

1994

An inventory and condition survey of the Murchison River catchment, Western Australia

Peter James Curry


A L. Payne

K A. Leighton

P Hennig

D A. Blood

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Technical Bulletin

**An inventory and condition survey
of the Murchison River catchment
and surrounds, Western Australia**

No. 84



P.J. Curry
A.L. Payne
K.A. Leighton
P. Hennig
D.A. Blood

An inventory and condition survey of the Murchison River catchment, Western Australia

By: P.J. Curry, A.L. Payne, K.A. Leighton, P. Hennig and D.A. Blood

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SOUTH PERTH 6151
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The authors

P.J. Curry¹, A.L. Payne, P. Hennig and D.A. Blood,
Natural Resources Assessment Group, Department of
Agriculture, Western Australia and K.A. Leighton,
Geodetic Branch, Department of Land
Administration, Western Australia.

Other contributors

A. Laws, Geological Survey, Department of
Minerals and Energy, Western Australia.

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633.202099413

¹ Current address
PO Box 316
Kelmscott 6111 WA

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Summary

Scope of the survey

The area surveyed by fieldwork during 1985-88 covers approximately 88,360 km² of arid zone rangelands situated between Mt Magnet and Meekatharra in the east and the catchments of the Greenough and Wooramel rivers in the west. This area includes most of the catchment of the Murchison River and its tributaries the Sanford, Roderick and Yalgar rivers; as well as most of the catchment of Lake Austin.

Land use in the area is dominated by 67 pastoral leases, the lands of which fall wholly within the survey in 53 cases and partly so for 14 others. Gold mining was the only other land use operating at a high level of activity, throughout the auriferous areas.

This report details a descriptive reference accompanying a 1:250,000 scale map series to the biophysical characteristics of the area. Descriptions of climatic patterns, geology and hydrogeology, soil types, land types, land systems, land units and vegetation types are presented as a regional inventory of land resources.

Land characteristics

The survey area exhibits a characteristically arid climate (mean annual rainfall 190-240 mm) throughout, with the exception of the moister far south-western corner. When subjected to analysis in terms of moisture potential for widespread plant growth, long-term records show the clear predominance of effective winter rainfall (probability 55-80% throughout) and the highly unreliable nature of effective summer rainfall (< 20% throughout). A probability-based assessment of rainfall and plant growth presented here provides a basis for long-term strategic planning for pastoralists and other land managers who are operating in a highly erratic and unreliable seasonal environment.

Geologically, the area is dominated by a granite-greenstone terrain of the Archaean Yilgarn Craton, with the hill ranges widely separated by very flat plains derived from colluvium and alluvium. Soils are mainly shallow, sandy and infertile, and across most of the lower areas are distinctively underlain by red-brown siliceous hardpan.

Shallow aquifers found extensively below this hardpan and elsewhere have provided most of the groundwaters on which development of the area for pastoral and mining industries has depended. Groundwater consumption by the pastoral industry is small compared to estimated storage. The origins and quality of groundwater was described from survey work conducted by the Geological Survey (Department of Minerals and Energy) in the context of 12 major sub-catchments in the area.

Lands within the area have been described and mapped into 19 broad land types composed of 74 land systems. Their individual extent varies greatly, and over half the area is made up by just eight land systems (Yanganoo, Kalli, Koonmarra, Challenge, Sherwood, Bebele, Mindura and Narryer). The land system approach attempts an integrated or natural classification of land from predominant biophysical features in an inventory which will be useful to all future land management and land use planning.

At a more detailed level, the component land units of each land system are described by their landform features, soils and vegetation associations. In this way, the mapped divisions of the landscape are related through their component parts to any position or site of interest on the ground.

Vegetation

The flora of the area is diverse, with about 830 recorded vascular species, of which 97% are native and about 4.5% endemic or near-endemic. No described species are thought to have become extinct. Associations considered at the scale of the land unit are objectively classified and described as 23 major types. All but three of these types are shrublands or low woodlands of which the majority are naturally depauperate in grasses. Mulga (*Acacia aneura*) and cotton bush (*Ptilotus obovatus*) are the most ubiquitous perennials.

Intensive sampling of 14 of these types at 1256 'condition sites' throughout the area revealed the patterns of variation that exist, partly as natural variation but otherwise as a consequence of changes related to cumulative impact by grazing animals and pastoral management. In this way, analysis of the observed variation in perennial vegetation at comparable sites has enabled simple and objective criteria to be defined for classes of vegetation condition. Land managers and administrators will be able to reassess the condition of vegetation in an area of interest and compare their findings with quantified relativities recorded during 1985-88.

In terms of adverse impact on perennial communities by pastoral usage, approximately 42% by area of all vegetation was in poor to very poor condition, 37% remained in fair condition and 21% was still in good to very good condition. Taken overall, these summary data indicate that the vegetation in this survey area is in poorer condition than that recorded from other regional rangeland surveys in Western Australia.

General symptoms of poor condition are a loss of perennial plant diversity and numbers per unit area, loss of palatable perennial diversity and density, while sites in the poorest condition states show general loss of vegetation structure, cover and hence subsequent denudation. Secondary increases and invasions by unpalatable species such as prickly acacia (*Acacia victoriae*) and needle bush (*Hakea preissii*) are common on disturbed or deflated soil surfaces, mainly on river

and tributary alluvial plains with duplex soils. The most widely degraded vegetation types are the halophytic shrublands (mainly saltbush and bluebush types), hardpan mulga shrublands and calcrete shrubby grasslands. They have been preferentially grazed for 80-110 years in most areas.

Introduced (exotic) plants in the area are mainly local in occurrence, annual or short-lived species, and associated with disturbed or nutrient-enriched or wetland sites.

Soils and soil erosion

Accelerated soil erosion is widespread in the area. Affected areas invariably show perennial vegetation in less than good condition. Erosion problems have evidently started and accelerated primarily as a consequence of loss of perennial vegetation. Natural processes which serve to stabilise otherwise vulnerable soil surfaces have been fragmented or disrupted. Many land units and soil surfaces on stony hills and plains are highly resistant to erosion. Others are highly susceptible. The pivotal role of perennial vegetation in good condition on susceptible soils is illustrated by the major vegetation type, hardpan mulga shrubland, in which sites exhibiting either of the two most diverse and dense vegetation condition classes were never encountered showing significant accelerated erosion. Sites in the more depauperate vegetation classes showed a 9% incidence of accelerated erosion.

By two different survey methods the incidence of at least minor accelerated erosion was estimated at 15-17% of the area. Commonest forms of erosion are scalding and surface sheeting over 10-50% of the surface. The most susceptible soil types are red duplex types on areas with some slope and subject to concentrated sheet flows after major rainfall events.

The preponderance of shallow soils (< 50 cm deep over hardpan or baserock) has meant that this erosion is not characterised by spectacular gullyng. Nor has the problem been highlighted by acute off-site effects, such as siltation of dams or estuaries. Eroded areas in the Murchison are mainly patchily vegetated or denuded flats, with deflated or no topsoil and exposed saline subsoils or inert hardpan remaining as the land surface.

Areas of extensive severe degradation and erosion (sde) larger than 40 ha were mapped and total 1.8% of the survey area (1561 km²), an area more than half as large as the Australian Capital Territory. The incidence of sde is largely confined to a small number of susceptible and preferentially grazed land units, mainly on Beringarra, Ero and Sherwood land systems.

Historical *cf.* contemporary effects

The Murchison's history and its development as a major pastoral and mining area indicates a high correlation between the location of early pastoral

development along the river plains with the present-day patterns of pastoral use and the recorded incidence of land degradation. Parts of many individual leases showed clear signs of recent recovery in the perennial vegetation. However, some local areas of recent vegetation degradation and soil erosion were encountered.

Management implications

For the present pastoral industry, about half of the land area grazed is in mainly poor condition but not severely degraded and eroded. It is these areas with mainly intact soil surfaces which present the best prospects for economically feasible perennial regeneration in the short to medium term.

Most of the eroded duplex plains will remain irreversibly deflated and degraded until practical solutions are more fully researched and developed (a) to manage total grazing pressure throughout each affected sub-catchment; and (b) to enhance plant establishment and soil accretion on deflated areas on the major drainage systems and breakaway footslopes.

Aerial census of kangaroos, goats and other large animals, conducted across the area at the time of the survey indicated that the grazing pressure exerted by domestic stock was less than 50% of the total pressure from all grazing animals. Successful control of kangaroos and goats will be essential for implementing vegetation regeneration by controlling all grazing pressure.

The operating circumstances and financial position of woolgrowers in the area has changed rapidly for the worse since the survey began and will probably continue to change. Environmental awareness and technical knowledge of the soil and vegetation patterns within the pastoral industry and the wider community continues to grow. In terms of management recommendations, this report marks a significant departure from previous surveys, in which broad recommendations were made about how pastoralists might change management practices to address land degradation problems. The failure of such a government-led approach to the problem of land degradation and management planning in rangelands (and any other land under productive use) is now widely acknowledged.

