1.25 ± 0.25m; PFC < 1%; density < 20 shrubs/ha.

FREQUENT SPP: *Eremophila mitchellii.*

INFREQUENT SPP: *Enchylaena tomentosa, Eremophila maculata.*

GROUND LAYER: Ht < 1m; PFC < 5%.

FORBS:

FREQUENT SPP: *Abutilon oxycarpum, Bassia birchii, B. tetracuspis, Boerhavia diffusa.*

INFREQUENT SPP: *Atriplex semibaccata, Chenopodium trigonon, Evolvulus alsinoides, Ocimum canotum, Zygophyllum apiculatum.*

GRAMINOIDS:

FREQUENT SPP: *Enteropogon acicularis, Paspalidium constrictum, Sporobolus caroli.*

INFREQUENT SPP: *Chloris divaricata, Enneapogon polyphyllus, Eriochloa pseudoacrotricha, Tragus australianus.*

LAND USE:

Capable of producing useful pasture with a high component of acceptable perennial grasses; standover feed adequate; drought grazing capacity low but useful; shade adequate; high AWC; fair to high surface fertility.
Condition: good. Trend: stable.

SITES: B 254, 255. R1258.

LAND UNIT 55

LANDFORM:

Gently undulating plains with slopes < 2%.

GEOLOGY:

Weathered sediments of Cretaceous *Mackunda Formation.*

SOILS:

Moderately deep to deep, brown cracking clays with alkaline reaction. Linear gilgais prominent on the slopes. Textures are predominantly heavy clays, occasionally with light clays at the surface. Surfaces are self-mulching beneath weak crusts. $CaCO_3$ occurs throughout the profile with some accumulation of gypsum at depth. UG 5.23, UG 5.31. Strongly alkaline pH; low C and N; high K; fair to high AP; low to fair BP; predominantly montmorillonite type clay; strongly sodic and saline subsoils. *Cootabynia.* Representative soil analysis B40, 144.

VEGETATION:

Mitchell grass, boree wooded tussock grassland to open tussock grassland rarely vine tree grassy tall open shrubland. Usually *Astrebla* spp. (Mitchell grasses) predominate with scattered tall shrubs and trees conspicuous especially *Acacia cana* (boree). Tall open shrubland with *Ventilago viminalis* (vinetree) predominant rarely occurs. Other short grasses and forbs occur forming a variable ground cover. Scattered low shrubs, tall shrubs and trees are usually present. The grassland may approach a low open woodland in places.

STRUCTURAL FORMATION: Tussock grassland to open tussock grassland.

TREE/TALL SHRUB LAYER: Ht 8 ± 2m; PFC < 1% rarely 5%; density 80 ± 70 trees/ha.

FREQUENT SPP: *Acacia cana, Flindersia maculosa, Ventilago viminalis.*

INFREQUENT SPP: *Eremophila mitchellii.*

LOW SHRUB LAYER: Ht 1.25 ± 0.25m; PFC (variable) < 3%; density 75 ± 70 shrubs/ha.

FREQUENT SPP: *Acacia farnesiana.*

INFREQUENT SPP: *Apophyllum anomalum, Capparis lasiantha.*

GROUND LAYER: Ht < 1m; PFC 30 ± 20%.

PREDOMINANT SPP: *Astrebla lappacea*, Ht < 0.75m; PFC 20 ± 10%.

FORBS:

FREQUENT SPP: *Abutilon malvifolium, Atriplex muelleri, Bassia bicornis* var. *horrida, Boerhavia diffusa, Ipomoea lonchophylla, I. racemigera, Malvastrum americanum, Portulaca* sp. aff. *P. oleracea, Polymeria longifolia, P. marginata, Salsola kali, Sida trichopoda, S. virgata, Trianthema triquetra.*

INFREQUENT SPP: *Bassia calcarata, Desmodium varians, Flaveria australasica, Glycine falcata, Goodenia subintegra, G. strangfordii, Psoralea cinerea, Ptilotus exaltatus, P. murrayi, Rhynchosia minima, Sida fibulifera, Trianthema portulacastrum, Tribulus terrestris.*

GRAMINOIDS:

FREQUENT SPP: *Astrebla elymoides, A. pectinata, Chrysopogon fallax, Dactyloctenium radulans, Enneapogon avenaceus, Sporobolus actinocladus.*

INFREQUENT SPP: *Aristida latifolia, Brachyachne convergens, Cenchrus ciliaris, Dichanthium affine, Eragrostis setifolia, Iseilema membranaceum, Sporobolus australasicus, S. caroli, Tripogon loliiformis.*

LAND USE:

Pastures variable; capable of producing useful pasture with a high component of acceptable perennial species; standover feed usually adequate; limited topfeed; drought grazing capacity low but useful; shade adequate; medium to high AWC; fertility variable, but generally adequate.
Condition: fair. Trend: stable to slightly downwards.

SITES: B 40, 144.

LAND UNIT 56

LANDFORM:

Crests of low rises on gently undulating plains.

GEOLOGY:

Weathered sediments of the Cretaceous *Mackunda Formation.*

SOILS:

Very shallow, reddish brown clays with neutral reaction, usually grading into calcareous sandstone. Textures are medium to heavy clays with sand throughout, commonly with lighter textured sandy loam to clay loam surfaces. UG 5.37. Weathered rock (calcareous sandstone) outcrops in places. Low C and N; very fair to high K; low to very low AP and BP; predominantly montmorillonite type clay; low salt levels; non-sodic. *Mellew.* Representative soil analysis B39, 250.

VEGETATION:

Mixed open woodland to tall open shrubland. This unit is variable in composition with various tree species forming a distinct but discontinuous upper layer canopy. Prominent species may include *Acacia excelsa, Albizia basaltica, Lysiphyllum gilvum, Eucalyptus terminalis* and *Ventilago viminalis* and any of these species may predominate depending on local conditions. Scattered low shrubs are usually present but rarely form a well defined layer. Grasses usually predominate the ground layer but forbs also occur forming a variable ground cover. In places this unit approaches a wooded open tussock grassland.

STRUCTURAL FORMATION: Open woodland to tall open shrubland.

TREE/TALL SHRUB LAYER: Ht 10 ± 4m; PFC 3 ± 2%; density 150 ± 125 trees/ha.

FREQUENT SPP: *Acacia excelsa, Albizia basaltica, Eucalyptus terminalis, Lysiphyllum gilvum, Ventilago viminalis.*

INFREQUENT SPP: *Acacia cana, Atalaya hemiglauca, Eucalyptus melanophloia* (rare), *Flindersia maculosa, Grevillea striata, Heterodendrum oleifolium.*

LOW SHRUB LAYER: Ht 1.25 ± 0.75m; PFC < 1% rarely 2.5%; density 80 ± 70 shrubs/ha.

FREQUENT SPP: *Acacia farnesiana.*

INFREQUENT SPP: *Apophyllum anomalum, Eremophila mitchellii.*

GROUND LAYER: Ht 0.75 ± 0.25m; PFC (variable) 15 ± 10% (rarely 5%).

FORBS:

FREQUENT SPP: *Bassia birchii, B. lanicuspis, Heliotropium tenuifolium, Portulaca* sp. aff. *P. oleracea, Salsola kali, Trianthema triquetra.*

INFREQUENT SPP: *Abutilon malvifolium, Chenopodium cristatum, Portulaca filifolia, Sida trichopoda, S. virgata.*

GRAMINOIDS:

FREQUENT SPP: *Aristida contorta, Astrebla lappacea, Bothriochloa ewartiana, Enneapogon avenaceus, Enteropogon acicularis, Sporobolus australasicus, Tragus australianus.*

INFREQUENT SPP: *Aristida browniana, A. latifolia, Cenchrus ciliaris, Dactyloctenium radulans, Digitaria ammophila, D. divaricatissima, Enneapogon polyphyllus.*

LAND USE:

Limited in extent; pastures variable; capable of producing useful ephemeral pasture with a low component of acceptable perennial species; standover feed limited; limited topfeed; limited drought grazing capacity; low AWC; low fertility.
Condition: mediocre. Trend: stable.

SITES: B39, 42, 250.

LAND UNIT 57

LANDFORM:

Low rises on gently undulating plains. Minor areas only.

GEOLOGY:

Cretaceous *Winton Formation.*

SOILS:

Moderately deep, red cracking clays. Textures are medium to heavy clays throughout. Surfaces are crusting with scattered gravel.

VEGETATION:

Mitchell grass wooded open tussock grassland. *Astrebla* spp. (Mitchell grasses) predominate and together with other grasses and forbs form a distinct but discontinuous ground layer. The composition of the ground flora is variable and depends on seasonal conditions. Scattered low shrubs and trees emerge above the well defined ground layer.

STRUCTURAL FORMATION: Open tussock grassland.

TREE/TALL SHRUB LAYER: Ht 6 ± 2m; PFC < 1%; density < 25 trees/ha.

FREQUENT SPP: *Atalaya hemiglauca.*

INFREQUENT SPP: *Acacia cambagei* (gullies).

LOW SHRUB LAYER: Ht 1.5 ± 0.5m; PFC < 1%; density 30 ± 20 shrubs/ha.

FREQUENT SPP: *Acacia farnesiana.*

GROUND LAYER: Ht 0.75 ± 0.25m; PFC (variable) 25 ± 10%.

FORBS:

FREQUENT SPP: *Abutilon malvifolium, Bassia calcarata, Maireana coronata, Salsola kali.*

INFREQUENT SPP: *Bassia anisacanthoides, Hibiscus trionum, Malvastrum americanum, Portulaca* sp. aff. *P. oleracea, Sida trichopoda, Threlkeldia proceriflora, Trianthema triquetra.*

GRAMINOIDS:

FREQUENT SPP: *Aristida latifolia, A. leptopoda, Astrebla elymoides, A. lappacea, A. pectinata, Dichanthium sericeum, Heteropogon contortus, Panicum decompositum, Sporobolus actinocladus, Tragus australianus.*

INFREQUENT SPP: *Dactyloctenium radulans, Iseilema membranaceum, Sporobolus caroli.*

LAND USE:

Very limited in extent; produces useful pastures.

SITES: R 64.

LAND UNIT 58

LANDFORM:

Flat to very gently undulating plains with slopes < 0.5%.

GEOLOGY:

Weathered sediments of the Cretaceous *Winton Formation.*

SOILS:

Shallow to moderately deep, brown cracking clays. Soil reaction is alkaline. Textures are heavy clays throughout with soft self-mulching surfaces overlying strongly structured subsoils. Occasional patches of scattered stone occur on the surface. $CaCO_3$ is present throughout the profile. UG 5.32. Moderately to strongly alkaline pH; very low C and N; high AP; fair BP; sodic subsoils with high salt levels. *Thornleigh.* Representative soil analysis B64.

VEGETATION:

Bassia, Mitchell grass open herbfield. *Bassia* spp. and *Astrebla lappacea* (curly Mitchell grass) occur with either predominating depending on seasonal conditions. Other forbs and grasses are usually present. Trees and shrubs are absent.

STRUCTURAL FORMATION: Open herbfield.

GROUND LAYER: Ht < 0.75m; PFC 5 ± 4%.

FORBS:

FREQUENT SPP: *Abutilon malvifolium, Atriplex lindleyi, A. spongiosa, Bassia bicornis, B. calcarata, B. lanicuspis, Boerhavia diffusa, Portulaca* sp. aff. *P. oleracea, Ptilotus exaltatus, Salsola kali, Trianthera triquetra.*

INFREQUENT SPP: *Bassia anisacanthoides, Hibiscus trionum.*

GRAMINOIDS:

FREQUENT SPP: *Astrebla lappacea, Dactyloctenium radulans, Enneapogon polyphyllus.*

INFREQUENT SPP: *Astrebla elymoides, Iseilema membranaceum.*

LAND USE:

Rainfall variable; moderate to heavy rainfall required for pasture response after extended dry periods; capable of producing useful pastures of moderate grazing capacity; a high component of acceptable perennial grasses; standover feed adequate; drought grazing capacity low but useful; topfeed absent; high AWC; adequate fertility.
Condition: fair to good. Trend: stable to upwards.

SITES: B 64.

LAND UNIT 59

LANDFORM:

Gently undulating to undulating plains. Slopes 2% or less.

GEOLOGY:

Weathered sediments of the Cretaceous *Winton Formation.*

SOILS:

Shallow to moderately deep, brown cracking clays with alkaline soil reaction. Surfaces are soft and self-mulching, with occasional small sink-holes and scattered gravel. Textures are medium to heavy clays throughout. UG 5.32. Strongly to very strongly alkaline pH; very low C and N; high K; very high AP; fair BP; predominantly montmorillonite type clay; strongly sodic subsoils with medium to high salt levels. *Thornleigh.* Representative soil analysis B201.

VEGETATION:

Mitchell grass forby open tussock grassland. *Astrebla pectinata* (barley Mitchell grass) and *A. elymoides* (hoop Mitchell grass) usually predominate with other short grasses and forbs present. Shrubs are not usually present but isolated shrubs of *Enchylaena tomentosa* may occur.

STRUCTURAL FORMATION: Open tussock grassland.

LOW SHRUB LAYER: Ht < 1m; PFC < 1%.

INFREQUENT SPP: *Enchylaena tomentosa.*

GROUND LAYER: Ht < 0.75m; PFC 15 ± 5%.

PREDOMINANT SPP: *Astrebla elymoides, A. pectinata.*

FORBS:

FREQUENT SPP: *Boerhavia diffusa, Ipomoea lonchophylla, Trianthera triquetra.*

INFREQUENT SPP: *Amaranthus mitchellii, Ipomoea plebeia, Maireana coronata, Salsola kali.*

GRAMINOIDS:

FREQUENT SPP: *Dactyloctenium radulans, Iseilema membranaceum.*

INFREQUENT SPP: *Enneapogon avenaceus, Panicum decompositum, Sporobolus australasicus, S. actinocladus, Tragus australianus.*

LAND USE:

Rainfall variable; moderate to heavy rainfall required for pasture response after extended dry periods; capable of producing useful pastures of moderate to low grazing capacity; a moderate component of acceptable perennial grasses; limited standover feed; topfeed absent; limited drought grazing capacity; high AWC; adequate fertility; slight sheet and rill erosion on slopes.
Condition: fair to good. Trend: stable to upwards.

SITES: B 201, 202.

LAND UNIT 60

LANDFORM:

Gently undulating to flat plains with slopes < 1%.

GEOLOGY:

Weathered sediments of the Cretaceous *Winton Formation* with thin veneer of stone and gravel derived from erosion of the Tertiary land surface.

SOILS:

Moderately deep to deep, red and brown cracking clays with neutral soil reaction. Textures are medium to heavy clays throughout. Surfaces have dense stone pavements with occasional small gilgais. UG 5.37. Very low C and N; very fair to high K; low AP and BP; strongly sodic and saline subsoils. *Lynbrydon.*

VEGETATION:

Mitchell grass forby open tussock grassland. In above average seasons *Astrebla pectinata* (barley Mitchell grass) predominates forming a variable ground cover. Other short grasses and forbs occur. Scattered *Acacia farnesiana* may be present along drainage lines. Trees are absent.

STRUCTURAL FORMATION: Open tussock grassland.

LOW SHRUB LAYER: Ht 1.5 ± 0.5m; PFC (isolated) < 1%; density < 25 shrubs/ha.

FREQUENT SPP: *Acacia farnesiana.*

GROUND LAYER: Ht < 0.75m; PFC 15 ± 10%.

PREDOMINANT SPP: *Astrebla pectinata,* Ht < 0.75m; PFC 10 ± 5%.

FORBS:

FREQUENT SPP: *Atriplex lindleyi, A. spongiosa, Bassia bicornis, B. lanicuspis, Salsola kali, Threlkeldia proceriflora.*

INFREQUENT SPP: *Bassia divaricata, Euphorbia drummondii, E. parvicarunculata, Frankenia serpyllifolia, Maireana coronata.*

GRAMINOIDS:

FREQUENT SPP: *Dactyloctenium radulans, Enneapogon avenaceus, E. polyphyllus, Sporobolus actinocladus.*

INFREQUENT SPP: *Brachyachne convergens, Iseilema membranaceum, Tripogon loliiformis.*

LAND USE:

Low and unreliable rainfall limiting; usually produces ephemeral pastures of low grazing capacity; during series of good seasons supports pasture with a moderate to high component to acceptable perennial grasses; standover feed rarely present; topfeed absent; drought grazing capacity nil.
Condition: fair to mediocre. Trend: stable to downwards.

SITES: B261.

LAND UNIT 61

LANDFORM:

Flat to gently undulating plains with slopes < 1%.

GEOLOGY:

Undifferentiated Quaternary colluvium formed by erosion and redeposition of material from the Tertiary land surface.