It is therefore most appropriate that this report provides an enduring technical reference to assist Land Conservation District Committees (which became established throughout the area during the survey program) and other stakeholders to become more deeply engaged in management planning, monitoring and technical investigations. In addition the report stands as a reference work useful to various Government agencies and private enterprises concerned with land use and land use planning in the region.

The Murchison River Catchment

Introduction

Rangeland surveys

The findings presented in this report are those of a regional survey of rangelands in the Murchison River catchment area of Western Australia. The work was undertaken by a joint team from the Department of Agriculture and the Department of Land Administration during 1985-88. This survey is the seventh of its type, in a program of land classification, mapping and natural resource evaluation in pastoral areas of the State. Other surveys in the program have been undertaken in the Gascoyne River catchment (Wilcox and McKinnon 1972), the West Kimberley (Payne *et al.* 1979), part of the Nullarbor Plain (Mitchell *et al.* 1979), part of the Ashburton River catchment (Payne *et al.* 1982), the Carnarvon Basin (Payne *et al.* 1987) and the Roebourne Plains (Payne

and Tille 1992). Field work on an eighth survey in the north-eastern Goldfields region was completed in 1990 (Pringle *et al.* 1994).

Murchison River catchment

The survey covered about 88,360 km² of land which is mostly under pastoral leaseholding, within the Murchisonia physiographic sub-division of Jutson (1950) and the Austin Botanical District of the Eremaean Botanical Province (Beard 1980). The area encompasses most of the catchment of the Murchison River and its tributaries the Sanford, Roderick and Yalgur rivers and also the headwaters of the Wooramel and Greenough rivers.

The survey area extends from Innouendy and Mt Gould stations in the north to Bullardoo and Wondinong stations in the south and to Polelle and Muggon stations in the east and west (Figure 1). Three small towns, Meekatharra, Cue and Mt Magnet, are situated in the east and south-east with the tiny settlement of Murchison in the west. A prominent feature in the south-east of the survey area is the extensive salt lake, Lake Austin. Smaller salt lakes include Lake Anneen between Cue and Meekatharra and the lakes on Muggon station in the far west. In the north, the boundaries of the survey were fixed at the limits of coverage achieved by the Gascoyne River catchment survey (Wilcox and McKinnon 1972) and in the north-west by the boundary of the Carnarvon Basin survey (Payne *et al.* 1987). In the east, the survey area overlapped with part of the Wiluna-Meekatharra survey (Mabbutt *et al.* 1963). Elsewhere the boundaries of the survey area were more or less defined by the boundaries of the 1:250,000 map sheets shown in Figure 2.

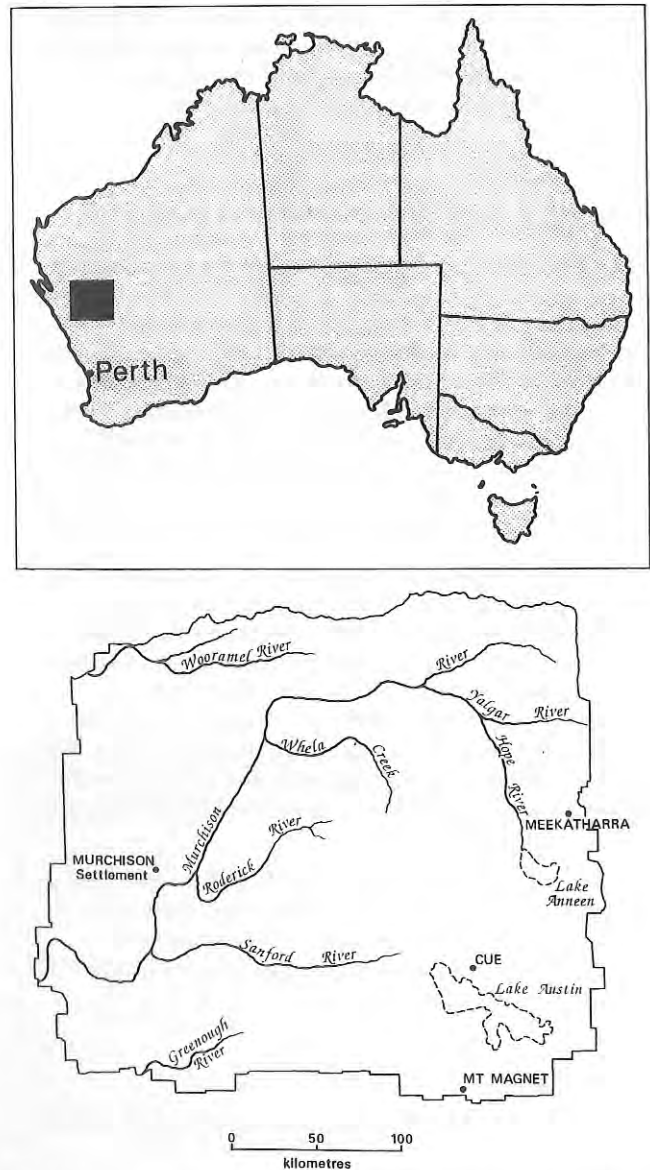


Figure 1. Location map, Murchison rangeland survey area.

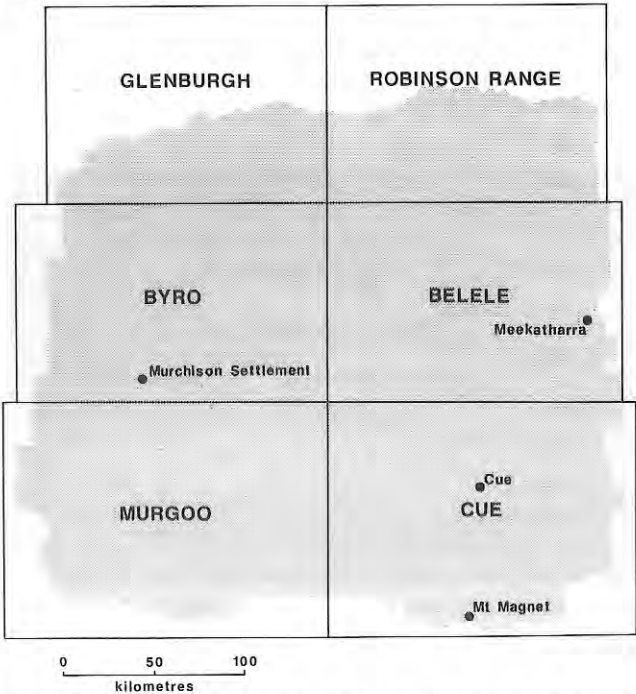


Figure 2. Murchison rangeland survey area showing relevant 1:250,000 map sheets.

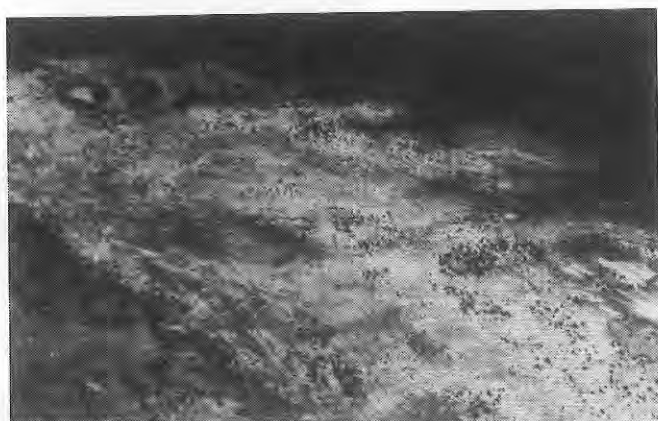
The survey area includes nearly all of the Murchison and Cue Land Conservation Districts (LCDs) and parts of the Yalgoo, Mt Magnet and Meekatharra LCDs.

The report

The purpose of the survey was to provide a comprehensive description and mapping of the biophysical resources of the region, together with an evaluation of the pastoral potential and the condition of the soils and vegetation. The report and the accompanying series of colour maps at 1:250,000 scale are primarily intended as a reference for present and future land managers, rangeland advisers, other state and local government officers and land administrators, the people most involved in planning and implementing management practices. The report and maps will also provide researchers and the public with a basic reference on the biogeographic features of the Murchison River catchment. The survey inventory also enables the recognition and location of land types of particular potential, land use or conservation value.

Survey findings give new perspectives on each type of land in good and poor condition, and the special circumstances of severely degraded areas. These can be considered by individual lessees and managers, Land Conservation District groups and by all future programs of government assistance to land managers. The report presents essential resource information required to plan sustainable land management at the scales of sub-catchment, lease or paddock.