SOILS:

Deep to very deep, red desert loams, becoming shallower toward the tops of the slopes. Soil reaction is alkaline. Surface textures range from silty clay loams to sandy loams to medium and heavy clays at depth. Ironstone shot and gravel pavements are common. Surfaces may be weakly gilgaied. $CaCO_3$ and/or gypsum are present in the profile. DR 2.12, DR 3.13. *Geiger.* Representative soil analysis B 181, 185.

VEGETATION:

Button grass, munyeroo open herbfield to Mitchell grass open tussock grassland. Grasses or forbs may predominate depending on the season. Principal grasses include *Astrebla pectinata, Brachyachne convergens* and *Dactyloctenium radulans. Atriplex* spp. *Bassia* spp. and *Portulaca* sp. aff. *P. oleracea* (munyeroo) are the major forbs present. Scattered low shrubs and trees may occur.

STRUCTURAL FORMATION: Sparse herbfield to open tussock grassland.

TREE/TALL SHRUB LAYER: Ht 3 ± 1m; PFC (isolated) < 1%; density < 10 trees/ha.

INFREQUENT SPP: *Atalaya hemiglauca.*

LOW SHRUB LAYER: Ht 1.25 ± 0.5m; PFC (isolated) < 1%; 20 ± 10 shrubs/ha.

FREQUENT SPP: *Cassia phyllodinea.*

GROUND LAYER: Ht < 0.75m; PFC 8 ± 7%.

FORBS:

FREQUENT SPP: *Abutilon malvifolium, Amaranthus mitchellii, Atriplex lindleyi, A. spongiosa, Bassia divaricata, B. lanicuspis, Euphorbia parvicarunculata, Portulaca* sp. aff. *P. oleracea.*

INFREQUENT SPP: *Euphorbia wheeleri, Neptunia dimorphantha, Salsola kali, Trianthema triquetra.*

GRAMINOIDS:

FREQUENT SPP: *Astrebla pectinata, Brachyachne convergens, Dactyloctenium radulans, Iseilema membranaceum, Sporobolus actinocladus, Tragus australianus.*

INFREQUENT SPP: *Eragrostis setifolia, Sporobolus australasicus, Tripogon loliiformis.*

LAND USE:

Low and unreliable rainfall limiting; usually low grazing capacity ephemeral pastures; following consecutive good seasons capable of producing pasture with a low to moderate component of acceptable perennial grasses; lower slopes benefit from run-on water; standover feed usually absent; topfeed absent; drought grazing capacity nil; medium AWC; low to very low fertility.
Condition: poor. Trend: slightly upwards.

SITES: B 181, 195.

LAND UNIT 62

LANDFORM:

Flat to very gently undulating plains with slopes < 1%.

GEOLOGY:

Weathered sediments of Cretaceous *Winton Formation.*

SOILS:

Shallow to moderately deep, brown cracking clays with alkaline soil reaction. Textures are heavy clays throughout. Very soft, self-mulching surfaces overlie strongly structured subsoils.

Occasional sink-holes occur. Surfaces have scattered silcrete gravel. Lime occurs throughout the profile with gypsum at depth. UG 5.36. Very low C and N; high K; high AP; low to fair BP; predominantly montmorillonite type clay. *Thornleigh.* Representative soil analysis B 179.

VEGETATION:

Sparse herbfield to Mitchell grass open tussock grassland depending on seasonal conditions. After favourable seasons *Astrebla* spp. (Mitchell grasses) predominate with other tussock grasses and forbs forming a dense ground cover. Forbs mainly *Atriplex* spp. (saltbushes) and *Bassia* spp. are predominant. In less favourable seasons ground cover may be very sparse. Trees and shrubs are absent.

STRUCTURAL FORMATION: Sparse herbfield to tussock grassland (depending on seasonal conditions).

GROUND LAYER: Ht < 0.75m; PFC 20 ± 15%.

FORBS:

FREQUENT SPP: *Abutilon malvifolium, Amaranthus mitchellii, Atriplex lindleyi, A. spongiosa, Bassia calcarata, B. divaricata, B. lanicuspis, Salsola kali, Sida fibulifera, S. virgata, Threlkeldia procariflora, Trianthema triquetra.*

INFREQUENT SPP: *Bassia anisacanthoides, Psoralea cinerea, Sida trichopoda, Stenopetalum nutans.*

GRAMINOIDS:

FREQUENT SPP: *Aristida anthoxanthoides, Astrebla pectinata, Dactyloctenium radulans, Enneapogon avenaceus, Iseilema membranaceum, Panicum whitei, Sporobolus actinocladus.*

INFREQUENT SPP: *Astrebla elymoides, A. lappacea.*

LAND USE:

Low and unreliable rainfall (< 250 mm) limiting; pastures seasonally dependant; usually low grazing capacity ephemeral pastures but following consecutive good seasons produces pasture with a moderate to high component of acceptable perennial grasses; medium to heavy falls of rain required for pasture response after extended dry periods; usually little standover feed; topfeed absent; drought grazing capacity nil; medium to high AWC; adequate fertility.
Condition: fair to good. Trend: slightly upwards.

SITES: B 179, B 260.

LAND UNIT 63

LANDFORM:

Undulating plains with slopes < 5%, median slope 3%.

GEOLOGY:

Exposed sediments of Cretaceous *Winton Formation* with a thin veneer of gravel formed by erosion of the Tertiary land surface.

SOILS:

Shallow to moderately deep, brown cracking clays with neutral to alkaline soil reaction and heavy clay textures. Black ironstone shot and silcrete gravel form a surface pavement. These soils form a intergrade between the self-mulching clays on the downs and the desert loams of Unit 61. UG 5.37, UG 5.32. Very low C and N; high K; high AP; low BP; sodic and saline surfaces; strongly sodic and saline subsoils. Poor surface properties have developed on soils where surface salt levels are not sufficiently high to keep the sodic clay flocculated. *Stewart, Lynbryon.* Representative soil analysis B 63, 190.

VEGETATION:

Sparse herbfield to open tussock grassland. Depending on seasonal conditions either grasses or forbs predominate resulting in a variable cover. Isolated low shrubs may occur. Trees are rare.

STRUCTURAL FORMATION: Sparse herbfield to open tussock grassland.

TREE/TALL SHRUB LAYER: Ht 3 ± 1m; PFC < 1%; density (isolated) < 10 trees/ha.

INFREQUENT SPP: *Flindersia maculosa.*

LOW SHRUB LAYER: Ht 1 ± 0.5m; PFC < 1%; density (isolated) < 10 shrubs/ha.

INFREQUENT SPP: *Apophyllum anomalum.*

GROUND LAYER: Ht 0.75 ± 0.25m; PFC 10 ± 5%.

FORBS:

FREQUENT SPP: *Atriplex lindleyi, A. spongiosa, Bassia divaricata, B. lanicuspis, Boerhavia diffusa, Portulaca* sp. aff. *P. oleracea, Sida virgata, Trianthema triquetra.*

INFREQUENT SPP: *Abutilon leucopetalum, A. malvifolium, Fairchildia villosa, Sida trichopoda, Threlkeldia procariflora.*

GRAMINOIDS:

FREQUENT SPP: *Aristida latifolia, Astrebla lappacea, Brachyachne convergens, Dactyloctenium radulans, Enneapogon avenaceus, Iseilema membranaceum, Sporobolus actinocladus.*

INFREQUENT SPP: *Aristida leptopoda, Astrebla pectinata, Enneapogon polyphyllus, Tragus australianus.*

LAND USE:

Limited in extent; requires heavy rains for maximum productivity; pasture seasonally dependent; usually ephemeral pasture but following consecutive good seasons capable of producing pasture with a low to moderate component of acceptable perennial grasses; standover feed usually absent; topfeed absent; drought grazing capacity nil; medium to high AWC; adequate fertility; susceptible to sheet and gully erosion on the slopes.
Condition: mediocre to fair. Trend: slightly downwards.

SITES: B63, 190.

LAND UNT 64

LANDFORM:

Flat to gently undulating plains with slopes < 2%, median slope 0.5%.

GEOLOGY:

Weathered sediments of the Cretaceous *Winton Formation.* Exposure of different beds in the formation leads to a striped pattern evident on aerial photographs, and sometimes detectable on the ground.

SOILS:

Moderately deep, brown cracking clays with alkaline soil reaction. Textures are heavy clays throughout. Surfaces are soft and self-mulching with very weak crusts which overlie strongly structured subsoils. Very minor areas with scalded surfaces occur. $CaCO_3$ is usually present throughout the profile, with gypsum occurring at depth. UG 5.22, UG 5.24, UG 5.32. Neutral to very strongly alkaline pH; low to very low C and N; high K; fair to very high AP; very low to high BP; predominantly montmorillonite type clay; sodic to strongly sodic subsoils with high salt levels. *Thornleigh, Lynbrydon.* Representative soil analysis. B 58, 59, 130, 131, 134, 135, 162.

VEGETATION:

Mitchell grass open tussock grassland to open herbfield. Usually *Astrebla* spp. (Mitchell grasses) predominate but forbs or other short grasses may predominate depending on seasonal conditions. Trees, tall shrubs and low shrubs are not conspicuous, but isolated plants may occur.

STRUCTURAL FORMATION: Open tussock grassland to open herbfield.

TREE/TALL SHRUB LAYER: Ht 3.5 ± 0.5m; PFC < 1%; density < 10 trees/ha.

INFREQUENT SPP: *Atalaya hemiglauca, Ventilago viminalis.*

LOW SHRUB LAYER: Ht 1.5 ± 0.5m; PFC < 1%; density < 20 shrubs/ha.

INFREQUENT SPP: *Acacia farnesiana.*

GROUND LAYER: Ht 0.75 ± 0.25m; PFC 20 ± 10%.

FORBS:

FREQUENT SPP: *Abutilon malvifolium, Atriplex lindleyi, A. muelleri, A. spongiosa, Bassia biocrnis, B. biocrnis* var. *horrida, B. calcarata, B. lanicuspis, Boerhavia diffusa, Euphorbia drummondii, Maireana coronata, Malvastrum americanum, Portulaca* sp. aff. *P. oleracea, Pterigeron adscendens, Rhynchosia minima, Salsola kali, Sida fibulifera, S. trichopoda, S. virgata, Trianthema triquetra.*

INFREQUENT SPP: *Amaranthus mitchellii, Cleome viscosa, Corchorus trilocularis, Crotalaria dissitiflora, Daucus glochidiatus Desmodium campylocaulon, D. muelleri, Flaveria australasica, Goodenia strangfordii, Phyllanthus maderaspatensis, Psoralea cinerea, Ptilotus exaltatus, Sida goniocarpa, Threlkeldia proceriflora, Tribulus terrestris, Trianthema portulacastrum.*

GRAMINOIDS:

FREQUENT SPP: *Astrebla lappacea, A. squarrosa, Dactyloctenium radulans, Enneapogon avenaceus, Eragrostis setifolia, Iseilema membranaceum, Panicum whitei, Sporobolus actinocladus.*

INFREQUENT SPP: *Astrebla elymoides, Bothriochloa ewartiana, Cyperus bifax, Dichanthium affine, D. sericeum, Eriochloa pseudoacrotricha, Panicum decompositum, Iseilema vaginiflorum, Sporobolus caroli, Urochloecium truncatum.*

LAND USE:

Usually durable perennial Mitchell grass pastures; heavy falls of rain required for best production; adequate standover feed in normal seasons; topfeed virtually absent; drought grazing capacity very low; high AWC; fertility variable but generally adequate. Condition: fair to good. Trend: stable to upwards.

SITES: B 58, 59, 121, 130, 131, 134, 135, 162.

LAND UNIT 65

LANDFORM:

Gently undulating plains with slopes 0 - 1%.

GEOLOGY:

Weathered sediments of the Cretaceous *Winton Formation.*

SOILS:

Moderately deep, grey and brown cracking clays with alkaline soil reaction. Textures are medium to heavy clays throughout. Surfaces are self-mulching, occasionally with scattered gravel cover. Incipient gilgais. Subsoils are strongly structured. $CaCO_3$ is present throughout the profile. Gypsum may occur at depth. UG 5.22, UG 5.32, UG 5.35, UG 5.37. Strongly alkaline pH; low to very low C and N; high K; fair to very high AP; very low to low BP; predominantly montmorillonite type clays; sodic but non-saline subsoils. *Lynbrydon.* Representative soil analysis B 14, 29, 41, 43, 44, 46, 47.

VEGETATION:

Mitchell grass open tussock grassland to tussock grassland. *Astrebla* spp. (Mitchell grasses) predominate but other short grasses and forbs are usually present. In places *Acacia farnesiana* is very conspicuous but usually low shrubs, tall shrubs and trees only occur as isolated individuals.

STRUCTURAL FORMATION; Open tussock grassland to tussock grassland.

TREE/TALL SHRUB LAYER: Ht 4 ± 1m; PFC < 1%; density < 5 trees/ha.

INFREQUENT SPP: *Atalaya hemiglauca, Flindersia maculosa, Heterodendrum oleifolium, Ventilago viminalis.*

LOW SHRUB LAYER: Ht 1.25 ± 0.25m; PFC (variable) usually < 1%, in places up to 5%; density 200 ± 200 shrubs/ha.

FREQUENT SPP: *Acacia farnesiana.*

INFREQUENT SPP: *Acacia victoriae, Apophyllum anomalum, Cassia oligophylla, C. sturtii.*

GROUND LAYER: Ht 0.9 ± 0.4m; PFC 25 ± 15%.

PREDOMINANT SPP: *Astrebla lappacea.* Ht 0.9 ± 0.4 m; PFC 20 ± 10%.

FORBS:

FREQUENT SPP: *Abutilon malvifolium, Amaranthus mitchellii, Atriplex muelleri, Bassia biocrnis* var. *horrida, B. calcarata, Boerhavia diffusa, Ipomoea lonchophylla, Malvastrum americanum, Salsola kali, Sida trichopoda, S. virgata, Solanum esuriale, Trianthema triquetra.*

INFREQUENT SPP: *Abutilon oxycarpum, Bassia quinquecuspis, Convolvulus erubescens, Corchorus trilocularis, Desmodium campylocaulon, Goodenia strangfordii, G. subintegra, Hibiscus trionum, Polymeria longifolia, P. marginata, Portulaca* sp. aff. *P. oleracea, Psoralea cinerea, Rhynchosia minima, Threlkeldia proceriflora.*

GRAMINOIDS:

FREQUENT SPP: *Aristida latifolia, Astrebla elymoides, A. squarrosa, Brachyachne convergens, Cyperus bifax, Dactyloctenium radulans, Dichanthium sericeum, Enneapogon avenaceus, Iseilema membranaceum, I. vaginiflorum, Panicum decompositum, P. whitei, Sporobolus actinocladus, Tragus australianus.*

INFREQUENT SPP: *Aristida contorta, Bothriochloa bladhii, B. ewartiana, Chrysopogon fallax, Dichanthium affine, Enneapogon polyphyllus, Eragrostis setifolia, Sporobolus australasicus, S. caroli, Triraphis mollis.*

LAND USE:

Usually durable perennial Mitchell grass pastures; heavy falls of rain required for best production; adequate standover feed; associated wooded areas provide adequate shade and limited topfeed; low but very useful drought grazing capacity; medium to high AWC; fertility variable but generally adequate.
Condition: good to very good. Trend: stable to upwards.

SITES: B 14, 15, 29, 41, 43, 44, 46, 47, 145, 151, 152.

LAND UNIT 66

LANDFORM:

Gently undulating plains with slopes to 2%.

GEOLOGY:

Weathered sediments of the Cretaceous *Winton Formation.*

SOILS:

Shallow to moderately deep, brown cracking clays with alkaline soil reaction. Textures are medium to light clays. Surfaces are soft and self-mulching and overlie strongly structured subsoils. $CaCO_3$ is present throughout the profile, generally with gypsum at depth. UG 5.32. Strongly alkaline pH; very low C and N; high K; very high AP; low BP; predominantly montmorillonite type clay; subsoils are sodic but generally non-saline. *Lynbrydon.* Representative soil analysis B 192.

VEGETATION:

Open herbfield. Either short grasses or forbs predominate depending on seasonal conditions. Trees, tall shrubs or low shrubs are not usually present but stunted trees of *Atalaya hemiglauca* may occur.

STRUCTURAL FORMATION: Open herbfield.

TREE/TALL SHRUB LAYER: Ht < 3m; PFC < 1%; density < 10 trees/ha.

INFREQUENT SPP: *Atalaya hemiglauca.*

GROUND LAYER: Ht 0.5 ± 0.25m; PFC (variable) 20 ± 10%.

FORBS:

FREQUENT SPP: *Amaranthus mitchellii, Atriplex spongiosa, Boerhavia diffusa, Salsola kali.*

INFREQUENT SPP: *Abutilon malvifolium, Bassia calcarata, Polymeria longifolia, Portulaca* sp. aff. *P. oleracea, Sida trichopoda, S. virgata, Threlkeldia proceriflora.*

GRAMINOIDS:

FREQUENT SPP: *Dactyloctenium radulans, Enneapogon avenaceus, Iseilema membranaceum, Sporobolus actinocladus, S. australasicus.*

INFREQUENT SPP: *Brachyachne convergens, Dichanthium affine, D. sericeum, Enneapogon polyphyllus, Enteropogon acicularis, Triraphis mollis.*

LAND USE:

Low and unreliable rainfall limiting; usually ephemeral pasture but following consecutive good seasons capable of producing pasture with a low to moderate component of acceptable perennial grasses; little pasture response from light falls of rain; standover feed usually absent; topfeed absent; drought grazing capacity nil; high AWC; fertility adequate; susceptible to sheet and gully erosion on the slopes.
Condition: mediocre. Trend: slightly upwards.

SOILS: B 192, 262.

LAND UNIT 67

LANDFORM:

Gently undulating plains with slopes 1% or less.

GEOLOGY:

Exposed sediments of the Cretaceous *Winton Formation* with superficial surface gravel cover.

SOILS:

Deep, brown cracking clays with alkaline soil reaction. Textures are heavy clays throughout. Surface pavements of rounded quartz and silcrete gravel are characteristic. $CaCO_3$ is present throughout the profile with gypsum occurring at depth. UG 5.34. Moderately to strongly alkaline pH; low C and N; high K; fair to high AP; low BP; predominantly montmorillonite type clay; generally strongly sodic subsoils with high salt levels. *Lynbrydon.* Representative soil analysis B 155.

VEGETATION:

Mitchell grass open tussock grassland. *Astrebla* spp. (Mitchell grasses) predominate forming a mid-dense ground cover. Other short grasses and forbs occur. Isolated trees of *Acacia cana* and *Ventilago viminalis* may be conspicuous.

STRUCTURAL FORMATION: Open tussock grassland.

TREE/TALL SHRUB LAYER: Ht 5 ± 1m; PFC (isolated) < 1%; density < 5 trees/ha.

FREQUENT SPP: *Acacia cana, Ventilago viminalis.*

GROUND LAYER: Ht 1 ± 0.25m; PFC 15 ± 5%.

PREDOMINANT SPP: *Astrebla elymoides, A. lappacea, A. squarrosa.*

FORBS:

FREQUENT SPP: *Abutilon malvifolium, Amaranthus mitchellii, Boerhavia diffusa, Portulaca* sp. aff. *P. oleracea, Sida trichopoda, S. virgata.*

INFREQUENT SPP: *Bassia tetracuspis, B. quinquecuspis, Cleome viscosa, Hibiscus trionum, Malvastrum americanum.*

GRAMINOIDS:

FREQUENT SPP: *Dactyloctenium radulans, Iseilema membranaceum, I. vaginiflorum, Panicum decompositum, Tragus australianus.*

INFREQUENT SPP: *Aristida latifolia, Astrebla pectinata, Dichanthium sericeum, Eriochloa pseudoacrotricha, Eulalia fulva.*

LAND USE:

Limited in extent; durable perennial Mitchell grass pastures; little pasture response to light falls of rain; adequate standover feed; associated wooded areas provide adequate shade and limited topfeed; low but useful drought grazing capacity; medium to high AWC; fertility adequate.
Condition: good to very good. Trend: stable to upwards.

SITES: B 155.

LAND UNIT 68

LANDFORM:

Flat to gently sloping plains with slopes < 1%.

GEOLOGY:

Weathered clay beds of the Tertiary *Glendower Formation.*

SOILS:

Moderately deep, red cracking clays with alkaline reaction. Textures are heavy clays, tending lighter at depth, with traces of sand throughout. Weakly gilgaied. Surfaces are weakly crusting with occasional sink-holes and patches of ironstone gravel. $CaCO_3$ is present at depth in the profile. UG 5.37. Very low C and high K; very low to fair AP; very low BP; sodic to strongly sodic; generally saline subsoils. *Booloorоо.* Representative soil analysis B 195, 221.

VEGETATION:

Short grass open tussock grassland. Short grasse usually predominate with *Dactyloctenium radulans, Iseilema* spp., *Brachyachne convergens* and less frequently *Astrebla* spp. conspicuous. However, forbs occur and may even predominate depending on seasonal conditions. Isolated low shrubs of *Cassia* spp. may be found. *Acacia farnesiana* and *A. victoriae* are associated with drainage lines. Trees are absent.

STRUCTURAL FORMATION: Open tussock grassland to tussock grassland.

LOW SHRUB LAYER: Ht 1 ± 0.25m; PFC < 1%; density 40 ± 40 shrubs/ha.

INFREQUENT SPP: *Cassia oligophylla, C. phyllodinea.*

GROUND LAYER: Ht 0.75 ± 0.25m; PFC 30 ± 15%.

FORBS:

FREQUENT SPP: *Abutilon malvifolium, Bassia bicornis, B. calcarata, Boerhavia diffusa, Euphorbia drummondii, Neptunia dimorphantha, Rhynchosia minima, Salsola kali, Sida virgata, Trianthema triquetra.*

INFREQUENT SPP: *Bassia ventricosa, Euphorbia tannensis* ssp. *eremophila* var. *eremophila, Evolvulus alsinoides, Hibiscus trionum, Malvastrum americanum, Operculina* sp. aff. *O. turpethum, Polymeria longifolia, P. marginata, Portulaca* sp. aff. *P. oleracea, Ptilotus exaltatus, P. polystachyus, Sida fibulifera, S. trichopoda, Threlkeldia proceriflora.*

GRAMINOIDS:

FREQUENT SPP: *Astrebla pectinata, Brachyachne convergens, Chloris pectinata, Dactyloctenium radulans, Iseilema membranaceum, I. vaginiflorum, Panicum whitei, Sporobolus actinocladus, S. australasicus, Tragus australianus.*

INFREQUENT SPP: *Aristida latifolia, Astrebla elymoides, Enneapogon polyphyllus.*

LAND USE:

Limited in extent; seasonal ephemeral pastures of low grazing capacity; standover feed negligible; topfeed absent; drought grazing capacity nil; high AWC; low to very low fertility.
Condition: poor to mediocre. Trend: downwards.

SITES: B 195, 203, 211.

LAND UNIT 69

LANDFORM:

Gently undulating to undulating convex plains. Slopes 1 - 3%. Median 2%.

GEOLOGY:

Weathered sediments of Cretaceous *Winton Formation* mantled with a dense cover of silcrete gravel, stone, and boulders derived from the erosion of the Tertiary *(Glendower)* land surface.

SOILS:

Deep to very deep, very stony, red and brown clays. Weakly gilgaied. Surface stone may be desert varnished. Soils are usually alkaline, medium to heavy clays, with $CaCO_3$ and gypsum present in the profile. Gypsum increases with depth. UG 5.38, UG 5.36. * *Karmona.*

VEGETATION:

Chenopod grassy herbfield to open herbfield. Forbs usually predominate but grasses may predominate depending on seasonal conditions. Trees and shrubs are absent.

STRUCTURAL FORMATION: Herbfield to open herbfield.

GROUND LAYER: Ht < 0.75m; PFC (variable) 20 ± 10%.

PREDOMINANT SPP: *Atriplex lindleyi, A. spongiosa, Bassia calcarata, B. lanicuspis, Salsola kali, Threlkeldia proceriflora.*

FORBS:

FREQUENT SPP: *Bassia aniacanthoides, B. divaricata, Boerhavia diffusa, Lepidium rotundum.*

INFREQUENT SPP: *Amaranthus mitchellii, Bassia eriacantha, B. parallelicuspis, Euphorbia australis, E. parvicarunculа, Neptunia dimorphantha, Pimelea trichostachya, Portulaca filifolia, Psoralea cinerea, Ptilotus exaltatus, Trianthema portulacastrum, T. triquetra, Velleia glabrata, Zygophyllum ammophilum.*

GRAMINOIDS:

PREDOMINANT SPP: *Astrebla pectinata, Brachyachne convergens, Dactyloctenium radulans, Sporobolus actinocladus, Tragus australianus.*

FREQUENT SPP: *Enneapogon polyphyllus, Iseilema membranaceum, I. vaginiflorum, Panicum whitei.*

INFREQUENT SPP: *Aristida anthoxanthoides, Chloris pectinata, Panicum decompositum.*

LAND USE:

Low and erratic rainfall limiting; usually seasonal ephemeral pastures of low grazing capacity; Mitchell grass is present in the gilgai depressions and during good seasons may become a significant component of the pasture; topfeed absent; little use as a drought reserve; light falls of rain produce little pasture growth; high AWC; adequate fertility.
Condition: mediocre. Trend: stable to slightly downwards.

SITES: A 120, 162, 164.

* A full description of this soil mapping unit may be found in Western Arid Region Land Use Survey - Part I, Chapter 4.

LAND UNIT 70

LANDFORM:

Levees and banks of major drainage channels.

GEOLOGY:

Quaternary alluvia.

SOILS:

Very deep, grey and brown clays with silt and sand bands common in the profile. Surface crusts of silt and sand occur. Minor areas of alluvial texture contrast soils are intermixed. UG 5.28 UG 5.24. *Korunda, Powell.*

VEGETATION:

Coolibah, river red gum fringing woodland. *Eucalyptus microtheca* (coolibah) and *E. camaldulensis* (river red gum) predominate. Frequently a tall shrubby layer is well defined. Usually there is no well defined low shrubby layer but scattered low shrubs do occur. *Muehlenbeckia cunninghamii* (lignum) may form a well defined layer in places. Ground cover is variable composed mainly of grasses and sedges but forbs are always present.

STRUCTURAL FORMATION: Woodland.

TREE LAYER: Ht 14 ± 6m; PFC 15 ± 10%; density 300 ± 200 trees/ha.

PREDOMINANT SPP: *Eucalyptus camaldulensis,* Ht 15 ± 5m; PFC 10 ± 5%; *E. microtheca,* Ht 12 ± 4m; PFC 10 ± 5%.

FREQUENT SPP: *Lysiphyllum gilvum, Melaleuca linariifolia.*

INFREQUENT SPP: *Acacia salicina.*

TALL SHRUB LAYER: Ht 4 ± 2m; PFC 2.5 ± 2%; density 40 ± 20 shrubs/ha.

FREQUENT SPP: *Acacia stenophylla, Eremophila bignoniiflora.*

LOW SHRUB LAYER: Ht < 2m; PFC 3 ± 3%.

FREQUENT SPP: *Chenopodium auricomum, Muehlenbeckia cunninghamii, Myoporum acuminatum.*

INFREQUENT SPP: *Cassia nemophila, C. pumila, Eremophila sturtii.*

GROUND LAYER: Ht < 1.5m; PFC 40 ± 30% (in places < 10%).

FORBS:

FREQUENT SPP: *Aeschynomene indica, Alternanthera nodiflora, Atriplex eardleyae, A. muelleri, A. spongiosa, Bassia divaricata, B. quinquecuspis, Boerhavia diffusa, Bulbinopsis* sp., *Centipeda thespidioides, Marsilea drummondii, M. hirsuta, Minuria integerrima, Plantago pritzelii, Psoralea cinerea, P. eriantha, P. patens.*

INFREQUENT SPP: *Amaranthus mitchellii, Bassia bicornis, B. bicornis* var. *horrida, B. birchii, Brachyscome ciliaris* var. *lanuginosa, Calotis anagrocarpa, Calostemma luteum, Commelina cyanea, Euphorbia drummondii, Evolvulus alsinoides, Goodenia lunata, G. subintegra, Helipterum moschatum, H. strictum, Ipomoea diamantinensis, I. plebeia, Ixiolaena leptolepis, Justicia procumbens, Lotus cruentus, Malvastrum americanum, Mimulus prostratus, Minuria denticulata, Morgania glabra, Pimelea trichostachya, Portulaca* sp. aff. *P. oleracea, Pterigeron adscendens, Ptilotus murrayi, Ranunculus pentandrus* var. *platycarpus, Rutidosis helichrysoides, Seebania cannabina, Teucrium racemosum, Trianthema portulacastrum, Tribulus terrestris, Trigonella suavissima, Xanthium pungens.*

GRAMINOIDS:

FREQUENT SPP: *Chloris pectinata, Chrysopogon fallax, Cyperus betchii, C. bifax, C. dactylotes, C. difformis C. exaltatus, C. iria, C. victoriensis, Dichanthium sericeum, Eragrostis dielsii, E. leptocarpa, E. parviflora, E. setifolia, E. tenellula, Eulalia fulva, Leptochloa digitata, Lomandra longifolia, Paspalidium jubiflorum.*

INFREQUENT SPP: *Astrebla lappacea, Bothriochloa ewartiana, Brachyachne convergens, Chloris barbata, Dactyloctenium radulans, Dichanthium affine, Echinochloa colona, Eleocharis pallens, Enneapogon polyphyllus, Eriochloa pseudoacrotricha, Heteropogon contortus, Iseilema membranaceum, Juncus aridicola, Panicum decompositum, P. effusum, P. whitei, Sporobolus actinocladus, S. elongatus, S. mitchellii, Themeda australis, Trigue australianus, Tripogon loliiformis.*

LAND USE:

Limited in extent, subject to natural channel movement and susceptible to scalding, capable of producing durable perennial pastures but usually overgrased; drought grazing capacity negligible, useful shade.
Condition: poor to good. Trend: slightly downwards.

SITES: B 54, 93, 126, 154, 164, 182, 187.

LAND UNIT 71

LANDFORM:

Braided channels on alluvial plains.

GEOLOGY:

Recent alluvia.

SOILS:

Very deep, grey and brown cracking clays and alluvial texture contrast soils. Sand and silt bands are common in the profile. Silty crusts predominate. UG 5.24, UG 5.25. Very low to fair C and N; low to high AP and BP; generally low salt levels. *Morunda, Powell.* Representative soil analysis B13, 125.

VEGETATION:

Coolibah grassy low open woodland to woodland. *Eucalyptus microtheca* (Coolibah) predominates. Other trees and tall shrubs occur and may become dominant. Usually there is no well defined tall shrub layer. Isolated low shrubs also occur rarely forming a well defined layer. Ground cover is variable composed of grasses and forbs with either predominating depending on seasonal conditions.

STRUCTURAL FORMATION: Low open woodland.

TREE LAYER: Ht 10 ± 5m; PFC 7.5 ± 2.5%; density 80 ± 40 trees/ha.

PREDOMINANT SP: *Eucalyptus microtheca*, Ht 10 ± 5m; PFC 7.5 ± 2.5%.

FREQUENT SPP: *Lysiphyllum gilvum.*

INFREQUENT SPP: *Eucalyptus camaldulensis, Capparis spinosa* var. *nummularia.*

TALL SHRUB LAYER: Ht 5 ± 1m; PFC 2.5 ± 2.5%; density < 40 shrubs/ha.

FREQUENT SPP: *Acacia stenophylla, Eremophila bignoniiflora.*

INFREQUENT SPP: *Acacia cambagei, A. omalophylla, Santalum lanceolatum.*

LOW SHRUB LAYER: Ht 1.5 ± 0.5m; PFC < 1% (in places up to 5%); density 75 ± 50 shrubs/ha.

FREQUENT SPP: *Acacia farnesiana, Chenopodium auricomum, Maehlenbeckia cunninghamii.*

INFREQUENT SPP: *Capparis lasiantha, Cassia phyllodinea, Myoporum acuminatum.*

GROUND LAYER: Ht 1 ± 0.5m; PPC 30 ± 20%.

FORBS:

FREQUENT SPP: *Aeschynomene indica, Alternathera nodiflora, Bassia quinquecuspis, Boerhavia diffusa, Goodenia lunata, Helipterum strictum, Maireana aphylla, Malvastrum americanum, Marsilea spp., Minuria integerrima, Phyllanthus maderaspatensis, Portulaca filifolia, P.* sp. aff. *P. oleracea, Ptilotus exaltatus, Psoralea cinerea, Salsola kali, Tribulus terrestris.*

INFREQUENT SPP: *Abutilon malvifolium, Atriplex muelleri, Bassia anisacanthoides, Rhynchosia minima, Solanum esuriale, Sida goniocarpa, Trianthema portulacastrum, T. trianthema, Zygophyllum apiculatum.*

GRAMINOIDS:

FREQUENT SPP: *Astrebla lappacea, Brachyachne convergens, Cyperus betchei, C. bifax, C. victoriensis, Chloris pectinata, Dactyloctenium radulans, Dichanthium sericeum, Enteropogon acicularis, Eragrostis setifolia, Iseilema membranaceum, Leptochloa digitata, Panicum decompositum, Paspalidium jubiflorum, Sporobolus actinocladus, S. mitchellii.*

INFREQUENT SPP: *Aristida leptopoda, Astrebla elymoides, A.squarrosa, Bothriochloa ewartiana, Cyperus iria, C. pygmaeus, Echinochloa colona, Eragrostis tenellula, Eriochloa pseudoacrotricha, Eleocharis pallens, Eulalia fulva, Iseilema vaginiflorum, Scirpus laevis, Sporobolus australasicus, S. caroli.*

LAND USE:

A productive unit which benefits from local and general flooding; supports both durable, acceptable perennial pastures and useful ephemeral pastures; subject to overgrazing and susceptible to scalding, drought grazing capacity very low; useful shade; fertility variable but adequate.
Condition: variable; poor to good. Trend: stable to slightly downwards.