This report provides vegetation type descriptions and indicates the spatial relationships of land units necessary for the strategic location of monitoring sites. It also provides information for 'do it yourself' assessment of condition of major vegetation types, and objective criteria by which such future assessment can be compared to this baseline survey. Monitoring of vegetation change is well established in the Western Australian rangelands, and can be considerably enhanced by such insight.



Aerial view of a typical area of 'river frontage' country. The large central portion depicts an alluvial plain on which the gross signs of accelerated water erosion are predominant. Note the lack of seasonal vegetation growth on the affected surfaces. The major river channels, flanked by coolabahs and river red gums, are visible in the top right.

The first three sections of this report provide an overview of historical aspects of land use and the fundamental biophysical features of the survey region. In many instances, little detailed information has been previously published for the region. These sections draw together some of the disparate information which is available and serve as an introduction to the later, more detailed land system descriptions and the detailed accounts of vegetation and soils. The Geology and Hydrogeology section includes a description of the physiography of the region which relates directly to the land systems (or more precisely to groups of land systems) which are detailed later in the report.

The three major sections within the report are the land system descriptions, vegetation types and soils. These sections provide information on landform, vegetation and soil at mapping scale and within map units at the land unit level. Used in conjunction with the maps, these provide an inventory of the whole rangeland resource.

The Appendices provide information too detailed to include within the text of the main report. Included are listed summaries of biophysical data collected at 1,968 individual sites investigated during the survey. These original data have been made available for the reference of individual lessees and managers, who may wish to use such sites as benchmarks.

Changing face of the pastoral industry

The period over which the survey was conducted and its results subsequently analysed has been marked by rapid and serious changes of circumstance for the pastoral industry of the region. In 1985, the economic setting was one of high wool prices and a buoyant Australian economy. Following the Australian Stock Market crash in 1987, wool prices fell, to be followed by the removal of the floor price support scheme in 1990. A decline in premiums for fine wools and record low prices have continued throughout 1992 and 1993.

Such severe economic pressure on the industry has brought previously profitable properties to crisis point. Complementary income derived from other industries and enterprises on pastoral leases, mainly from mining and tourism, and the relatively favourable position for cattle producers, have been critical in the continued operation of some leases. The full extent of the consequences for the future structure and operation of individual leases and the industry as a whole, is still unclear.

A regional inventory such as this will be of value in planning and managing the changing patterns of pastoral land use, as well as for investigating the potential of new and developing industries based on natural resource management.

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Brief history of pastoral use

The Murchison River was named after Roderick Impey Murchison, President of the Geographic Society, London, by Lt George Grey in 1839.

Assistant surveyor Robert Austin led the first expedition through the upper Murchison, travelling west from the southern fringes of Lake Austin during the spring of 1854. After a dry or indifferent winter season, Austin's party was repeatedly short of water and almost perished towards the end of the journey. As a consequence, Austin did not assess the Murchison as having pastoral potential. The first claims of promise for grazing potential were made by F.T. Gregory, S. Trigg and I. Roe in 1857, who reported grass 'two to three feet high' around Mt Welcome, and 'a fine sward of grass' below the gums on the river. They concluded that the area was 'fair average cattle pasture'.

The first sheep to be grazed along the upper Murchison River were brought through the area by E.T. Hooley, who successfully drove a flock from Galena to the Ashburton in the winter of 1866. By this time T. Burges and J. Perks were already bringing flocks along the Greenough River as far as Yuin, and were granted the first pastoral leases made available in the region, in 1864, as 10,000 acre blocks leased for fourteen years. Burges and the Wittenoom brothers led the first wave of pastoral settlement and development which proceeded up the main arms of the Murchison River during the late 1860s and 1870s.

Early selections of country

Pioneer pastoralists made their first choices of country for pastoral leases along the river plains of the Greenough, Sanford, Murchison and Roderick rivers. Small blocks which are now parts of Yuin, Murgoo, Boolardy, Wooleen, Woolgorong, Wandina

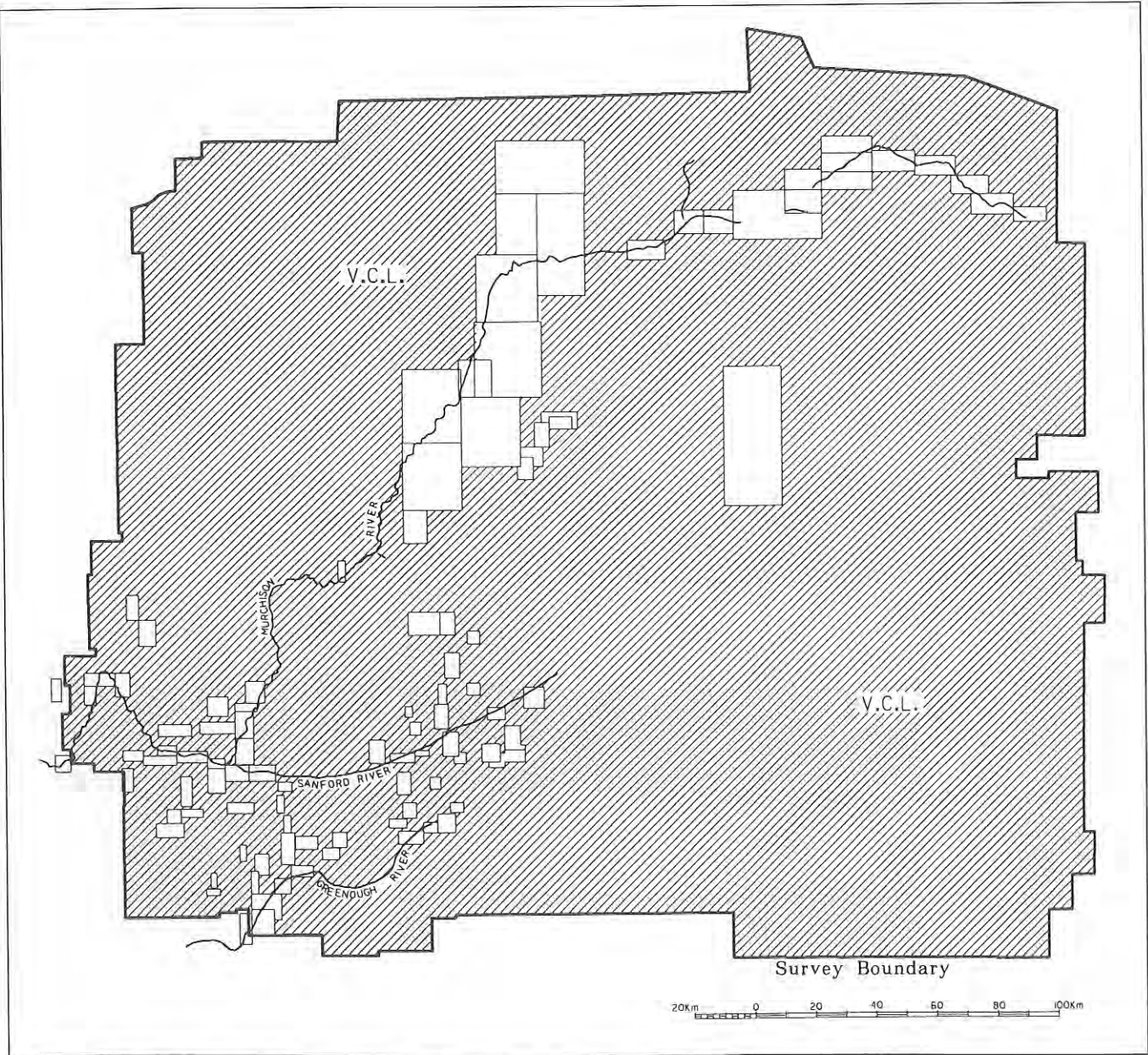


Figure 3. Pastoral leases on the Murchison River and its tributaries as at about 1880.

and Byro stations were settled by 1874. F. Wittenoom continued to explore the upper Murchison River, and by 1880 Nookawara, Billabalong, Beringarra, Milly Milly, the present Boolardy (Wittenoom's headquarters), Murgoo and Annean were established (Figure 3).

Sites selected for early shepherds' camps, and subsequently for homesteads, generally had two common features: one or more wells yielding plentiful water of an acceptable quality and proximity to the river plains. Most homesteads became established near some point where hardpan wash plains meet river plains, and on a slightly elevated site (such as a calcrete platform) which was more or less flood free. Wells sunk in the alluvium further out on the river plains proved brackish or saline more often than not. Thus, the first land used for pastoral development tended to be the zones around the wells, of which the shallowest (to dig by hand into 'Murchison cement' or red-brown siliceous hardpan) and most reliable were sought after. Such strategic locations for the wells allowed grazing access to both the mulga country of the sheet wash (or 'wanderrie') plains and the more saline river plains with their extensive bluebush and saltbush and more local perennial grass pastures on the clayey drainage zones and the limestone platforms. Away from the river frontages, New Forest station appears to have been established on the strength of its reputation as a water supply alone.