SITES: B13, 38, 53, 125, 137.

LAND UNIT 72

LANDFORM:

Low-lying swamps on alluvial plains. Floors are usually channelled.

GEOLOGY:

Recent alluvia.

SOILS:

Very deep, poorly drained grey clays. Textures are heavy clays with some silt and sand bands in the profile. Surfaces are widely cracking, usually with silty crusts. Subsoils are strongly structured to massive. UG 5.24, UG 5.28. Very low C and N; high K; very fair AP; fair BP; subsoils sodic with high salts. *Pelican.* Representative soil analysis B 80.

VEGETATION:

Coolibah, lignum shrubby low open woodland rarely lignum, bluebush low open shrubland. *Eucalyptus microtheca* (coolibah) predominates forming a well defined but discontinuous upper canopy. Scattered tall shrubs may occur. *Muehlenbeckia cunninghamii* (lignum) is present usually forming a distinct low shrub layer. Ground cover is variable composed of grasses and forbs.

In places *Eucalyptus microtheca* may be absent and structurally the unit becomes a low open shrubland.

STRUCTURAL FORMATION: Low open woodland.

TREE/TALL SHRUB LAYER: Ht 8 ± 2m; PFC < 5%; density 75 ± 50 trees/ha.

PREDOMINANT SPP: *Eucalyptus microtheca*, Ht 8 ± 2m; PFC < 5%.

FREQUENT SPP: *Acacia stenophylla.*

INFREQUENT SPP: *Acacia cambagei.*

LOW SHRUB LAYER: Ht < 1.5m; PFC 5 ± 4%; 500 ± 300 shrubs/ha.

FREQUENT SPP: *Chenopodium auricomum, Muehlenbeckia cunninghamii.*

GROUND LAYER: Ht < 0.5 m; PFC (variable) 15 ± 10%.

FORBS:

FREQUENT SPP: *Aeschynomene indica, Alternanthera nodiflora, Centipeda thespidioides, Commelina cyanea, Corchorus trilocularis, Epaltes cunninghamii, Ipomoea lonchophylla, Marsilea drummondii, Portulaca* sp. aff. *P. oleracea, Psoralea cinerea.*

INFREQUENT SPP: *Bassia divaricata, Ipomoea muelleri, Morgania glabra, Neptunia gracilis, Phyllanthus maderaspatensis, Pterigeron adscendens.*

GRAMINOIDS:

FREQUENT SPP: *Cyperus victoriensis, Elytrophorus spicatus, Eragrostis tenellula, Iseilema membranaceum, Sporobolus mitchellii.*

INFREQUENT SPP: *Diplachne muelleri, Panicum whitei.*

LAND USE:

Swampy areas capable of producing excellent quality ephemeral pastures after both local and general flooding; quality of the pasture depends on the type of flooding (local or general), and the season and period of inundation; general inundation occurs one year in two on average; standover feed limited; topfeed scattered; drought grazing capacity very low; dense lignum stands may restrict access and act as a refuge for pigs; high AWC; fair fertility.
Condition: fair. Trend: stable.

SITES: B 80, 172, 222.

LAND UNIT 73

LANDFORM:

Broad swamp depressions in alluvial plains. Swamp floors are flat to very slightly concave, with gilgaied or channelled areas of microrelief.

GEOLOGY:

Quaternary alluvia.

SOILS:

Very deep, poorly drained grey clays. Surfaces are widely cracking. Massive structured heavy clays. Traces of carbonate are usually present. UG 5.24, UG 5.28. Very low to low C and N; high K; fair to high AP; low to high BP; subsoils have low to medium salt levels and may be sodic. *Pelican.* Representative soil analysis B 56, 61, 97.

VEGETATION:

Bluebush low open shrubland to bluebush, lignum low open shrubland rarely Channel millet open tussock grassland. *Chenopodium auricomum* (bluebush) usually predominates and forms a distinct low shrub layer with a discontinuous canopy. In places *Muehlenbeckia cunninghamii* (lignum) may be conspicuous emerging above the low shrub layer. Ground cover is variable depending on seasonal conditions composed of grasses and forbs. In some situations, *Echinochloa turnerana* (channel millet) predominates and the association approaches an open tussock grassland.

Trees are usually absent but in places *Eucalyptus microtheca* low open woodland may fringe this unit.

STRUCTURAL FORMATION: Low open shrubland.

LOW SHRUB LAYER: Ht 1.0 ± 0.5m; PFC 8 ± 7%; density 3000 ± 2000 shrubs/ha.

PREDOMINANT SPP: *Chenopodium auricomum*, Ht 1.0 ± 0.5m; PFC 8 ± 7%.

FREQUENT SPP: *Muehlenbeckia cunninghamii.*

INFREQUENT SPP: *Eremophila bignoniiflora.*

GROUND LAYER: Ht 1.5 ± 0.75m; PFC (variable) 25 ± 25%.

FORBS:

FREQUENT SPP: *Alternanthera nodiflora, Bassia quinquecuspis, B. stelligera, Marsilea drummondii, Minuria leptophylla, Portulaca* sp. aff. *P. oleracea.*

INFREQUENT SPP: *Aeschynomene indica, Commelina cyanea, Damasonium minus, Justicia procumbens, Morgania floribunda, Psoralea cinerea, P. patens, Ptilotus murrayi, Teucrium racemosum.*

GRAMINOIDS:

FREQUENT SPP: *Eleocharis pallens, Elytrophorus spicatus, Eragrostis tenellula, Sporobolus mitchellii.*

INFREQUENT SPP: *Echinochloa turneriana, Panicum whitei.*

LAND USE:

Swampy areas capable of producing useful ephemeral and perennial pastures after local or general flooding; quality of pasture depends on the type and season of flooding, and the period of innundation; general innundation occurs frequently (one year in two on average for Channel Country areas); useful standover feed; blue bush very palatable when dried off; high AWC; generally fair to good fertility; N may be limiting; serves as a useful drought reserve but is subject to overgrazing.
Condition: (variable) poor to good. Trend: stable to slightly downwards.

SITES: B 23, 56, 61, 97.

LAND UNIT 74

LANDFORM:

Occasionally flooded interchannel alluvial plains of channel country rivers.

GEOLOGY:

Quaternary alluvia.

SOILS:

Very deep, grey and brown cracking clays with silt and sand bands intermixed. Surfaces have strong, silty crusts. Subsoils are strongly structured to massive. UG 5.24, UG 5.34. Very low C and N; high K; fair to high AP and BP; subsoils become sodic at 120 cm; with low to medium salt levels. *Blackwater.* Representative soil analysis B188.

Herbfield. The vegetation is dependant on seasonal conditions. It ranges from herbfields to areas devoid of vegetation. Either grasses or forbs may predominate. Isolated low shrubs may occur. Trees and tall shrubs are absent.

STRUCTURAL FORMATION: Herbfield to sparse herbfield.

LOW SHRUB LAYER: Ht < 1.25m; PFC < 1%; density < 10 shrubs/ha.

INFREQUENT SPP: *Chenopodium auricomum.*

GROUND LAYER: Ht < 0.75m; PFC 30 ± 30%.

FORBS:

FREQUENT SPP: *Alternanthera nodiflora, Atriplex spongiosa, Centipeda thespidioides, Commelina cyanea, Iponoea lonchophylla, I. muelleri, Marsilea* spp., *Psoralea cinerea, Ptilotus murrayi.*

INFREQUENT SPP: *Aeschynomene indica, Calotesma luteum, Crinum angustifolium, Corchorus trilocularis, Craspedia pleiocephala, Daucus glochidiatus, Eryngium supinum, Frankenia uncinata, Phyllanthus maderaspatensis, Portulaca* sp. aff. *P. oleracea, Pterigeron adscendens, Sesbania brachycarpa, Trigonella suavissima, Vigna lanceolata* var. *latifolia.*

GRAMINOIDS:

FREQUENT SPP: *Chloris pectinata, Dactyloctenium radulans, Eragrostis setifolia, E. tenellula, Iseilema membranaceum, Panicum whitei.*

INFREQUENT SPP: *Astrebla elymoides, A. lappacea, A. pectinata, A. squarrosa, Cyperus iria, Echinochloa turneriana, Sporobolus actinocladus, Tripogon loliiformis, Urochloa truncatum.*

LAND USE:

Capable of producing excellent ephemeral pastures of high grazing capacity following both general and local flooding; quality of pasture depends on the type and season of flooding and period of innundation; general flooding occurs one year in four on average; little standover feed; topfeed absent; drought grazing capacity very low; high AWC; fair to good fertility (N may be limiting); excellent cattle fattening country following floods.
Condition: (variable) poor to excellent. Trend: stable.

SITES: B 174, 183, 188.

LAND UNIT 75

LANDFORM:

Flat alluvial plains.

GEOLOGY:

Recent alluvia.

SOILS:

Very deep, alkaline, brown cracking clays with silt and sand bands intermixed. Surfaces have thin silty crusts. $CaCO_3$ may be present in the profile at depth. UG 5.24. Low C and N; high K; fair to high AP and BP; generally low salt levels. *Moruda.* Representative soil analysis B 173.

VEGETATION:

Coolibah forby low open woodland. *Eucalyptus microtheca* (coolibah) predominates. Other trees, tall shrubs and low shrubs occur but do not form well defined layers. Ground cover is variable depending on seasonal conditions and is composed of forbs and grasses.

STRUCTURAL FORMATION: Low open woodland.

TREE/TALL SHRUB LAYER: Ht 8 ± 2m; PFC < 5%; density 80 ± 40 trees/ha.

PREDOMINANT SPP: *Eucalyptus microtheca*, Ht 8 ± 2m; PFC < 5%.

INFREQUENT SPP: *Lysiphyllum gilvum.*

LOW SHRUB LAYER: Ht 1.5 ± 5m; PFC 1%; density 80 ± 40 shrubs/ha.

FREQUENT SPP: *Acacia farnesiana, Eremophila bignoniiflora.*

INFREQUENT SPP: *Acacia victoriae, Chenopodium auricomum, Muehlenbeckia cunninghamii.*

GROUND LAYER: Ht < 1m; PFC (variable) 15 ± 15%.

FORBS:

FREQUENT SPP: *Aeschynomene indica, Alternanthera nodiflora, Commelina cyanea, Epaltes cunninghamii, Vigna lanceolata* var. *latifolia.*

INFREQUENT SPP: *Amaranthus mitchellii, Calotesma luteum, Corchorus trilocularis, Haloragis glauca, Ipomoea lonchophylla, I. muelleri, Malvastrum americanum, Morgania floribunda, Marsilea drummondii, Peplidium maritimum, Teucrium racemosum.*

GRAMINOIDS:

FREQUENT SPP: *Chloris pectinata, Eragrostis tenellula.*

INFREQUENT SPP: *Cyperus victoriensis, Iseilema membranaceum, I. vaginiflorum.*

LAND USE:

Capable of producing ephemeral pastures with a high grazing capacity following both general and local flooding, the quality of the pasture depends on the type and season of flooding and period of innundation; general flooding occurs one year in four on average; very limited standover feed; scattered topfeed; drought grazing capacity negligible; medium to high AWC; fair to good fertility.
Condition: (variable) poor to good. Trend: stable to slightly downwards.

SITES: B 173.

LAND UNIT 76

LANDFORM:

Flat alluvial plains.

GEOLOGY:

Recent alluvia.

SOILS:

Very deep, alkaline grey cracking clays, with sand bands at depth. Surfaces are self-mulching with weak crusts. $CaCO_3$ is present throughout the profile. UG 5.29. Low to very low C and N; high K; fair to low AP and BP; sodic subsoils with medium to high salt levels at depth. *Moruda.* Representative soil analysis B 246.

VEGETATION:

Coolibah, Mitchell grass grassy low open woodland. *Eucalyptus microtheca* (coolibah) predominates. Scattered shrubs may occur and in places form a conspicuous well defined layer. Ground cover is variable composed of grasses and forbs but grasses usually predominate.

STRUCTURAL FORMATION: Low open woodland.

TREE/TALL SHRUB LAYER: Ht 8 ± 2m; PFC 6 ± 4%; 300 ± 200 trees/ha.

PREDOMINANT SPP: *Eucalyptus microtheca*, Ht 8 ± 2m; PFC 6 ± 4%.

INFREQUENT SPP: *Heterodendrum oleifolium.*

LOW SHRUB LAYER: Ht < 2m (rarely 2.5m); PFC (variable) usually < 1%, up to 7.5%; 200 ± 200 shrubs/ha.

FREQUENT SPP: *Eremophila mitchellii.*

INFREQUENT SPP: *Eremophila bignoniiflora.*

GROUND LAYER: Ht 0.75 ± 0.25m; PFC 20 ± 10%.

FORBS:

FREQUENT SPP: *Bassia quinquecuspis, Boerhavia diffusa, Salsola kali.*

INFREQUENT SPP: *Alternanthera nodiflora, Bassia birchii, B. lanicuspis.*

GRAMINOIDS:

FREQUENT SPP: *Aristida [illegible], A. [illegible],*

Dactyloctenium radulans, Eragrostis setifolia, Panicum decompositum, Sporobolus mitchellii.

INFREQUENT SPP: *Aristida latifolia, Cyperus bifax.*

LAND USE:

Capable of producing useful acceptable perennial pastures of medium to high grazing capacity; benefits from flooding; standover feed adequate; topfeed very sparse, drought grazing capacity moderate; low to fair fertility; subject to overgrazing.
Condition: fair to good. Trend: stable.

SITES: B 246, R1226, 1202.

LAND UNIT 77

LANDFORM:

Seasonally flooded, flat scalded alluvial plains.

GEOLOGY:

Quaternary alluvia.

SOILS:

Very deep, brown clays (with minor areas of red and grey clays) with scalded surfaces. Soil reaction is neutral to alkaline. Platy or vesicular crusts up to 2 cm thick overlie strongly structured subsoils. Fine polygonal cracking of this crust is characteristic. UG 5.24, UG 5.34, UG 5.38. Very low C and N; K generally high (may be limiting on Kyabra and Powell Creeks); very low to low AP and BP; severely scalded sites have saline and sodic surfaces; sodicity and alkalinity increase slightly down the profile indicating little water movement through the soil; subsoils are sodic with medium to high salt levels. *Powell, Moonbang.* Representative soil analysis B 28, 37, 55, 84, 124, 127, 242.

VEGETATION:

Sparse herbfield to Mitchell grass open tussock grassland. In places this unit is devoid of vegetation. Usually forbs frequently *Atriplex* spp. and *Bassia* spp. predominate with short grasses present becoming dominant and co-dominant in some situations. In places *Astrebla* spp. (Mitchell grasses) may be dominant. Shrubs and trees are usually absent but isolated plants of *Acacia victoriae, Flindersia maculosa* and *Heterodendrum oleifolium* may be conspicuous.

STRUCTURAL FORMATION: Variable, usually sparse herbfield infrequently open tussock grassland.

TREE/TALL SHRUB LAYER: Ht 3 ± 1m; PFC (isolated) < 1%; density < 10 trees/ha.

FREQUENT SPP: *Acacia victoriae.*

INFREQUENT SPP: *Flindersia maculosa, Heterodendrum oleifolium.*

GROUND LAYER: Ht 0.75 ± 0.5m; PFC (variable) 7.5 ± 7.5%.