In this initial phase of settlement, higher country away from the rivers was virtually ignored. Flocks were shepherded and little or no infrastructure was used other than brush yards for confining animals at night and for shearing. It was not until the first decade of the twentieth century that wire fences and windmills were erected for stock control around the established pastoral settlements.

Early compilations of the boundaries of pastoral leases shown on Lands Department plans suggest that there was some contraction in the extent of areas leased after the initial major wave of occupation before about 1895. Areas of granite country with kite leaf poison, and the waterless 'bowgada' sandy plains, were two types of country subsequently avoided by



River frontage plains with productive soils and vegetation attracted the early pastoralists into the Murchison; sago bush-dominated plain of the Beringarra land system, Mileura station.

pastoral developers. However, pastoral settlement continued and was enhanced in the 1890s when gold was discovered in the Murchison and new towns and a railway link to the coast were built. By 1900 the areas held under lease had expanded greatly (although some were not occupied or developed) and incorporated all of the frontage lands to the Murchison River and its tributaries and much of the hinterland (Figure 4).

In 1890, the Wittenoom brothers are said to have sold Murgoo Station to Messrs Holmes and Maloney with 16,000 sheep. Flock sizes were generally built up rapidly, under expectations of huge carrying capacities. A description of the new shearing shed at Milly Milly in 1887, describes it as 'capable of providing accommodation for 100,000 sheep' (*The West Australian*, 16 November 1887).

The enormous seasonal variations in grazing productivity inherent in the Murchison's arid environment were well understood by some pioneer pastoralists in the light of their shepherding experience accumulated before 1900. Frank Wittenoom commented in his journal that:

'The Murchison country is so light carrying that runs were very large. It would be hard to strike the average carrying capacity as in a really good season it would carry a sheep to 2 or 3 acres, but in a bad season, 100 acres or more. The top feed is wonderful in a drought'.

Arguably, it was the recurrent predicament of seasonal failure and the needs of the early industry to maintain stock, on the same country and in the absence of alternative pastures or marketing opportunities, that initiated the degradation of vegetation and soils on the frontage plains.

Development after 1900

Between 1900 and 1930 there was a rapid expansion and development of leases. Shepherding declined as stations became more developed with paddocks and water points away from river frontage country. Wool prices were generally good. By 1918 sheep numbers in the present survey area had reached just over 800,000 and later, in 1934, peaked at about 840,000 (Figure 5).

In company with other pastoral areas south of Kimberley, the Murchison suffered a severe drought in the mid and late 1930s. This, coupled with very high initial sheep numbers, resulted in large sheep losses and extensive damage to vegetation. Burnside (1979), using information from Fyfe (1940), states that sheep numbers in pastoral areas of Western Australia fell from 5,519,000 to 3,051,000 between 1934 and 1939. In the area covered by the present survey, sheep losses were even more drastic with numbers falling from 840,000 in 1934 to about 250,000 in 1940 (Figure 5). In the Murchison-Meekatharra area, it was estimated that by 1940, 75 per cent of the saltbush (*Atriplex* spp.) and 25 per cent of the acacias had been destroyed. Losses of up to 90 per cent of scrub and shrubs were reported.

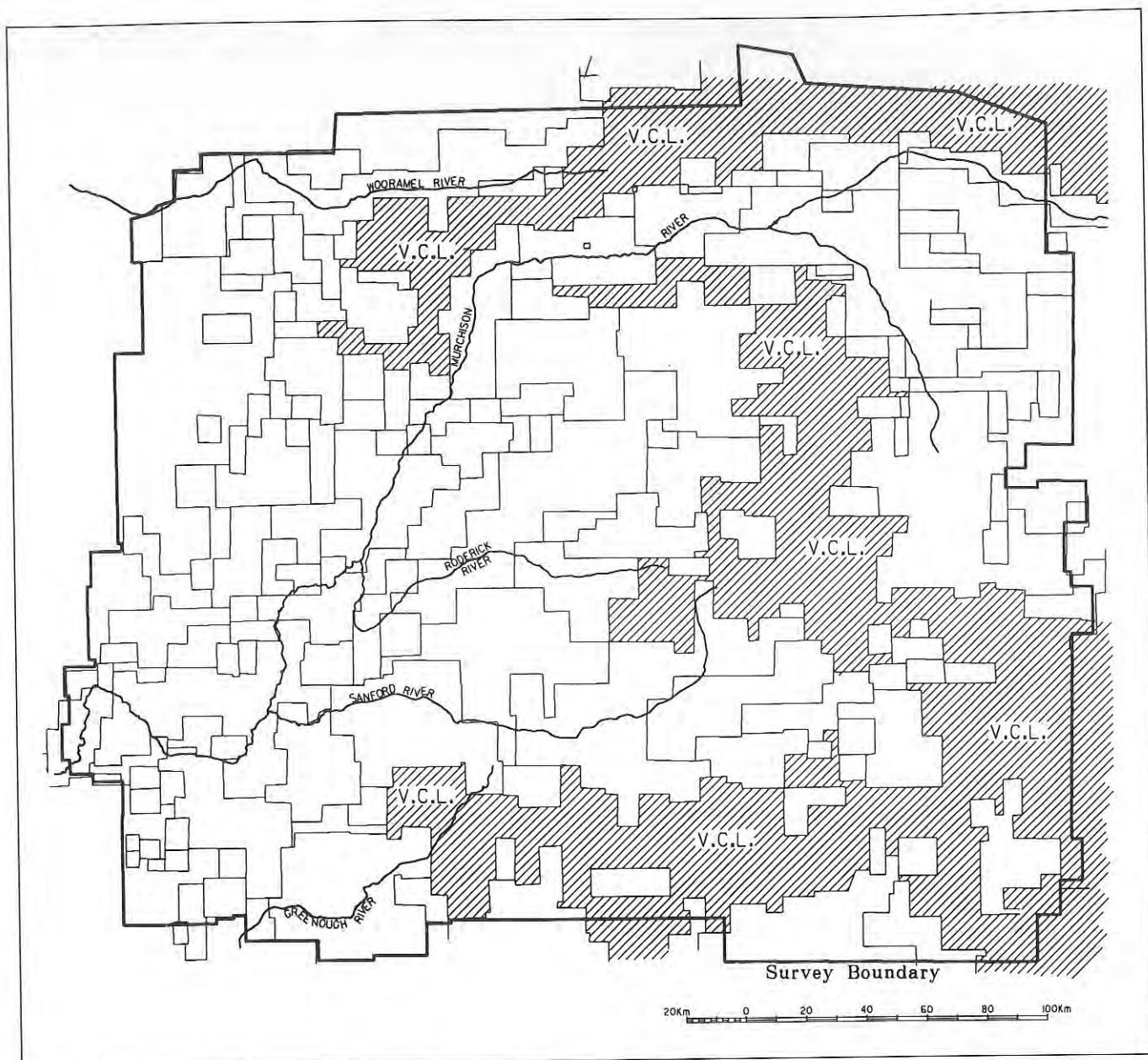


Figure 4. Pastoral leases on the Murchison River and its tributaries, 1900.

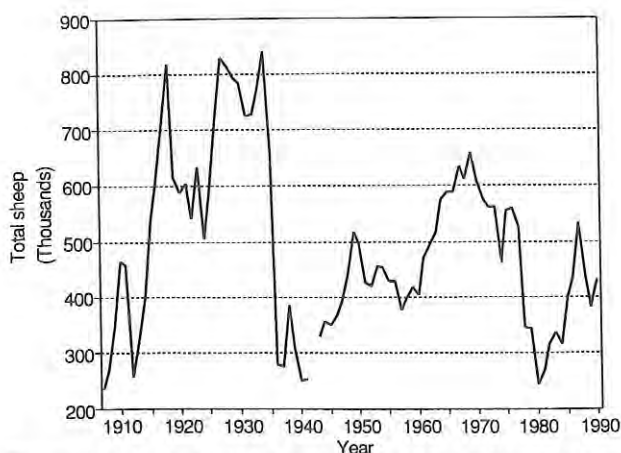


Figure 5. Sheep numbers in the Murchison rangeland survey area, 1907-1990.

Seasons during the 1950s were mediocre but better seasonal conditions in the 1960s saw partial recovery of pastures and modest recovery in sheep numbers from the drought induced low of 1940. High wool prices compensated for reduced stock numbers and pastoralists generally enjoyed a prosperous period.

In recent decades poor wool prices and the natural vagaries of climate have again posed severe difficulties for the pastoral industry. In the survey area sheep numbers fell to an all time low of about 250,000 in 1980 but by 1990 had recovered to 430,000. Figure 6 shows the location and extent of present day pastoral leases in the survey area. The total area held under lease is similar to that of 1900 but amalgamation and restructuring has resulted in fewer, generally larger, leases in 1990.