FORBS:

FREQUENT SPP: *Atriplex spongiosa, Bassia anisacanthoides, B. calcarata, B. divaricata, B. lanicuspis, B. ventricosa, Boerhavia diffusa, Maireana coronata, Portulaca filifolia, P. sp. aff. P. oleracea, Salsola kali, Threlkeldia proceriflora, Trianthema triquetra.*

INFREQUENT SPP: *Atriplex lindleyi, Bassia convexula, B. quinquecuspis, Centipeda thespidioides, Goodenia lunata, Pimelea trichostachya, Sida goniocarpa.*

GRAMINOIDS:

FREQUENT SPP: *Aristida latifolia, Brachyachne convergens, Chloris pectinata, C. scariosa, Dactyloctenium radulans, Eragrostis dielsii, E. setifolia, Sporobolus actinocladus, Tripogon loliiformis.*

INFREQUENT SPP: *Aristida anthoxanthoides, A. contorta, Astrebla elymoides, A. lappacea, Enneapogon polyphyllus, Enteropogon acicularis, Sporobolus australasicus, Tragus australianus.*

LAND USE:

Extent and severity of scalding are seasonal; however considerable areas are permanently scalded; capable of producing limited ephemeral pastures of low grazing capacity; moderate AWC; very low to low fertility; subject to degradation; surface crusting a problem due to sodicity; vegetation limited where high surface salt levels occur.
Condition: very poor to mediocre. Trend: (variable) from downwards to upwards.

SITES: B28, 37, 55, 84, 124, 127, 240, 242.

LAND UNIT 78

LANDFORM:

Flat alluvial plains with some low ridges, usually formed on the levees of braided channels. In places weak gilgai microrelief occurs.

GEOLOGY:

Recent alluvia.

SOILS:

Very deep, brown cracking clays with sand and silt throughout the profile. Soil reaction is alkaline. Surfaces are usually weakly crusting and self-mulching. $CaCO_3$ is present throughout the profile, commonly with increasing quantities of gypsum at depth. UG 5.24, UG 5.25, UG 5.31, UG 5.34, UG 5.38. Low to very low C and N; high K; low to high AP; low to fair BP; at depth profiles become sodic to strongly sodic with high salt levels. *Blackwater.* Representative soil analysis B 27, 36, 74, 136.

VEGETATION:

Mitchell grass open tussock grassland to tussock grassland. *Astrebla* spp. (Mitchell grasses) predominate forming a distinct but discontinuous canopy. Other grasses and forbs are usually present. Scattered low shrubs and isolated trees may emerge above the canopy.

STRUCTURAL FORMATION: Open tussock grassland to tussock grassland, depending on seasonal conditions.

TREE/TALL SHRUB LAYER: Ht 7 ± 3m; PFC < 1%; density < 10 trees/ha.

INFREQUENT SPP: *Acacia cambagei, Eucalyptus microtheca, Flindersia maculosa, Heterodendrum oleifolium, Lysiphyllum gilvum.*

LOW SHRUB LAYER: Ht 1.25 ± 0.75m; PFC < 1%; density < 25 shrubs/ha.

FREQUENT SPP: *Acacia farnesiana.*

INFREQUENT SPP: *Apophyllum anomalum, Capparis lasiantha, Eremophila bignoniiflora, E. maculata.*

GROUND LAYER: Ht < 1m; PFC (variable) 35 ± 15%.

PREDOMINANT SPP: *Astrebla elymoides, A. lappacea, A. squarrosa.*

FORBS:

FREQUENT SPP: *Abutilon malvifolium, Atriplex muelleri, Bassia anisacanthoides, B. calcarata, B. quinquecuspis, Boerhavia diffusa, Calostemma luteum, Malvastrum americanum, Portulaca sp. aff. P. oleracea, Salsola kali, Sida fibulifera, Tribulus terrestris.*

INFREQUENT SPP: *Bassia bicornis var. horrida, B. biflorus var. cephalocarpa, Crinum angustifolium, Hibiscus trionum, Maireana aphylla, M. coronata, M. dichoptera, Neptunia gracilis, Polymeria longifolia, Rhynchosia minima, Solanum esuriale, Threlkeldia proceriflora, Trianthema triquetra, Xanthium pungens.*

GRAMINOIDS:

FREQUENT SPP: *Aristida latifolia, Dactyloctenium radulans, Iseilema membranaceum, Panicum decompositum, Tragus australianus.*

INFREQUENT SPP: *Aristida leptopoda, Bothriochloa ewartiana, Brachyachne convergens, Cyperus bifax, Dichanthium sericeum, Enneapogon avenaceus, Eragrostis setifolia, Eriochloa pseudoacrotricha, Iseilema vaginiflorum, Panicum whitei, Sporobolus actinocladus, S. caroli, Tripogon loliiformis.*

LAND USE:

Capable of producing useful pastures with a high component of acceptable perennial grasses and ephemeral forbs; benefits from seasonal flooding; standover feed adequate; scattered topfeed, drought grazing capacity low; medium to high AWC; adequate fertility; frequently overgrazed; continued overgrazing may lead to seasonal scalding.
Condition: (variable) mediocre to good. Trend: stable to slightly downwards.

SITES: B12, 27, 35, 74, 136, 158.

LAND UNIT 79

LANDFORM:

Flat alluvial plains with occasional low ridges and swales. In places minor channels are developed.

GEOLOGY:

Quaternary alluvia.

SOILS:

Very deep, red and brown heavy cracking clays, with grey clays in gilgais. Sand bands may be present at depth. Soil reaction is alkaline. Gypsum is present at depth on most profiles. UG 5.24, UG 5.34, UG 5.39. Very low C and N; high K; very low to fair AP and BP; sodic subsoils with high salt levels. *Conniston.* Representative soil analysis B 75.

VEGETATION:

Gidgee tall open shrubland to low open woodland. *Acacia cambagei* (gidgee) predominates forming a distinct but discontinuous canopy. Scattered low shrubs usually occur but in places the low shrub density increases and forms a well defined low shrub layer. Ground cover is variable depending on seasonal conditions and is composed of forbs and grasses.

STRUCTURAL FORMATION: Tall open shrubland to low open woodland.

TALL SHRUB LAYER: Ht 6.5 ± 1.5m; PFC < 5%; density 175 ± 75 shrubs/ha.

PREDOMINANT SPP: *Acacia cambagei,* Ht 6.5 ± 1.5m; PFC < 5%.

LOW SHRUB LAYER: Ht 1.25 ± 0.5m; PFC (variable) usually < 1% in places 5%; density 300 ± 300 shrubs/ha.

FREQUENT SPP: *Cassia desolata, C. oligophylla, Eremophila maculata, Maireana aphylla.*

INFREQUENT SPP: *Chenopodium auricomum, Eremophila bignoniiflora, E. polyclada.*

GROUND LAYER: Ht 0.75 ± 0.25m; PFC 15 ± 10%.

FORBS:

FREQUENT SPP: *Abutilon malvifolium, Alternanthera nodiflora* [4], *Atriplex elachophylla, Bassia lanicuspis, B. ventricosa, Boerhavia diffusa, Marsilea drummondii* [4], *Portulaca sp. aff. P. oleracea, Pterigeron adecendens, Trianthema triquetra.*

INFREQUENT SPP: *Amaranthus mitchellii, Bassia quinquecuspis, Ipomoea lonchophylla, Justicia procumbens, Poranthera microphylla, Psoralea cinerea, Pterocaulon sphacelatum, Sida trichopoda, S. virgata, Solanum esuriale, Trianthema portulacastrum, Zygophyllum apiculatum.*

GRAMINOIDS:

FREQUENT SPP: *Cyperus gilesii,* Chloris pectinata, Dactyloctenium radulans, Enteropogon acicularis, Eragrostis setifolia, E. tenellula *, Sporobolus actinocladus, S. mitchellii *, Uranthoecium truncatum *.*

INFREQUENT SPP: *Astrebla elymoides *, A. lappacea, A. pectinata, A. squarrosa *, Brachyachne convergens, Cynodon dactylon, Iseilema membranaceum, Tragus australianus.*

* *Species associated with gilgais.*

LAND USE:

Capable of producing useful pasture with a low to moderate component of acceptable perennial grasses; standover feed very limited; topfeed very sparse, drought grazing capacity nil; medium to high AWC; low fertility; subject to overgrazing and susceptible to scalding.
Condition: Poor to fair. Trend: stable to slightly downwards.

SITES: B75, 84, 224, 235.

LAND UNIT 80

LANDFORM:

Minor drainage lines on gently undulating plains.

GEOLOGY:

Weathered sediments of the Cretaceous *Winton Formation*. These are sometimes covered with a thin veneer of recent alluvium.

SOILS:

Moderately deep, brown cracking clays with alkaline soil reaction. Textures are heavy clays throughout. Surfaces are soft and self-mulching under weak silty crusts. $CaCO_3$ is usually present throughout the profile. UG 5.32. Strongly alkaline pH; very low C and N; high K; fair to high AP; low BP; subsoils strongly sodic and saline. *Thornleigh*. Representative soil analysis B 133.

VEGETATION:

Mitchell grass tussock grassland. *Astrebla* spp. (Mitchell grasses) predominate forming a variable but usually well developed ground layer. Forbs also occur. Usually scattered low shrubs of *Acacia farnesiana* are conspicuous.

STRUCTURAL FORMATION: Tussock grassland.

LOW SHRUB LAYER: Ht < 1.5m; PFC (isolated) < 1%; density < 10 shrubs/ha.

FREQUENT SPP: *Acacia farnesiana.*

GROUND LAYER: Ht < 1m; PFC 40 ± 10%.

PREDOMINANT SPP: *Astrebla elymoides, A. lappacea.*

FORBS:

FREQUENT SPP: *Abutilon ralvifolium, Atriplex spongiosa, Bassia anisacanthoides, B. bicornis, B. calcarata, Boerhavia diffusa, Daucus glochidiatus, Trianthema triquetra, Sida virgata.*

INFREQUENT SPP: *Atriplex elachophylla, Crotalaria dissitiflora, Euphorbia parvicarunculata, Plantago pritzellii, Portulaca* sp. aff. *P. oleracea, Rhynchosia minima, Sida trichopoda, Threlkeldia proceriflora.*

GRAMINOIDS:

FREQUENT SPP: *Dichanthium sericeum, Enneapogon avenaceus, Sporobolus actinocladus.*

INFREQUENT SPP: *Aristida anthoxanthoides, Astrebla pectinata, A. squarrosa, Dactyloctenium radulans, Iseilema membranaceum, Tragus australianus.*

LAND USE:

Limited in extent; capable of producing useful pasture with a moderate component of acceptable perennial grasses; benefits from run-on water; moderate drought grazing capacity; medium to high AWC; fertility adequate.
Condition: fair. Trend: stable.

SITES: B 133.

LAND UNIT 81

LANDFORM:

Flat alluvial plains.

GEOLOGY:

Quaternary alluvia.

SOILS:

Very deep to moderately deep, red, alluvial texture contrast soils with predominantly alkaline soil reaction. Textures are sandy loams to clay loams over medium to heavy clays with sand and silt intermixed. A sporadic bleach occurs. Surfaces are crusting, commonly with vesicular structure. Scattered stone occurs on the surface in some areas. $CaCO_3$ and ferruginous inclusions may occur. DR 1.12, DR 1.13, DR 2.13, DR 2.43. Very low C and N; fair to high K; low to very low AP and BP; subsoils are sodic with medium salt levels at depth. *Cumberoo*. Representative soil analysis B111, 197.

VEGETATION:

Cassia phyllodinea low open shrubland rarely open herbfield. *Cassia phyllodinea* usually predominated forming a distinct but very discontinuous low canopy. In places scattered trees emerge above the canopy. Ground cover is variable composed of grasses and forbs. In places the low shrubs are so scattered that the association grades into an open herbfield.

STRUCTURAL FORMATION: Low open shrubland.

TREE/TALL SHRUB LAYER: Ht 4 ± 1m; PFC < 1%; density < 5 trees/ha.

INFREQUENT SPP: (isolated) *Grevillea striata, Hakea leucoptera, Lysiphyllum gilvum.*

LOW SHRUB LAYER: Ht 1.25 ± 0.5m; PFC 3 ± 2%; density 350 ± 300 shrubs/ha.

PREDOMINANT SPP: *Cassia phyllodinea,* Ht < 0.75m; PFC 3 ± 2%.

FREQUENT SPP: *Atalaya hemiglauca, Eremophila maculata.*

INFREQUENT SPP: *Capparis lasiantha* (rare), *Cassia desolata, C. oligophylla, Eremophila glabra, E. mitchellii, Maireana aphylla.*

GROUND LAYER: Ht < 0.75m; PFC (variable) 15 ± 10%.

FORBS:

FREQUENT SPP: *Goodenia subintegra, Portulaca* sp. aff. *P. oleracea, Salsola kali, Sida fibulifera.*

INFREQUENT SPP: *Brachyscome ciliaris* var. *lanuginosa, Bassia cornishiana, B. lanicuspis, Chenopodium rhadinostachyum, Cleome viscosa, Gnephosis foliata, Maireana brevifolia, Ptilotus helipteroides, P. macrocephalus, Rhynchosia minima, Sida platycalyx, Trianthema triquetra.*

GRAMINOIDS:

FREQUENT SPP: *Chloris pectinata, Dactyloctenium radulans, Enneapogon polyphyllus, Eragrostis setifolia, Sporobolus actinocladus, Tripogon loliiformis, Tragus australianus.*

INFREQUENT SPP: *Aristida contorta, Astrebla pectinata, Bothriochloa ewartiana, Chloris scariosa, Eragrostis dielsii, Fimbristylis dichotoma, Iseilema membranaceum.*

LAND USE:

Limited in extent; capable of producing useful pastures with a high component of ephemeral species and a low component of perennial species; standover feed limited; topfeed sparse; drought grazing capacity nil; benefits from run-on water; subject to erosion; low to medium AWC; very low fertility.
Condition: mediocre Trend: slightly downwards.

SITES: B111, 180, 197, 208.

LAND UNIT 82

LANDFORM:

Alluvial plains with numerous braided channels.

GEOLOGY:

Quaternary alluvia.

SOILS:

Very deep, brown cracking clays with varying amounts of silt and sand intermixed. Surfaces have thin silty crusts. Soil reaction is neutral. Iron staining is common at depth. UG 5.34. Very low C and N; high K; fair AP and BP; sodic subsoils with medium salt levels at depth. *Comiston*. Representative soil analysis B 210.

VEGETATION:

Gidgee tall open shrubland. *Acacia cambagei* (gidgee) predominates forming a distinct upper stratum with a discontinuous canopy. Other scattered trees and tall shrubs occur, some emerging above the canopy. Isolated low shrubs may be present but do not form a distinct layer. Ground flora is variable with either grasses or forbs predominating.

STRUCTURAL FORMATION: Tall open shrubland.

TREE/TALL SHRUB LAYER: Ht 6 ± 2m; PFC 7.5 ± 2.5%, density 300 ± 200 shrubs/ha.

PREDOMINANT SPP: *Acacia cambagei,* Ht 5 ± 1m; PFC 7.5 ± 2.5%.

FREQUENT SPP: *Eucalyptus microtheca.*

INFREQUENT SPP: *Acacia stenophylla, Atalaya hemiglauca.*

LOW SHRUB LAYER: Ht 1.25 ± 0.75m; PFC < 1%; density < 10 shrubs/ha.

INFREQUENT SPP: *Enchylaena tomentosa, Eremophila bignoniiflora.*

GROUND LAYER: Ht < 1.2m; PFC 25 ± 15%.

FORBS:

FREQUENT SPP: *Amaranthus mitchellii, Portulaca* sp. aff. *P. oleracea, Psoralea cinera, Trianthema portulacastrum, T. triquetra.*

INFREQUENT SPP: *Alternanthera nodiflora, Aeschynomene indica, Goodenia subintegra, Minuria integerrima, Pterigeron adscendens, Sesbania cannabina, Teucrium racemosum.*

GRAMINOIDS:

FREQUENT SPP: *Astrebla squarrosa, Chloris pectinata, Echinochloa turnerana, Eragrostis tenellula, Paspalidium jubiflorum.*

LAND USE:

Capable of producing useful pasture with a low component of acceptable perennial species; quality of the pasture dependent on season and frequency of flooding; limited standover feed; topfeed sparse; drought grazing capacity nil; medium AWC; adequate fertility; seasonally scalded.
Condition: poor to mediocre. Trend: slightly downwards.

SITES: B 191, 210.

LAND UNIT 83

LANDFORM:

Flat alluvial plains with single or braided minor channels. Seasonally scalded.

GEOLOGY:

Recent alluvia.

SOILS:

Very deep, neutral, brown clays (minor areas of red and grey clays are included) with light to heavy clay textures. Silt and sand are intermixed throughout the profile. Surfaces are crusting. UG 5.34, UF 6.31, *Powell*. Representative soil analysis B 109, 166.

VEGETATION:

Open herbfield to sparse herbfield infrequently Mitchell grass open tussock grassland. Forbs and grasses occur with either predominating depending on seasonal conditions. Scattered low shrubs may occur. Trees are usually absent. In places *Mairoana aphylla* becomes predominant forming a low open shrubland.

STRUCTURAL FORMATION: Open herbfield to sparse herbfield.

LOW SHRUB LAYER: Ht 1.25 ± 0.75m; PFC < 1%; density < 10 shrubs/ha.