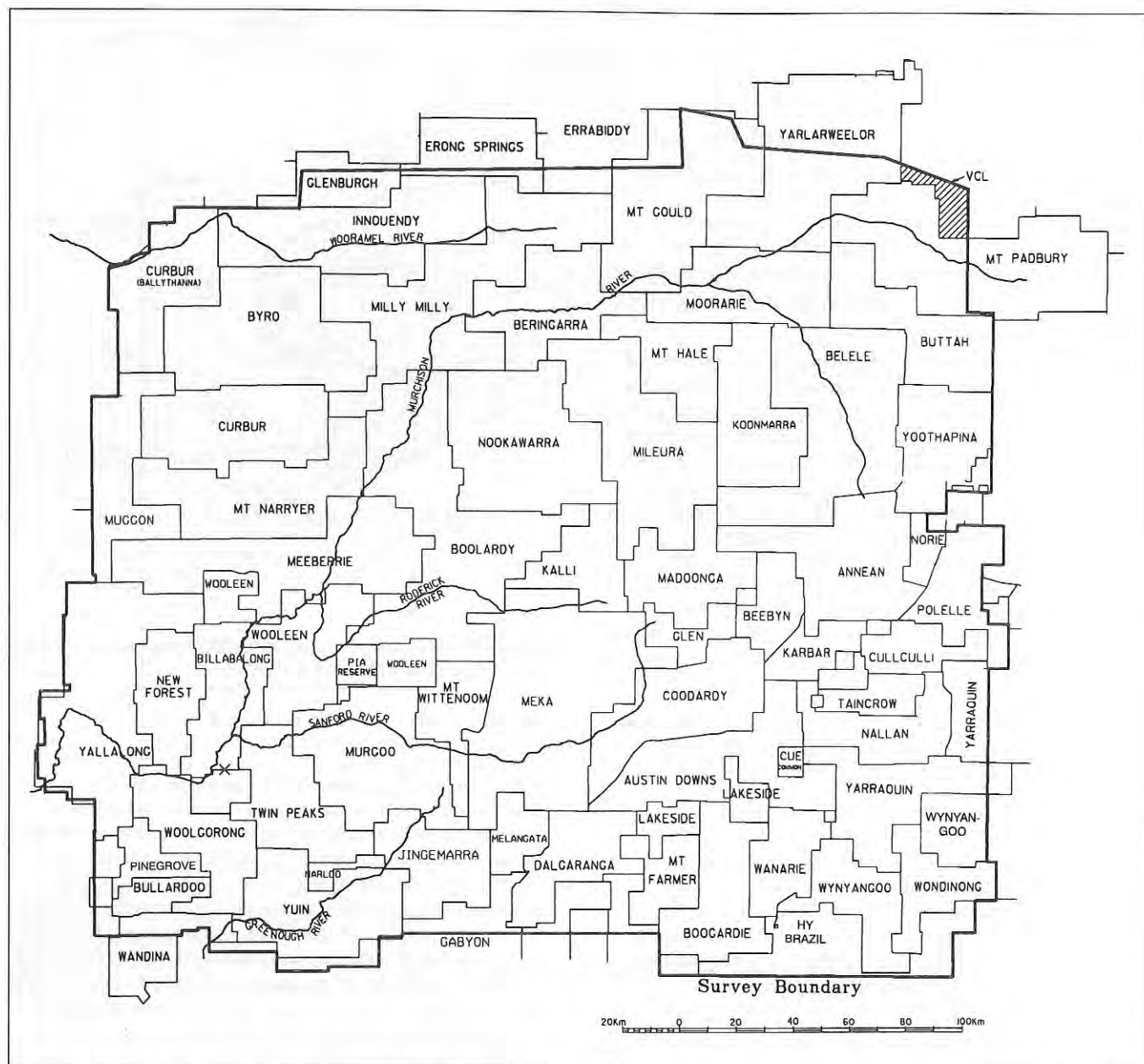


Figure 6. Pastoral leases on the Murchison River and its tributaries, 1992.

In the early days of settlement most people involved with the industry, including explorers, surveyors, pastoralists and land administrators had unrealistic expectations as to the productive capacity of the land. In an environment where there was no information on the effects of continuous grazing on native vegetation and soils the land was grazed at levels which were non sustainable.

The Murchison pastoral lands remain a valuable renewable resource but many formerly favoured parts are historically degraded and the vegetation and soils are still under heavy pressure from domestic, feral and native animals.

The challenge for today's managers is to run a viable livestock enterprise whilst at the same time ensuring that each country type is used according to its capability for sustained production. An additional aim for managers needs to be the rehabilitation of degraded areas.

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Climate

Introduction

The climate of the Murchison River catchment is described by Meigs (1953) and most subsequent authorities as being arid. Beard (1976) followed Bagnouls and Gaussen (1957) classifying the area as 'desert' with bimodal (summer and winter) rainfall trending to semi-desert mediterranean in the south-west corner.

Climatic descriptions generally classify an area as arid when it normally receives insufficient rainfall to sustain the growth of rainfed crops at any season. Because of regional variations in latitude, seasonal patterns of rainfall and evaporation deficits, aridity cannot be universally defined by the mean annual rainfall being below a certain figure. As a working delineation for the southern boundary of the arid zone of Western Australia, several authors have stressed the co-incidence between the 250 mm isohyet for mean annual rainfall and the transition between the Eremaean (arid) Botanical Province and the South-Western Botanical Province (Beard 1976, Curry and Hacker 1990).

The mean (average) annual rainfall for the region is about 210 mm, ranging from about 240 mm in the south-west to about 190 mm in the north-east.

The dominant synoptic feature of the region's climate is the sub-tropical high pressure cell, which is composed of descending air and brings fine, stable weather conditions and prevailing easterly winds when located to the south of the survey area. The high, with its associated ridge is at its northernmost during winter and is most southerly during summer, gives rise to two dominant seasons. This is accompanied by large variations of temperature and moisture availability.

Sources of climatic data

Long-term climatic information for representative recording stations in, or adjacent to, the survey area, was obtained from the Bureau of Meteorology. Eight of the stations (Cue, Mt Magnet, Meekatharra, Billabalong, Meeberrie, Byro, Mileura and Murgoo) are within the survey area and two stations (Errabiddy and Yalgoo) approximate to northern and southern limits of the area (see Figure 7). Together, the records from all these centres give a cross-section of essential climatic conditions throughout the region.

Seasonal patterns

1. Summer (November to April)

Summers are characterised by hot, dry days and mild to warm dewless nights. The summer synoptic weather pattern is dominated by a high pressure anticyclonic cell located south of Western Australia,

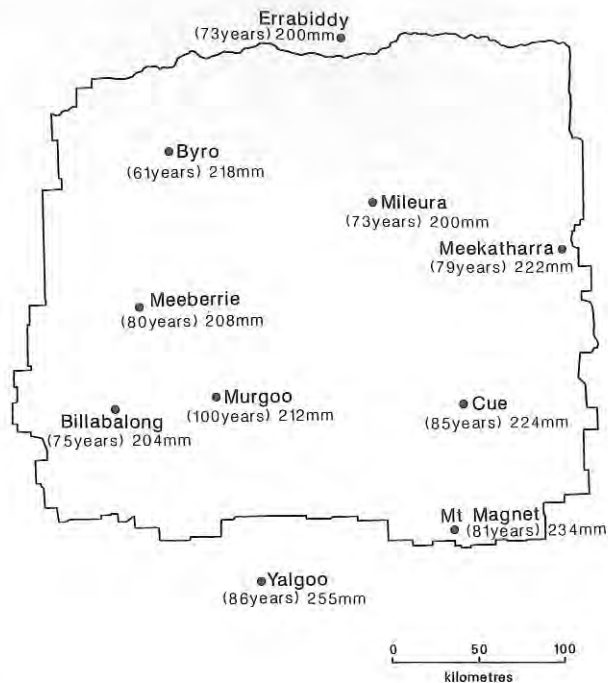


Figure 7. Recording centres (showing mean annual rainfall) for climatic data within the survey area.

which brings fine and warm conditions to the Murchison. As the anticyclones move eastward, a trough often develops along the west coast of Western Australia bringing dry north-easterly winds from central Australia (see Figure 8). Occasionally a low pressure cell is formed in the trough causing day-time temperatures east of the trough to rise sharply. After a few days the trough moves eastward and is followed by cooler north-west to south-west winds which bring a cool change across the region. The cycle of steady warming begins again as a new anticyclone moves into the Great Australian Bight. Average maximum daily temperatures range from 38°C in January, to 29°C in April. Maxima exceed 42°C at least once a year everywhere in the area. The average daily minimum temperatures range from 22°C to about 14°C (Figure 9).

An occasional influence is the development of intense low pressure disturbances off the north-west coast of Western Australia. These depressions can form tropical cyclones which often intensify near the Pilbara coast. Some cyclones run parallel to the coast, while others dissipate out to sea. Cyclones that cross the coast weaken as they move inland and become rain bearing depressions. Cyclones can occur at any time between November and April but their frequency is highest in the late summer months February and March. The intensity of rain varies from light drizzle to widespread heavy falls.