INFREQUENT SPP: *Acacia farnesiana, Eremophila maculata, Mairoana aphylla.*

GROUND LAYER: Ht < 0.75m; PFC (variable) 15 ± 10%.

FORBS:

FREQUENT SPP: *Atriplex spongiosa, Bassia divaricata, B. lanicuspis, B. quinquecuspis, Chenopodium rhadinostachyum, Euphorbia drummondii, Mairoana coronata, Portulaca* sp. aff. *P. oleracea, Salsola kali, Trianthema triquetra.*

INFREQUENT SPP: *Abutilon malvifolium, Boerhavia diffusa, Evolvulus alsinoides, Euphorbia parvicarunculata, Indigofera australis, Goodenia subintegra, Maireana dichoptera, Pteriqeron adscendens, Sida fibulifera.*

GRAMINOIDS:

FREQUENT SPP: *Brachyachne convergens, Chloris pectinata, Dactyloctenium radulans, Eragrostis dielsii, E. setifolia, Iseilema membranaceum, Sporobolus actinocladus, S. australasicus.*

INFREQUENT SPP: *Aristida contorta, Astrebla elymoides, A. lappacea, A. pectinata, A. squarrosa, Chloris scariosa, Enneapogon polyphullus, Panicum effusum, P. whitei.*

LAND USE:

Usually supports useful ephemeral pastures; rarely pastures with a moderate component of acceptable perennial species, quality of pasture depends on season and frequency of flooding; limited standover feed; topfeed sparse; drought grazing capacity nil; medium AWC; very low to low fertility; subject to seasonal scalding.
Condition: (variable) poor to fair. Trend: slightly upwards.

SITES: B 74, 109, 166, 234, 267.

LAND UNIT 84

LANDFORM:

Flat alluvial plains with braided channels.

GEOLOGY:

Recent alluvia.

SOILS:

A complex of deep to very deep, red and brown alluvial texture contrast soils and brown and grey clays on alluvia. Alkaline, medium to heavy clays are overlain by neutral clay loam to silty clay loam textures. Surfaces have crusts of silt and sand. $CaCO_3$ and gypsum may be present in the subsoil. DR 1.12, DR 1.13, DR 2.13, UG 5.24. *Caiwarro, *Manna.

VEGETATION:

Yapunyah shrubby low open woodland to woodland. *Eucalyptus ochrophloia* (yapunyah) predominates. In places *Acacia cambagei* (gidgee) is conspicuous and other scattered trees may occur. There may be a well defined shrubby layer present. Scattered low shrubs occur and in places form a distinct layer. Ground cover is variable depending on seasonal conditions. Either grasses or forbs may predominate.

STRUCTURAL FORMATION: Low open woodland to woodland.

TREE/TALL SHRUB LAYER: Ht 8 ± 3m; PFC 15 ± 10%; density 250 ± 200 trees/ha.

PREDOMINANT SPP: *Eucalyptus ochrophloia*, Ht 8 ± 3m; PFC 15 ± 10%.

FREQUENT SPP: *Acacia cambagei, Eremophila mitchellii.*

INFREQUENT SPP: *Eucalyptus camaldulensis.*

LOW SHRUB LAYER: Ht 1.25 ± 0.75m; PFC 5 ± 4%; density 700 ± 500 shrubs/ha.

FREQUENT SPP: *Cassia nemophila, Eremophila mitchellii, E. maculata, Myoporum deserti.*

INFREQUENT SPP: *Cassia desolata, Eremophila polyclada, Ptilotus obovatus.*

GROUND LAYER: Ht < 0.75m; PFC (variable) 15 ± 10%.

FORBS:

FREQUENT SPP: *Abutilon otocarpum, A. oxycarpum, Bassia birchii, B. convexula, B. divaricata, B. tricuspis, Boerhavia diffusa, Hibiscus trionum, Malvastrum americanum, Marsilea drummondii, Salsola kali, Solanum ellipticum, S. quadriloculatum.*

INFREQUENT SPP: *Justicia procurlens, Mairoana villosa, Portulaca* sp. aff. *P. oleracea.*

GRAMINOIDS:

FREQUENT SPP: *Chloris pectinata, Dactyloctenium radulans, Enteropogon acicularis, Eragrostis setifolia, Eriochloa pseudoacrotricha, Tragus australianus.*

INFREQUENT SPP: *Aristida latifolia, Astrebla lappacea, Sporobolus actinocladus, S. caroli, Tripogon loliiformis.*

LAND USE:

Limited in extent; usually in a degraded state but capable of producing useful pasture with a moderate component of perennial species; capable of producing standover feed; limited topfeed; potential woody weed problem; susceptible to erosion and seasonal scalding; very low drought grazing capacity.
Condition: poor to mediocre. Trend: downwards.

SITES: A 68, 87, 156, R 420, 916.

LAND UNIT 85

LANDFORM:

Minor drainage lines and local alluvial plains.

GEOLOGY:

Recent alluvia.

SOILS:

Shallow to moderately deep, sandy clay loam to clay loam soils with stone and gravel intermixed. Small areas of brown and red clays occur in places.

VEGETATION:

Mineritchie tall open shrubland. *Acacia cyperophylla* (mineritchie) predominates forming pure stands in places. Other scattered trees may occur. Isolated low shrubs occur but usually do not form a well defined layer. Ground cover is variable composed of grasses and forbs.

STRUCTURAL FORMATION: Tall open shrubland.

TREE/TALL SHRUB LAYER: Ht 7 ± 2m; PFC usually 1% up to 5%; density 150 ± 100 shrubs/ha

PREDOMINANT SPP: *Acacia cyperophylla*, Ht 7 ± 2m; PFC usually 1% up to 5%.

FREQUENT SPP: *Acacia cambagei* (in places).

INFREQUENT SPP: *Eucalyptus camaldulensis, E. microtheca*, (rare).

LOW SHRUB LAYER: Ht < 1.3m; PFC < 1%.

INFREQUENT SPP: *Acacia farnesiana, A. tetragonophylla, Cassia helmsii, C. nemophila, C. oligophylla.*

GROUND LAYER: Ht < 0.75m; PFC (variable) 5 ± 5%.

FORBS:

INFREQUENT SPP: *Atriplex spongiosa, Bassia divaricata, B. lanicuspis, Mairoana coronata, M. villosa.*

GRAMINOIDS:

INFREQUENT SPP: *Astrebla pectinata, Bothriochloa ewartiana, Brachiaria miliiformis, Chloris pectinata, Dactyloctenium radulans, Enneapogon polyphyllus, Eragrostis setifolia, Panicum decompositum, P. whitei.*

LAND USE:

Very limited in extent; benefits from local run-on water; capable of producing useful ephemeral pastures; drought grazing capacity nil.
Condition: poor to mediocre. Trend: stable.

SITES: R 1232, 1233, 1236, 1237.

LAND UNIT 86

LANDFORM:

Alluvial plains with braided channels and some low ridge and swale microrelief.

GEOLOGY:

Recent alluvia.

SOILS:

Very deep, grey and brown cracking clays on alluvia with silt and sand intermixed. Surfaces have firm silty crusts which may be vesicular or platy. UG 5.34. *Connieston*. Representative soil analysis B 8.

VEGETATION:

Brigalow shrubbly low woodland to woodland. *Acacia harpophylla* (brigalow) predominates forming a well defined tall layer with a discontinuous canopy. *Acacia cambagei* (gidgee) is conspicuous in places. Other scattered trees may occur. Low shrubs are usually present and form a well developed low shrubby layer in some situations. Ground flora is composed of forbs and grasses. Ground cover is variable.

* A full description of these soil mapping units may be found in Western Arid Region Land Use Study - Part I, Chapter 4.

STRUCTURAL FORMATION: Low woodland to woodland.

TREE/TALL SHRUB LAYER: Ht 10 ± 2m; PFC 15 ± 5%; density 350 ± 100 trees/ha.

PREDOMINANT SPP: *Acacia harpophylla*, Ht 10 ± 2m; PFC 15 ± 5%.

FREQUENT SPP: *Acacia cambagei*.

INFREQUENT SPP: *Capparis loranthifolia*, *Eucalyptus thozetiana*, *Geijera parviflora*, *Lysiphyllum gilvum*, (rare).

LOW SHRUB LAYER: Ht 1.25 ± 0.5m; PFC 7.5 ± 2.5%; density 900 ± 600 shrubs/ha.

FREQUENT SPP: *Apophyllum anomalum*, *Carissa ovata*, *Eremophila mitchellii*.

INFREQUENT SPP: *Acacia farnesiana*, *Cassia nemophila*, *Eremophila longifolia*, *Myoporum insertum*.

GROUND LAYER: Ht < 0.75m; PFC 15 ± 10%.

FORBS:

FREQUENT SPP: *Amaranthus mitchellii*, *Atriplex stipitata*, *A. muelleri*, *Bassia birchii*, *B. quinquecuspis*, *Boerhavia diffusa*, *Chrysocoma ciliata*, *Portulaca* sp. aff. *P. oleracea*, *Salsola kali*.

INFREQUENT SPP: *Achyranthes aspera*, *Atriplex holocarpa*, *A. lindleyi*, *Bassia triptera*, *B. ventricosa*, *Cucumis myriocarpus*, *Dysphania aristata*, *Marsilea drummondii*, *Solanum cleistogamum*, *Trianthema portulacastrum*.

GRAMINOIDS:

FREQUENT SPP: *Chloris pectinata*, *Dactyloctenium radulans*, *Enteropogon acicularis*, *Eragrostis setifolia*, *Sporobolus actinocladus*, *S. caroli*.

INFREQUENT SPP: *Brachiaria gilesii*, *Cyperus bifax*, *Panicum decompositum*.

LAND USE:

Limited in extent; seasonally flooded; subject to natural gully erosion; capable of producing useful pastures; woody weeds a problem; drought grazing capacity nil; medium AWC; adequate fertility.
Condition: mediocre. Trend: stable to slightly downwards.

SITES: B 8, 148.

LAND UNIT 87

LANDFORM:

Flat, poorly drained claypans.

GEOLOGY:

Quaternary alluvia.

SOILS:

Very deep, grey and brown cracking clays with crusting surfaces predominate. Textures are medium to heavy clays with traces of sand and silt usually present. Mottling is common at depth. Minor areas of texture contrast soils with hardsetting sandy loam surfaces occur where sand has built up around shrubs and other objects. UG 5.28, DY 3.12. *Cakham*.

VEGETATION:

Swamp cane grass open tussock grassland. *Eragrostis australasica* (swamp cane grass) predominates and in places forms almost pure stands. Frequently shrubs of *Chenopodium auricomum* and *Muehlenbeckia cunninghamii* occur. Grasses, sedges and forbs are present. Many of the species are associated with sandy rises.

Scattered trees of *Eucalyptus microtheca* may occur.

STRUCTUAL FORMATION: Open tussock grassland.

TREE/TALL SHRUB LAYER: Ht 6 ± 2m; PFC < 1%; density < 25 trees/ha.

INFREQUENT SPP: *Atalaya hemiglauca* (rare), *Eucalyptus microtheca*.

LOW SHRUB LAYER: Ht < 1.5m; PFC (variable) usually < 1% up to 5% in places; density usually < 50 shrubs/ha, up to 800 shrubs/ha.

FREQUENT SPP: *Chenopodium auricomum*, *Muehlenbeckia cunninghamii*.

INFREQUENT SPP: *Acacia farnesiana* (rare), *Eremophila bignoniiflora* (rare).

GROUND LAYER: Ht < 1.5m; PFC 25 ± 24%.

PREDOMINANT SPP: *Eragrostis australasica*, Ht 1.25 ± 0.25m; PFC 5 ± 4%.

FORBS:

FREQUENT SPP: *Aeschynomene indica*, *Alternanthera nodiflora*, *Marsilea* spp.

INFREQUENT SPP: *Atriplex flabelliformis*, *A. spongiosa*, *Bassia bicornis*, *B. divaricata*, *B. paradoxa*, *B. quinquecuspis*, *Eryngium plantagineum*, *E. supinum*, *Ranunculus denticulata*, *R. integerrima*, *Myriolus prostratus*, *Portulaca* sp. aff. *P. oleracea*, *Salsola kali*, *Trigonella suavissima*.

GRAMINOIDS:

FREQUENT SPP: *Cyperus fulvus*, *C. rigidellus*, *Dicanthium pallens*, *Elytrophorus spicatus*, *Sporobolus mitchellii*, *Uranthoecium truncatum*.

INFREQUENT SPP: *Chloris pectinata*, *Diplachne muelleri*, *Echinochloa turnerana*, *Eragrostis leptocoma*, *E. setifolia*, *E. tenerrima*.

LAND USE:

Limited in extent; subjected to inundation for extended periods; produces very low grazing capacity pasture with limited areas of higher grazing capacity (channel forage); very low drought grazing capacity.
Condition: poor. Trend: stable.

SITES: B 108, 175, 233.

LAND UNIT 88

LANDFORM:

Flat plains forming scalded margins around poorly drained claypans.

GEOLOGY:

Quaternary alluvia.

SOILS:

(a) Very deep, grey cracking clays with alkaline soil reaction. Surfaces are crusting. $CaCO_3$ and Mn are present at depth in the profile. UG 5.28. *Wambarg*.

(b) Very deep, texture contrast soils with coarse sandy loams overlying the alkaline, grey clay subsoils of (1). A bleached A_2 is commonly present. Surfaces are usually hardsetting. DG 2.43. *Retreat*.

VEGETATION:

Sparse forbland to forbland. Floristic composition is varied and dependent on seasonal conditions. Forbs usually predominate. Scattered clumps of *Muehlenbeckia cunninghamii* (lignum) and the shrub-like grass *Eragrostis australasica* (swamp cane grass) may occur. Other grasses may be present. Trees are absent.

STRUCTURAL FORMATION: Sparse forbland to forbland.

LOW SHRUB LAYER: Ht < 1.5m; PFC < 1%; density < 80 shrubs/ha.

INFREQUENT SPP: *Muehlenbeckia cunninghamii*.

GROUND LAYER: Ht < 0.75m; PFC (variable) 25 ± 25%.

FORBS:

FREQUENT SPP: *Atriplex holocarpa*, *A. lindleyi*, *Centipeda thespidioides*, *Morgania floribunda*, *M. glabra*, *Tenorium racemosum*.

INFREQUENT SPP: *Bassia birchii*, *Bassia divaricata*, *Calocephalus multiflorus*, *Glinus lotoides*, *Portulaca* sp. aff. *P. oleracea*, *Peplidium rarum*, *Salsola kali*, *Trianthema* [illegible].

GRAMINOIDS:

FREQUENT SPP: *Eragrostis australasica*, *E. falcata*, *Sporobolus mitchellii*.

INFREQUENT SPP: *Dactyloctenium radulans*, *Digitaria muelleri*, *Iseilema vaginiflorum*.

LAND USE:

Limited in extent; subject to inundation; produces ephemeral low grazing capacity pastures; subject to scalding; adequate fertility; very low drought grazing capacity.
Condition: poor. Trend: stable to slightly downwards.

SITES: B 106, 107.

LAND UNIT 89

LANDFORM:

Flat plains formed in run-on situations.

GEOLOGY:

Cainozoic limestone and chalcedony.

SOILS:

Shallow to moderately deep, red clays with alkaline soil reaction. Textures are heavy to medium clays commonly with sand grains throughout the profile. Small areas of texture contrast soils occur where sand encroaches. LG 5.32, UG 5.37, DR 2.13.

VEGETATION:

Western bloodwood low open woodland. *Eucalyptus terminalis* (western bloodwood) predominates forming a distinct tall stratum with a discontinuous canopy. Other scattered trees are usually present. Isolated low shrubs occur but do not form a well defined layer. Ground cover is variable depending on seasonal conditions. Grasses usually predominate but forbs are also conspicuous.

In places this association approaches a wooded open tussock grassland.

STRUCTURAL FORMATION: Low open woodland.

TREE/TALL SHRUB LAYER: Ht 8 ± 2m; PFC 1%; density 40 ± 20 trees/ha.

PREDOMINANT SPP: *Eucalyptus terminalis*, Ht 8 ± 2m; PFC < 1%.

FREQUENT SPP: *Grevillea striata*.

INFREQUENT SPP: *Atalaya hemiglauca*.

LOW SHRUB LAYER: Ht 1.25 ± 0.5m; PFC < 1%; density < 50 shrubs/ha.

FREQUENT SPP: *Acacia tetragonophylla*, *Cassia oligophylla*.

INFREQUENT SPP: *Cassia helmsii*.

GROUND LAYER: Ht < 1m; PFC 25 ± 15%.