While minor localised flooding is not uncommon, major floods are few. Historical descriptions and climatic records suggest there have been about nine major floods since 1848. Before 1960 the severity of floods was not recorded but since then major flooding has occurred in 1960, 1975 and 1980.

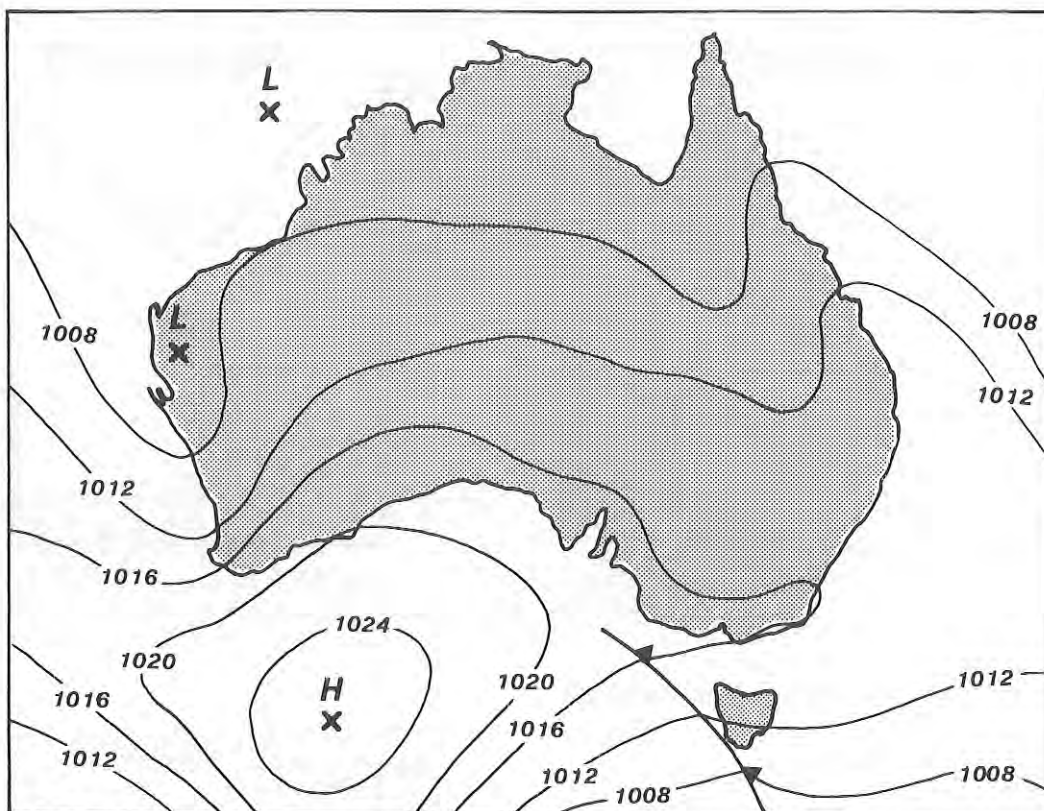
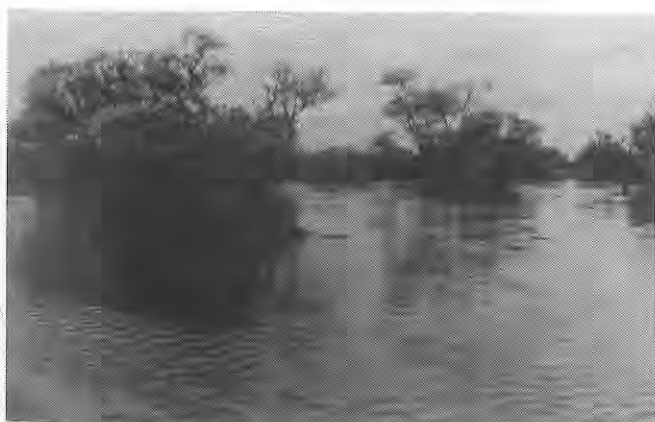


Figure 8. Surface chart depicting a typical summer synoptic pattern. The summer pattern shows anticyclonic circulation centred in the Great Australian Bight bringing north-easterly winds across the survey area to the south of the 'heat' low over the Pilbara and northern Gascoyne and extending a trough down the west coasts.

Thunderstorms resulting from convectional activity bring sharply isolated falls of highly variable intensity throughout the region. Cyclones and thunderstorms thus provide the summer rainfall which occurs in two contrasting ways, either as rare widespread major falls or common localised minor falls which may be very heavy over a small area. The average monthly rainfall varies from about 5 mm in November to about 26 mm in January and February (Figure 9), with very low reliability in any particular month (Figure 10).



Major rainfall events result in run-off and sheet flow across huge areas of 'wash' plains which flank the major river and tributary drainage systems; Belele land system, Buttah station.

Rainfall during March-April, when significant, is likewise invariably derived from incursions of tropical air and is accompanied by relatively high temperatures. For these reasons, the growth response is of the summer type rather than that derived from rainfall received from May and later during winter.

2. Winter-Spring (May to October)

Winter is characterised by mild days and cool to cold nights. The beginning of winter is often marked by increased cold frontal activity associated with low pressure cells located well to the south of Western Australia in the Southern Ocean. Rain bearing cold fronts cross the south west coast of Western Australia and usually weaken considerably before reaching the Murchison region. Only strong fronts penetrate far enough inland to bring isolated showers and occasional strong winds (see Figure 11).

Occasionally cloud bands originating from the tropics to the north-west of the State interact with fronts to provide rain over central parts of Western Australia including the survey area. The frequency of such cloud bands is highest in the months of May, June and July, while the frequency and intensity of cold fronts peak in June and July.

The average monthly rainfall for May and June is between 25 and 40 mm and is the most reliable rainfall received throughout the region. Even so, the monthly coefficients of variation only decline to about 100%, reflecting the experience that anything between zero