FORBS:

FREQUENT SPP: *Amaranthus mitchellii, Atriplex lindleyi, A. spongiosa, Bassia cornishiana, Boerhavia diffusa, Euphorbia drummondii, Evolvulus alsinoides, Malvastrum americanum, Pimelea trichostachya, Ptilotus macrocephalus, P. polystachyus.*

INFREQUENT SPP: *Abutilon otocarpum, Bassia divaricata, Calotis hispidula, Crotalaria dissitiflora, Helipterum floribundum, Indigofera linifolia, I. linnaei, Salsola kali, Trianthema triquetra.*

GRAMINOIDS:

FREQUENT SPP: *Brachyachne convergens, Chloris pectinata, Dactyloctenium radulans, Eragrostis eriopoda, E. tenellula, Fimbristylis dichotoma, Iseilema membranaceum, Sporobolus australasicus, Themeda australis.*

INFREQUENT SPP: *Aristida browniana, Brachiaria miliiformis, Dichanthium sericeum, Enneapogon polyphyllus, Themeda avenacea, Triraphis mollis.*

LAND USE:

Limited in extent; low and unreliable rainfall limiting; benefits from run-on water; produces a useful pasture with a moderate component of acceptable perennial species and abundant ephemerals; standover feed usually adequate; topfeed sparse; drought grazing capacity low; high AWC; low fertility.
Condition: mediocre to fair. Trend: stable.

SITES: B 85, 87, 266.

LAND UNIT 90

LANDFORM:

Lower slopes of plains fringing minor alluvia.

GEOLOGY:

Thin veneers of Quaternary deposits over the Tertiary *Glendower Formation.*

SOILS:

Shallow, red, texture contrast soils, with neutral soil reaction. Clay loams overlie medium clays, commonly separated by a bleached layer. Surfaces are hardsetting. Ironstone gravel occurs in the lower parts of the profile. DR 2.42.

VEGETATION:

Acacia calcicola, Cassia spp. tall open shrubland. *Acacia calcicola* predominates with other trees and tall shrubs present. *Cassia* spp. are noticeable but rarely form a well defined layer. Ground cover is variable composed of grasses and forbs.

STRUCTURAL FORMATION: Tall open shrubland.

TREE/TALL SHRUB LAYER: Ht 3 ± 1m; PFC < 5%; density 250 ± 150 shrubs/ha.

PREDOMINANT SPP: *Acacia calcicola,* Ht 2.5 ± 0.5m; PFC < 5%.

FREQUENT SPP: *Acacia aneura.*

INFREQUENT SPP: *Acacia ramulosa, A. tetragonophylla, Eremophila mitchellii, Santalum lanceolatum.*

LOW SHRUB LAYER: Ht 0.75 ± 0.25m; PFC < 1%; density 150 ± 50 shrubs/ha.

FREQUENT SPP: *Cassia artemisioides, C. phyllodinea.*

INFREQUENT SPP: *Cassia nemophila* var. *nemophila, Eremophila duttonii.*

GROUND LAYER: Ht < 0.75m; PFC < 5%.

FORBS:

FREQUENT SPP: *Bassia convexula, B. divaricata, Ptilotus polystachyus, Salsola kali.*

INFREQUENT SPP: *Boerhavia diffusa, Helipterum floribundum, Ipomoea polymorpha, Portulaca* sp. aff. *P. oleracea.*

GRAMINOIDS:

FREQUENT SPP: *Enteropogon acicularis, Enneapogon polyphyllus, Eragrostis setifolia, Tripogon loliiformis.*

INFREQUENT SPP: *Chloris scariosa, Dactyloctenium radulans, Tragus australianus.*

LAND USE:

Very limited in extent; capable of producing low grazing capacity pastures with a low component of perennial species; standover feed very limited; scattered topfeed; drought grazing capacity nil.
Condition: poor. Trend: stable to slightly downwards.

SITES: B 120.

LAND UNIT 91

LANDFORM:

Local alluvial plains and run-on areas.

GEOLOGY:

Quaternary alluvia.

SOILS:

Deep to very deep, red, texture contrast soils with acid, sandy loams and sandy clay loams overlying neutral sandy medium clays. A bleached A_2 is usually present. Hardsetting loamy surfaces occur throughout. Ferruginous inclusions are present at depth. DR . 2.42. *Ambathala.* Representative soil analysis B 19.

VEGETATION:

Sandalwood, ironwood shrubby tall open shrubland. *Eremophila mitchellii* (sandalwood) predominates with *Acacia excelsa* (ironwood) emerging forming a discontinuous canopy. Other trees and tall shrubs are present. Scattered low shrubs occur, forming a well defined layer in places. The ground layer is composed of grasses and forbs forming a variable ground cover.

STRUCTURAL FORMATION: Tall open shrubland.

TREE/TALL SHRUB LAYER: Ht 6 ± 4m; PFC 7.5 ± 2.5%; density 300 ± 100 shrubs/ha.

PREDOMINANT SPP: *Acacia excelsa,* Ht 8 ± 2m; PFC < 3%; *Eremophila mitchellii,* Ht 3 ± 1m; PFC 7.5 ± 2.5%.

FREQUENT SPP: *Grevillea striata.*

INFREQUENT SPP: *Acacia cana, A. victoriae, Atalaya hemiglauca, Eremophila longifolia, Eucalyptus populnea.*

LOW SHRUB LAYER: Ht 1 ± 0.5m; PFC 5 ± 4%; density 600 ± 400 shrubs/ha.

FREQUENT SPP: *Cassia nemophila* var. *nemophila.*

INFREQUENT SPP: *Eremophila gilesii, E. glabra, E. maculata.*

GROUND LAYER: Ht < 0.75m; PFC < 1% (depends on seasonal conditions and shrub density).

FORBS:

FREQUENT SPP: *Bassia bicornis, B. birchii, Boerhavia diffusa, Sida platycalyx.*

INFREQUENT SPP: *Abutilon otocarpum, Helipterum strictum, Minuria integerrima.*

GRAMINOIDS:

FREQUENT SPP: *Eragrostis eriopoda, E. kennedyae, Tripogon loliiformis.*

INFREQUENT SPP: *Aristida contorta, Eriachne mucronata.*

LAND USE:

Very limited in extent; capable of producing very low grazing capacity ephemeral pastures; drought grazing capacity nil; low fertility; susceptible to erosion.
Condition: poor. Trend: downwards.

SITES: B 19.

LAND UNIT 92

LANDFORM:

Outer alluvial plains fringing major rivers.

GEOLOGY:

Recent sand and clay alluvia.

SOILS:

Very deep, texture contrast soils, usually with acid, coarse sand to coarse sandy loam surface soils overlying alkaline, sandy clay subsoils. A bleached A_2 may be present. $CaCO_3$ and mottling occur at depth in the profile. Small areas of earthy sands and sandy red earths also occur. DB 3.12, DB 4.13, DR 3.13, DY 5.43, GN 2.12, UC 1.23. Very low C and N; K may be limiting in some areas; variable AP, very low to very fair; very fair BP; subsoils are occasionally strongly sodic. *None.* Representative soil analysis B 51, 245.

VEGETATION:

Eastern dead-finish low open woodland to open woodland. *Albizia basaltica* (eastern dead-finish) usually predominates forming a distinct upper layer with a discontinuous canopy. Other trees such as *Grevillea striata* (beefwood), *Atalaya hemiglauca* (whitewood) and *Flindersia maculosa* (leopardwood) are usually conspicuous. A tall shrub understorey layer comprising *Ventilago viminalis* (vine tree) and *Geijera parviflora* (wilga) may occur. Isolated low shrubs are present but rarely form a well defined layer. Ground cover is variable with both grasses and forbs occurring.

In places a variant of this unit occurs. *Flindersia maculosa* predominates with *Lysiphyllum gilvum* conspicuous.

STRUCTURAL FORMATION: Low open woodland to open woodland.

TREE LAYER: Ht 10 ± 3m; PFC 5 ± 4%; density 275 ± 200 trees/ha.

PREDOMINANT SPP: *Albizia basaltica,* Ht 10 ± 3m; PFC < 5%.

FREQUENT SPP: *Atalaya hemiglauca, Flindersia maculosa, Grevillea striata.*

INFREQUENT SPP: *Acacia harpophylla* (rare), *Lysiphyllum gilvum* (rare), *Eucalyptus papuana* (rare), *E. populnea*

TALL SHRUB LAYER: Ht 4 ± 1m; PFC < 5%; density 200 ± 150 shrubs/ha.

FREQUENT SPP: *Geijera parviflora, Ventilago viminalis.*

INFREQUENT SPP: *Acacia aneura* (rare), *A. cambagei, Canthium oleifolium, Capparis loranthifolia, Heterodendrum oleifolium* (rare), *Owenia acidula* (rare).

LOW SHRUB LAYER: Ht 1 ± 0.5m; PFC < 5%; density 150 ± 100 shrubs/ha.

FREQUENT SPP: *Apophyllum anomalum, Capparis lasiantha.*

INFREQUENT SPP: *Acacia farnesiana, Carissa ovata, Cassia artemisioides, C. nemophila, Enchylaena tomentosa, Eremophila maculata, E. mitchellii, Pittosporum microcephala.*

GROUND LAYER: Ht < 1m; PFC (variable) 20 ± 10%.

FORBS:

FREQUENT SPP: *Abutilon otocarpum, Bassia birchii, B. cornishiana, Boerhavia diffusa, Evolvulus alsinoides, Portulaca* sp. aff. *P. oleracea, Salsola kali, Tribulus terrestris.*

INFREQUENT SPP: *Abutilon leucopetalum, Chenopodium rhadinostachyum, Cleome viscosa, Crimen angustifolium, Crotalaria linifolia, Goodenia subintegra, Hibiscus trionum, Indigofera linifolia, I. linnaei, Rhynchosia minima, Sida platycalyx, S. trichopoda, Tephrosia leptoclada, Verbena officinalis.*

GRAMINOIDS:

FREQUENT SPP: *Aristida browniana, A. contorta, Chrysopogon fallax, Dactyloctenium radulans, Eriocapogon polyphyllus, Enteropogon acicularis, Eragrostis eriopoda, Eriachne mucronata, Perotis rara.*

INFREQUENT SPP: *Aristida calycina, A. ingrata, Bothriochloa exartiana, Brachiaria miliiformis, Bulbostylis barbata, Chloris scariosa, Scirpus subaphyllus, Sporobolus actinocladus, Tragus australianus.*

LAND USE:

A productive unit; responds well to light falls of rain; produces useful pastures with a high component of acceptable perennial species; standover feed adequate; topfeed adequate; shade adequate; a valuable reserve of moderate drought grazing capacity but subject to overgrazing; adequate fertility.
Condition: fair to good. Trend: stable to slightly downwards.

SITES: B 51, 132, 212, 219, 220, 245, 271.

LAND UNIT 93

LANDFORM:

Flat alluvial plains.

GEOLOGY:

Recent alluvia.

SOILS:

Very deep, texture contrast soils predominate, with neutral, loamy sands and sandy loams overlying alkaline, sandyclays. A bleached A_2 may be present. Surfaces are hard setting. $CaCO_3$ occurs at depth in the profile. Minor areas of sandy loams overlying ferruginous hardpans occur. DR 2.13, DR 3.43, DY 5.43, GN 1.12. Very low C and N; fair K; very low to fair AP and BP; strongly sodic subsoils. *Mons.* Representative soil analysis B 52, 214.

VEGETATION:

Gidgee shrubby low open woodland to open woodland rarely tall open shrubland. *Acacia cambagei* (gidgee) predominates forming a distinct upper layer with a discontinuous canopy. Other scattered trees occur. Low shrubs are usually present and in places form a well defined low shrub layer. Ground cover is variable composed of grasses and forbs.

STRUCTURAL FORMATION: Low open woodland to open woodland.

TREE/TALL SHRUB LAYER: Ht 9 ± 3m; PFC 5 ± 4%; density 250 ± 175 trees/ha.

PREDOMINANT SPP: *Acacia cambagei,* Ht 9 ± 3m; PFC 5 ± 4%.

FREQUENT SPP: *Flindersia maculosa.*

INFREQUENT SPP: *Lysiphyllum gilvum, Santalum lanceolatum, Ventilago viminalis.*

LOW SHRUB LAYER: Ht 1.25 ± 0.75m; PFC (variable) 10 ± 9%; density 800 ± 700 shrubs/ha.

FREQUENT SPP: *Apophyllum anomalum, Carissa ovata, Cassia oligophylla, Enchylaena tomentosa, Eremophila mitchellii.*

INFREQUENT SPP: *Acacia victoriae, Eremophila glabra, Cassia artemisioides, C. nemophila, C. phyllodinea.*

GROUND LAYER: Ht < 0.75m; PFC 20 ± 10%.

FORBS:

FREQUENT SPP: *Abutilon otocarpum, Atriplex spongiosa, Bassia cornishiana, B. lanicuspis, B. ventricosa, Boerhavia diffusa, Chenopodium rhadinostachyum, Evolvulus alsinoides, Portulaca* sp. aff. *P. oleracea, Salsola kali, Trianthema triquetra.*

INFREQUENT SPP: *Atriplex elachophylla, Dipteracanthus primulaceus, Lepidium rotundum, Portulaca filifolia, Tribulus terrestris.*

GRAMINOIDS:

FREQUENT SPP: *Brachyachne convergens, Chloris pectinata, Dactyloctenium radulans, Enteropogon acicularis, Eragrostis setifolia, Sporobolus actinocladus, S. caroli, Tragus australianus, Tripogon loliiformis.*

INFREQUENT SPP: *Aristida contorta, Bulbostylis barbata, Chloris scariosa, Eragrostis dielsii, Fimbristylis dichotoma.*

LAND USE:

A productive unit; responds to light falls of rain; produces useful pastures with a low component of acceptable perennial species; standover feed limited; scattered topfeed; shade adequate; drought grazing capacity low; woody weeds a problem; low AWC; usually adequate fertility.
Condition: mediocre to fair. Trend: stable to slightly downwards.

SITES: B 52, 115, 205, 214, 239, R 897, 903, 1001.

LAND UNIT 94

LANDFORM:

Flat alluvial plains. Weak gilgai microrelief occurs in some areas. Seasonally scalded.

GEOLOGY:

Quaternary alluvia.

SOILS:

Very deep, alkaline, red and brown cracking clays. Textures are heavy clays throughout, with some sand and silt intermixed. Surfaces have thin silty crusts. UG 5.34, UG 5.38. *Blackwater, Powell.* Representative soil analysis B 118, 244.

VEGETATION:

Mitchell grasses open tussock grassland to open herbfield. Either *Astrebla* spp. (Mitchell grasses), other short grasses or forbs predominate depending on local environmental conditions. Scattered low shrubs may occur but do not form a well defined stratum. Trees and tall shrubs rarely are present.

STRUCTURAL FORMATION: Open tussock grassland to open herbfield.

TREE/TALL SHRUB LAYER: Ht 4 ± 1m; PFC < 1%; density < 5 shrubs/ha.

INFREQUENT SPP: *Acacia victoriae, Eucalyptus microtheca.*

LOW SHRUB LAYER: Ht 1 ± 0.25m; PFC < 1%; density < 25 shrubs/ha.

FREQUENT SPP: *Cassia phyllodinea.*

INFREQUENT SPP: *Arthrocnemum* spp., *Ptilotus obovatus.*

GROUND LAYER: Ht < 1m; PFC 15 ± 14%.

FORBS:

FREQUENT SPP: *Abutilon malvifolium, Bassia lanicuspis, B. quinqueuspis, Boerhavia diffusa, Portulaca* sp. aff. *P. oleracea, Sida fibulifera, S. trichopoda.*

INFREQUENT SPP: *Atriplex spongiosa, Chenopodium rhadinostachyum, Convolvulus erubescens, Evolvulus alsinoides, Goodenia lunata, Neptunia dimorphantha, Pterigeron adscendens, Ptilotus macrocephalus, Solanum esuriale, Threlkeldia proceriflora, Trianthema triquetra.*

GRAMINOIDS:

FREQUENT SPP: *Astrebla elymoides, A. lappacea, A. squarrosa, Eragrostis setifolia, Iseilema membranaceum, Panicum whitei, Sporobolus mitchellii.*

INFREQUENT SPP: *Aristida anthoxanthoides, A. contorta, A. leptopoda, Brachyachne convergens, Chloris pectinata, Dactyloctenium radulans, Dichanthium sericeum, Leptochloa digitata, Panicum decompositum, Sporobolus australasicus.*

LAND USE:

Seasonally flooded; little pasture response to light falls of rain but benefits from run-on water; usually ephemerals but capable of producing pasture with a moderate component of acceptable perennial species following consecutive good seasons; standover feed usually absent; topfeed absent; drought grazing capacity nil; medium to high AWC; fertility variable frequently low; seasonally scalded.
Condition: (variable) poor to fair. Trend: stable to slightly downwards.

SITES: B 118, 244, 268.