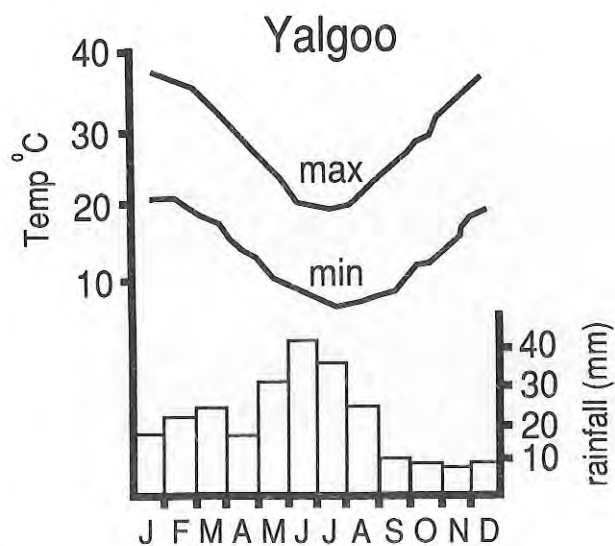
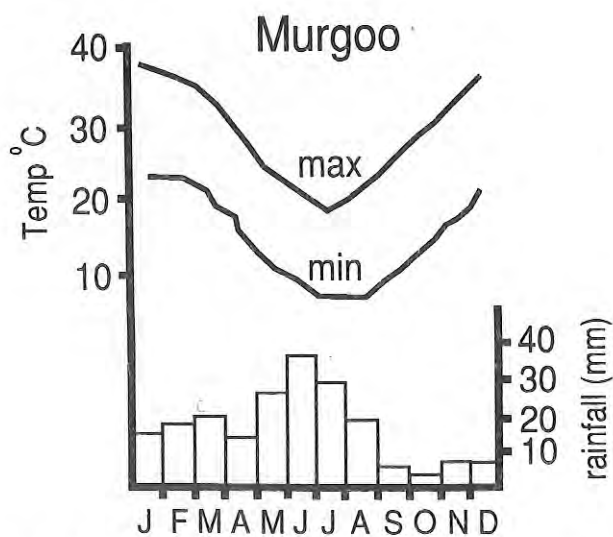
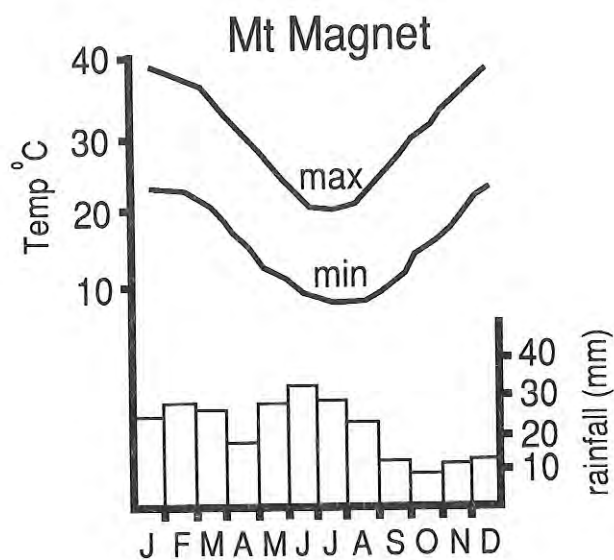
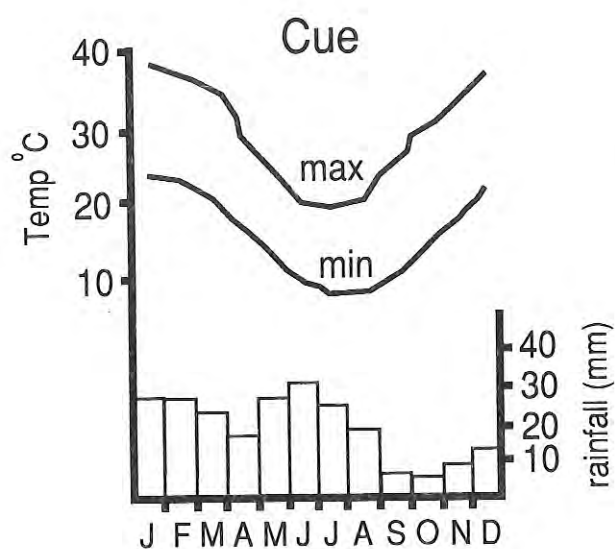
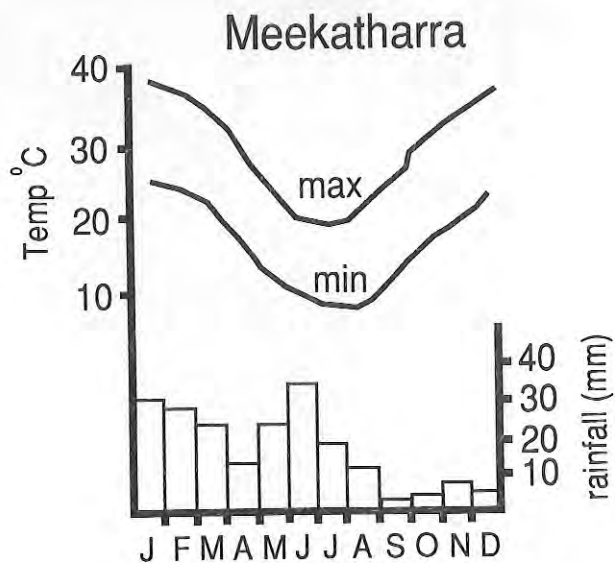
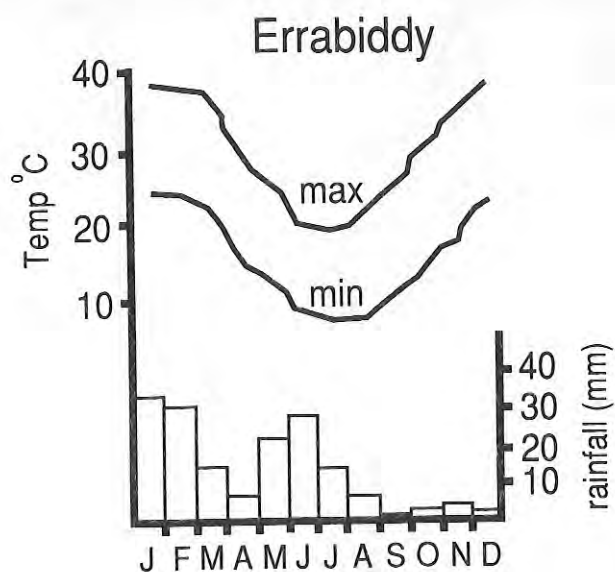


Figure 9. Mean monthly temperatures and rainfall at six centres.

Percentage coefficient of variation — monthly rainfall

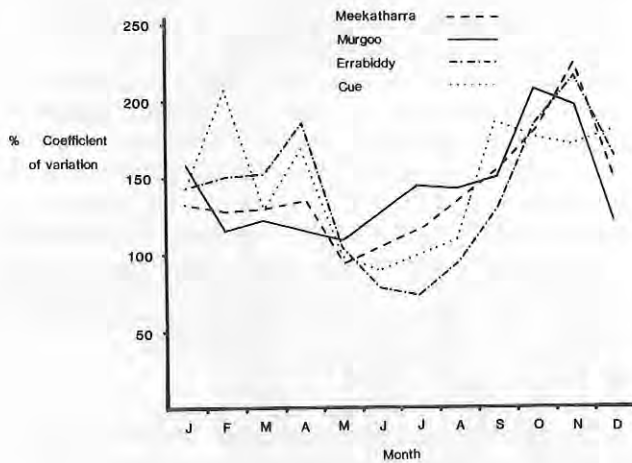


Figure 10. Annual variation in mean monthly rainfall expressed as percentage coefficient of variation.

rainfall and 50-80 mm will fall in any particular May or June in 68% of years (Figures 9 and 10). Rainfall after July decreases steadily and by October significant rain is rare and average monthly rainfall is less than 10 mm throughout.

Average daily maximum temperatures range from about 18-19°C in July rising to 28-29°C in October. Average daily minimum temperatures range from about 6°C in July to about 13°C in October (Figure 9).

Frosts occur occasionally in the mid-winter months throughout the area (Table 1). In the east, the average number of frosts during July and August is one to two, while in the central west and west the average is two to four. While the average number of frost days is low it may vary considerably between years. Mt Magnet recorded 11 frost days in July 1957, yet in 1959 in the same month no frosts were recorded.

Table 1. Frosts in Murchison region

Station	Frost days (average)		
	June	July	August
Errabiddy	0	1	0
Meekatharra	0	1	0
Cue	0	1	1
Mt Magnet	1	2	2
Murgoo	0	1	1
Yalgoo	1	4	3

Rainfall and rainfall effectiveness for plant growth

Trends across the area

The annual average rainfall for the survey area is generally lowest in the north-east and higher in the west and south. The highest mean monthly rainfall is in June throughout the region except in the north-east where the highest monthly mean rainfall is in January.

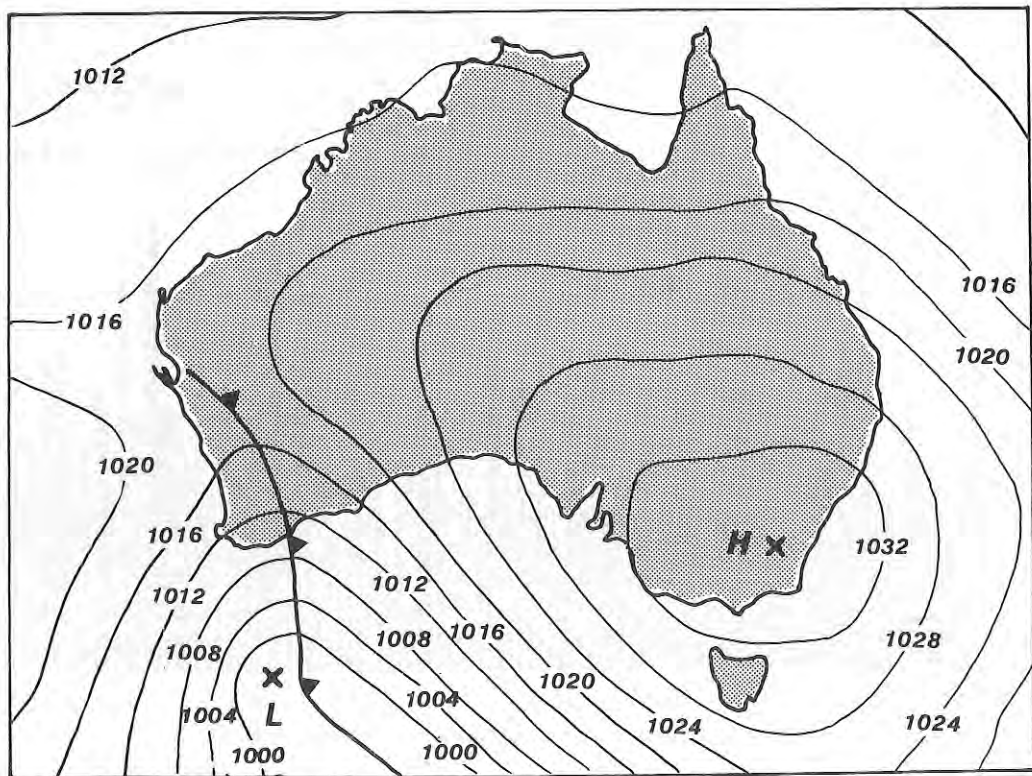


Figure 11. Surface chart depicting a typical winter synoptic pattern. The winter pattern depicts the passage of a cold front with its northern parts about to cross the survey area while an anticyclone has moved eastwards to be centred on Victoria.