LAND UNIT 95

LANDFORM:

Occasionally flooded, flat, outer alluvial plains of the "Channel Country" rivers.

GEOLOGY:

Quaternary alluvia.

SOILS:

Very deep, grey and brown cracking clays with silt and sand intermixed. Reaction is neutral to alkaline. Textures are heavy clays throughout. Surfaces have silty crusts and are self-mulching in some places. Gypsum is occasionally present at depth. UG 5.24, UG 5.34. Very low C and N; high K; fair to very high AP; low to fair BP; soils are frequently sodic and saline at depth with medium salt levels. *Moruada.* Representative soil analysis B 62, 79.

VEGETATION:

Open herbfield to herbfield. Either grasses or forbs predominate depending on seasonal conditions. Ground cover is variable. Scattered low shrubs of *Chenopodium auricomum* may occur. Trees are rare but stunted *Acacia cambagei* and *Eucalyptus microtheca* may be present. In places this unit is devoid of vegetation.

STRUCTURAL FORMATION: Open herbfield to herbfield.

TREE/TALL SHRUB LAYER: Ht 4 ± 1m; PFC < 1%; density < 5 trees/ha.

INFREQUENT SPP: *Acacia cambagei, Eucalyptus microtheca.*

LOW SHRUB LAYER: Ht < 1m; PFC < 1%; density < 20 shrubs/ha.

INFREQUENT SPP: *Chenopodium auricomum.*

GROUND LAYER: Ht < 1m; PFC (variable) 30 ± 30%.

FORBS:

FREQUENT SPP: *Atriplex elachophylla, A. stipitata, A. spongiosa, Bassia divaricata, B. quinqueuspis, Boerhavia diffusa, Centipeda thespidioides, Convolvulus*

cyanea, Ipomoea lonchophylla, I. muelleri, Portulaca sp. aff. *P. oleracea, Ptilotus murrayi, Salsola kali, Trianthema triquetra.*

INFREQUENT SPP: *Amaranthus mitchellii, Aeschynomene indica, Calostemma luteum, Frankenia serpyllifolia, Hibiscus trionum, Minuria integerrima, Neptunia gracilis, Psoralea cinerea.*

GRAMINOIDS:

FREQUENT SPP: *Chloris pectinata, Cyperus gilesii, Dactyloctenium radulans, Echinochloa turneriana, Isciloma membranaceum, Panicum whitei, Sporobolus actinocladus.*

INFREQUENT SPP: *Astrebla pectinata, Eragrostis tenellula, Sporobolus australasicus, S. mitchellii, Uranthoecium truncatum.*

LAND USE:

Capable of producing useful but mainly ephemeral pastures of moderate grazing capacity, topfeed absent; standover feed usually absent; drought grazing capacity very low; benefits from run-on water from adjacent land zones and local flooding in some areas; partially or wholly inundated by general flooding one year in four on average; high AWC; adequate fertility; seasonally scalded in some areas.
Condition: poor to fair (variable) Trend: stable to downwards.

SITES: B 62, 79, 163, 204, 215.

LAND UNIT 96

LANDFORM:

Flat alluvial plains. Seldom flooded.

GEOLOGY:

Quaternary alluvia.

SOILS:

Very deep, red cracking clays with neutral to alkaline soil reaction. Textures are light to heavy clays with some sand and silt intermixed. Surfaces are crusting, occasionally with scattered gravel. $CaCO_3$ and/or gypsum occurs at depth in the profile. UG 5.38. *Powell.* Representative soil analysis B 90.

VEGETATION:

Open herbfield to Mitchell grass open tussock grassland. Grasses or forbs predominate depending on seasonal conditions. Grasses include *Astrebla* spp. (Mitchell grasses) with *Atriplex* spp., *Bassia* spp. and *Sida* spp. the more frequently occurring forbs. Scattered low shrubs of *Cassia* spp. may be present. Isolated trees of *Acacia cambagei* (gidgee) also occur associated with depressions.

STRUCTURAL FORMATION: Open herbfield to open tussock grassland.

TREE/TALL SHRUB LAYER: Ht 3 ± 1m; PFC < 1%; density < 5 shrubs/ha.

INFREQUENT SPP: (isolated) *Acacia cambagei.*

LOW SHRUB LAYER: Ht 1 ± 0.5m; PFC < 1%; density 40 ± 20 shrubs/ha.

FREQUENT SPP: *Cassia phyllodinea.*

INFREQUENT SPP: *Cassia oligophylla, C. sturtii, Eremophila polyclada.*

GROUND LAYER: Ht 1 ± 0.25m; PFC (variable) 10 ± 10%.

FORBS:

FREQUENT SPP: *Atriplex lindleyi, A. spongiosa, Bassia bicornis, B. bicornis* var. *horrida, B. cornishiana, Malvastrum americanum, Portulaca* sp. aff. *P. oleracea, Sida fibulifera, S. goniocarpa, S. trichopoda.*

INFREQUENT SPP: *Atriplex muelleri, Boerhavia diffusa, Calostemma luteum, Heliotropium tenuifolium, Ipomoea lonchophylla, Portulaca filifolia, Ptilotus macrocephalus.*

GRAMINOIDS:

FREQUENT SPP: *Aristida latifolia, Astrebla clymoides, A. lappacea, A. squarrosa, Brachyachne convergens, Chloris pectinata, Dactyloctenium radulans, Isciloma membranaceum, Panicum whitei.*

INFREQUENT SPP: *Aristida contorta, Brachiaria miliiformis, Diplachne muelleri, Eragrostis setifolia, E. tenellula, Uranthoecium truncatum.*

LAND USE:

Limited in extent; capable of producing ephemeral pastures of low grazing capacity; rarely pastures with a moderate component of acceptable perennial species; standover feed usually absent; topfeed absent; drought grazing capacity nil; medium AWC; low fertility; seasonally scalded.
Condition: (variable) poor to fair. Trend: slightly downwards.

SITES: B 90, 167.

LAND UNIT 97

LANDFORM:

Poorly drained depressions in sandplains.

GEOLOGY:

Sand cover over Quaternary alluvia.

SOILS:

Very deep, texture contrast soils. Slightly acid, sandy clay loams overlie sandy clay subsoils. A bleached A_2 is common. Surfaces are hardsetting when dry. Mottling occurs at depth in the profile together with traces of MN. DY 5.42. *Retreat.* Representative soil analysis B 76.

VEGETATION:

Beefwood shrubby low open woodland. *Grevillea striata* (beefwood) predominates forming a well defined layer with a very discontinuous canopy. Other trees and tall shrubs are present. Scattered low shrubs occur and in places form a well defined layer. Ground flora is variable composed mainly of grasses but forbs are usually present. The composition is dependent on seasonal conditions.

STRUCTURAL FORMATION: Low open woodland.

TREE/TALL SHRUB LAYER: Ht 9 ± 3m; PFC < 1% in places 5%; density usually <50 trees/ha up to 150 trees/ha.

PREDOMINANT SPP: *Grevillea striata,* Ht 6 ± 2m; PFC usually 1% in places 2.5%.

FREQUENT SPP: *Capparis spinosa* var. *nummularia, Pittosporum phillyraeoides.*

INFREQUENT SPP: *Acacia aneura* (rare), *A. coriacea* (rare), *Atalaya hemiglauca, Clerodendrum floribundum, Owenia acidula, Ventilago viminalis* (rare).

LOW SHRUB LAYER: Ht 1.25 ± 0.75m; PFC < 5%; density < 200 shrubs/ha.

FREQUENT SPP: *Acacia tetragonophylla, Eremophila sturtii.*

INFREQUENT SPP: *Acacia omalophylla, Capparis lasiantha, Cassia nemophila* var. *nemophila, Eremophila latrobei*(rare).

GROUND LAYER: Ht < 1m; PFC (variable) 20 ± 10%.

FORBS:

FREQUENT SPP: *Bassia cornishiana, Euphorbia drummondii, Portulaca* sp. aff. *P. oleracea, Ptilotus polystachyus.*

INFREQUENT SPP: *Cuscuta australis, Jasminum lineare, Polycarpaea glabra.*

GRAMINOIDS:

FREQUENT SPP: *Aristida browniana, Eragrostis eriopoda, E. leptocarpa, E. setifolia, Themeda avenacea.*

INFREQUENT SPP: *Bothriochloa bladhii, B. ewartiana, Chloris pectinata, Dactyloctenium radulans, Eriachne helmsii, Fimbristylis dichotoma, Paraneurachne muelleri.*

LAND USE:

Very limited in extent; pasture dependant on seasonal conditions; usually produces limited pastures with a low component of acceptable perennial species; standover feed limited; topfeed scattered; drought grazing capacity nil.
Condition: mediocre Trend: slightly downwards.

SITES: B 76.

LAND UNIT 98

LANDFORM:

Flat plains associated with major alluvia.

GEOLOGY:

Quaternary alluvia.

SOILS:

A complex of very deep, grey and brown clays and associated alluvial texture contrast soils. Fine sandy clays to fine silty clays overlie medium to heavy clay subsoils. Surfaces are crusting. Gypsum is frequently present at depth in profile. DY 1.13. UG 5.25. *Tooratchie* * Representative soil analysis A205.

VEGETATION:

Old man saltbush low open shrubland. *Atriplex nummularia* (old man saltbush) predominates forming a distinct low shrub layer with a discontinuous canopy. In places it forms pure stands but may be associated with *Chenopodium auricomum* (blue bush). Infrequently other scattered shrubs emerge. The composition of the ground flora is variable depending on seasonal conditions. Grasses or forbs may predominate in the ground layer.

STRUCTURAL FORMATION: Low open shrubland to low shrubland.

TALL SHRUB LAYER: Ht 2 ± 1m; PFC < 1%; density < 20 shrubs/ha.

INFREQUENT SPP: *Acacia farnesiana, A. victoriae.*

LOW SHRUB LAYER: Ht 1.5 ± 0.5m; PFC 6 ± 4%; density 4000 ± 3500 shrubs/ha.

PREDOMINANT SPP: *Atriplex nummularia,* Ht 1.5 ± 0.5m; PFC 8 ± 7%.

FREQUENT SPP: *Chenopodium auricomum.*

GROUND LAYER: Ht < 0.75m; PFC 10 ± 10%.

FORBS:

FREQUENT SPP: *Atriplex holocarpa, A. spongiosa, Boerhavia diffusa.*

INFREQUENT SPP: *Centipeda thespidioides, Helipterum floribundum, H. strictum, Minuria leptophylla, Plantago pritzelii., Psoralea cinerea, Solanum esuriale, Teucrium racemosum.*

GRAMINOIDS:

FREQUENT SPP: *Aristida anthoxanthoides, Sporobolus mitchellii.*

* A full description of this soil mapping unit may be found in Western Arid Region Land Use Survey - Part I, Chapter 4.

INFREQUENT SPP: *Chloris pectinata, Eragrostis dielsii, E. leptocarpa, E. setifolia, Iseilema membranaceum, I. vaginiflorum, Panicum decompositum, P. whitei, Sporobolus actinocladus.*

LAND USE:

Limited in extent; capable of producing a useful pasture; excellent standover feed; useful drought reserve; medium AWC; infrequently flooded; subject to overgrazing; seasonally scalded and susceptible to sheet erosion.
Condition: poor to fair. Trend: downward.

SITES: A 205, R 1212.

LAND UNIT 99

LANDFORM:

Cemented aprons on the lower slopes and edges of dunes occurring on alluvial plains (slopes 1 - 4%).

GEOLOGY:

Aeolian Quaternary sands over Quaternary alluvia.

SOILS:

Very shallow to moderately deep, neutral, red sandy loams to sandy clay loams, usually with a ferruginous hardpan which is commonly exposed around the base of low sand mounds. Surface soil is hard and cemented often with concretionary lime present. UM 5.31, GN 2.12. *Gooyana* *. Associated are texture contrast soils. These soils comprise loose, neutral, red loamy coarse sands overlying alkaline, sandy clay loams to sandy clays. DY 5.53. *Bygrave* *.

VEGETATION:

Very sparse chenopod forbland. Scattered *Atriplex* spp. (saltbush) and *Bassia* spp. may occur. Extensive areas are devoid of vegetation.

STRUCTURAL FORMATION: Sparse forbland.

GROUND LAYER: Ht < 0.5m; PFC < 1%.

FORBS:

INFREQUENT SPP: *Atriplex lindleyi, A. spongiosa, Bassia divaricata, B. lanicuspis.*

INFREQUENT SPP: *Eragrostis dielsii.*

LAND USE:

Limited in extent; unproductive; of no significant use.

* A full description of these soil mapping units may be found in Western Arid Region Land Use Study - Part I, Chapter 4.

SOIL ANALYTICAL METHODS

by C.R. Ahern

SAMPLE PREPARATION

All samples were dried at 40°C in a forced air draught. Gravel was sieved out using a 2 mm sieve, while samples not containing gravel were ground to less than 2 mm. All determinations were carried out using the less than 2 mm soil fraction. All results are reported on an air dry basis except where indicated.

PARTICLE SIZE DISTRIBUTION

Particle size distributions were determined by a modification of the hydrometer method of Piper (1942). The modifications were that the soils were dispersed with sodium hexametaphosphate and sodium hydroxide and samples high in gypsum were sieved with 0.2 mm sieve after an initial boiling treatment prior to an acid treatment. Results are reported on an oven dry basis.

With soils containing carbonate, the sum of particle sizes may be less than 100% where acid treatment was used.

ELECTRICAL CONDUCTIVITY

A 1:5 soil:deionized water suspension was shaken for an hour and the electrical conductivity (E.C.) was measured at 25°C.

A 1:50 soil:water suspension was generally used on soils with E.C. greater than 1mS/cm, particularly if gypsum was suspected of being present.

Soluble salts can be estimated approximately from electrical conductivity readings by using the factor of Piper (1942).

% T.S.S. = E.C. mS/cm x 0.336 at 25°C.

This factor is an approximation, particularly for arid soils with unusually high concentrations of sulphates, bicarbonates, or calcium salts.

PH

After determination of electrical conductivity, the pH of the same 1:5 suspension was measured with a glass electrode and saturated calomel reference electrode.

CHLORIDES

After conductivity and pH readings were complete, potassium alum was added to the 1:5 soil water suspension. Chlorides were determined on the stirred suspension with a specific ion electrode (Haydon, Williams and Ahern, 1974).

CALCIUM CARBONATE

Calcium carbonate was determined on all samples which effervesced in HCl. The acid neutralization method described by U.S. Salinity Laboratory Staff (1954) was used. Results obtained by this method may be somewhat high, because soil constituents other than lime may react with the acid.

ORGANIC CARBON

The wet oxidation method of Walkley and Black (1934) was used on a finely ground sample. The reduced chromic ion (Cr^{+++}) was read colorimetrically (Sims and Haby, 1971). Results reported are uncorrected Walkley and Black values.

TOTAL NITROGEN

The sample was finely ground. Selenium catalyst was used in a semi-micro Kjeldahl digestion. An auto analyser system was used for estimation of ammonium in the digests.

EXTRACTABLE PHOSPHORUS

Acid Extractable P (0.01 N H_2SO_4) was determined by the Kerr and von Stieglitz (1938) method. REadings were carried out using an Auto Analyser technique.

Bicarbonate Extractable P (0.5 M Na HCO_3 adjusted to pH 8.5), was determined by the Colwell (1963) method.

TOTAL PHOSPHORUS, TOTAL POTASSIUM, TOTAL SULPHUR

About 3 g of soil sample were very finely ground and pelleted with boric acid. The pellet was then exposed to a beam of X-rays in a Phillips 1410 vacuum X-ray spectrograph. Simple linear calibration was used to obtain percentage phosphorus, potassium and sulphur from fluorescent intensities.

EXCHANGEABLE CATIONS

A method similar to that of Loveday (1974) was used.

After pre-washing with 60% ethanol, exchangeable cations were removed with 1N NH_4 Cl at pH 8.5 in 60% ethanol. Absorbed ammonium was removed with 1N sodium sulphate.

Ammonium and chloride in the sodium sulphate leachate were determined on an auto analyser using colormetric methods. The difference in milliequivalents was reported as the cation exchange capacity (C.E.C.).

Measurements for soil with low C.E.C. are not as precise as those for soils of high C.E.C. Calculated ratios such as C.E.C./clay may have considerable error when C.E.C. is low, particularly if clay percentage is also low.

Exchangeable calcium may be slightly inflated on soils containing gypsum.

MOISTURE CHARACTERISTICS

Moisture percentage at matric potentials of $-\frac{1}{3}$ and -15 bar was determined on samples ground to less than 2mm. A pressure plate apparatus of Soil Moisture Equipment Co. of California was used. Results are reported on an oven dry basis.

'Available soil water capacity' was approximated by the difference between these two laboratory measurements.

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