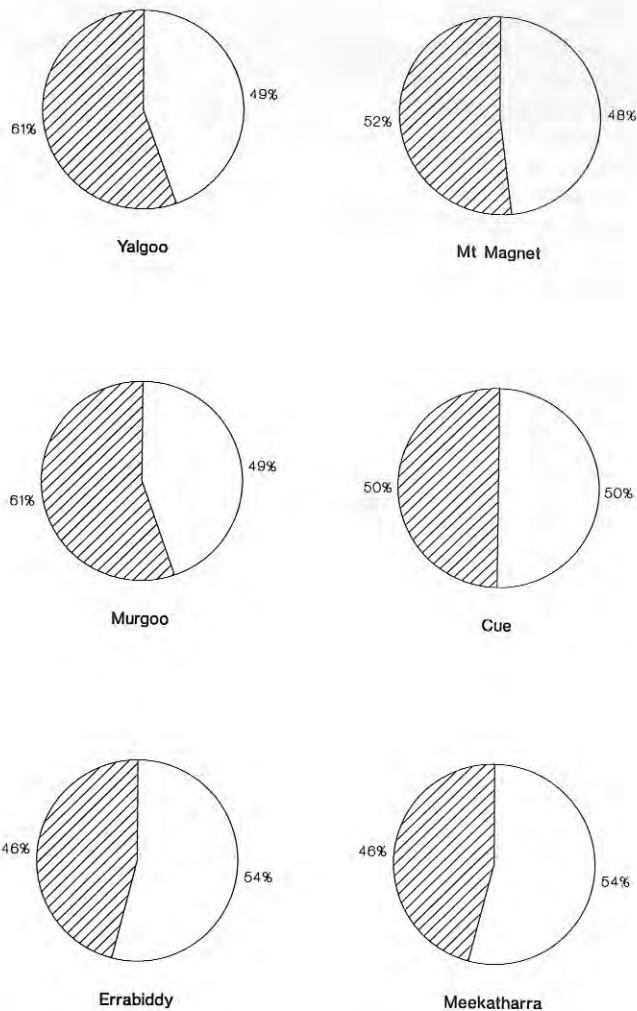


Figure 12. Proportions (%) of average winter (May-October) rainfall (shaded) to average summer (November-April) rainfall.

This difference in the peak of seasonal rainfall distribution reflects a steady geographical trend across the survey area. In the extreme south-west, winter rainfall is sufficient and regular enough to support semi-arid South Western Botanical Province vegetation, which dominates the Irwin Botanical District further west. A trend of decreasing winter rainfall and increasing summer rainfall exists from the south-west to the north-east. Winter rainfall accounts for about 46% of Errabiddy's yearly total, while at Yalgoo and Murgoo the figure is about 61%. Similarly on the eastern margin of the region less winter rain is recorded in the north than the south. At Meekatharra a mean of 46% of the annual rainfall is recorded during winter while at Cue the figure is 50% and at Mt Magnet, 52% (Figure 12).

The reliability and effectiveness of rainfall is the most critical factor in determining plant growth. The variability of rainfall expressed as coefficient of variations (Figure 11) shows rainfall is most reliable (but still highly variable) everywhere from May to July when rainfall is likely to be at it highest and least reliable from September to December when rainfall is at its lowest. Mid to late summer (January to March) shows less extreme monthly variation than early summer owing to a low peak of some rainfall expectancy from cyclones and thunderstorms, particularly at Meekatharra more than at other centres further south.

Seasonal patterns of effectiveness

Long-term rainfall trends and annual variation since the early part of this century are shown in Figures 13-15 for Meekatharra, Mt Magnet and Meeberrie. The bars represent annual rainfall and the line is a seven year moving average.

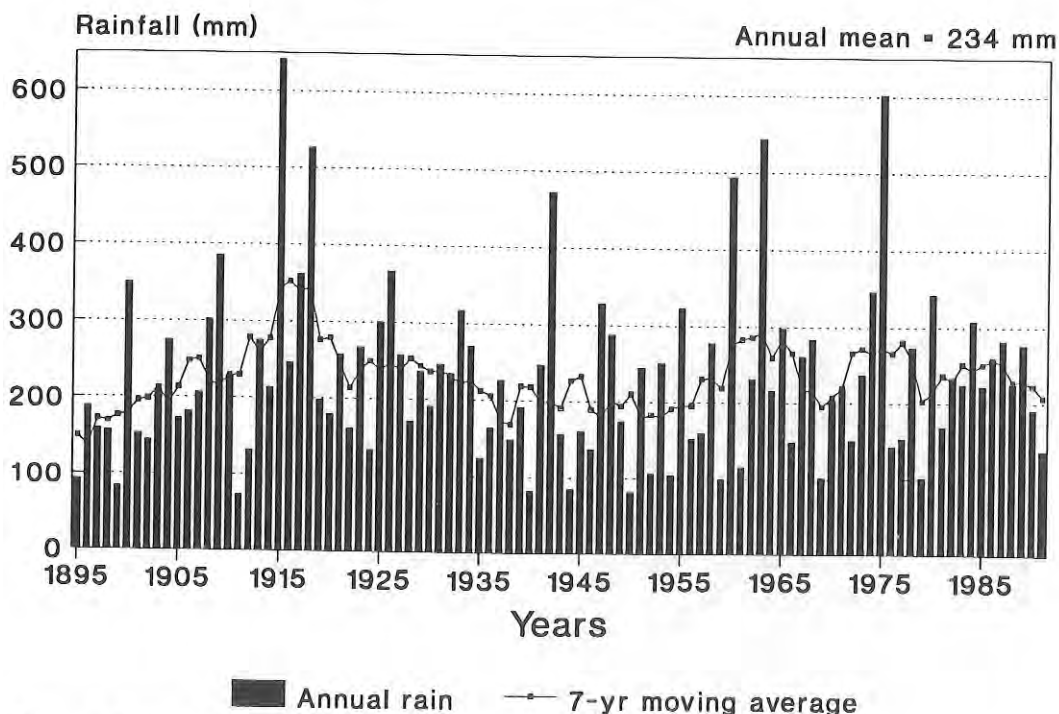


Figure 13. Meekatharra rainfall 1913 to 1991.

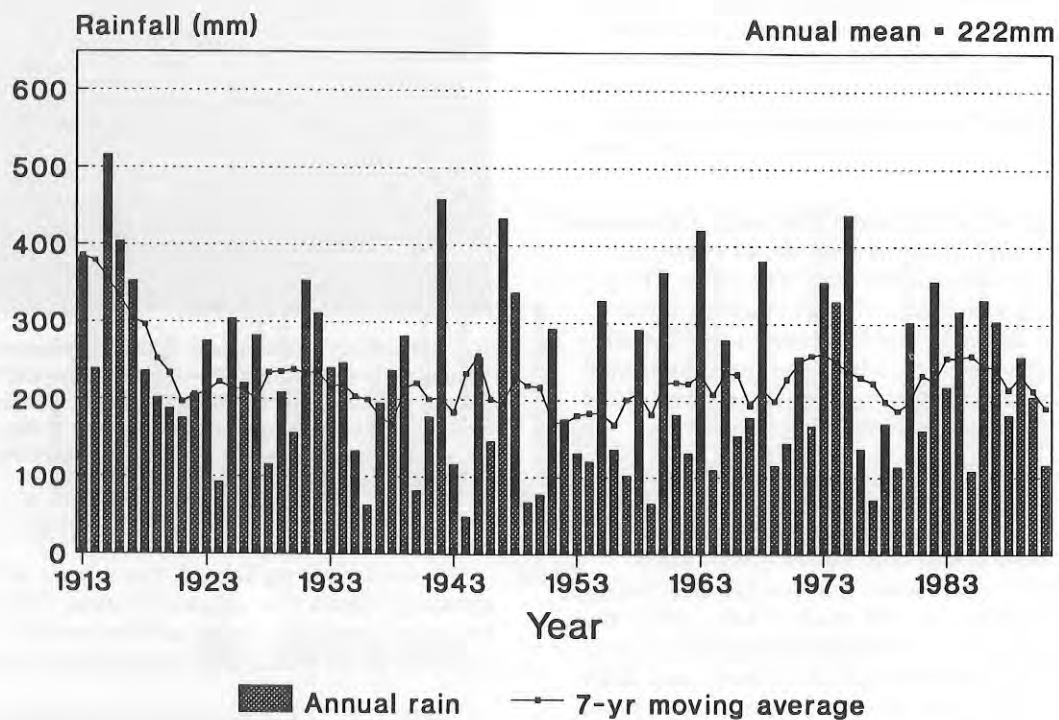


Figure 14. Mt Magnet rainfall 1895 to 1991.

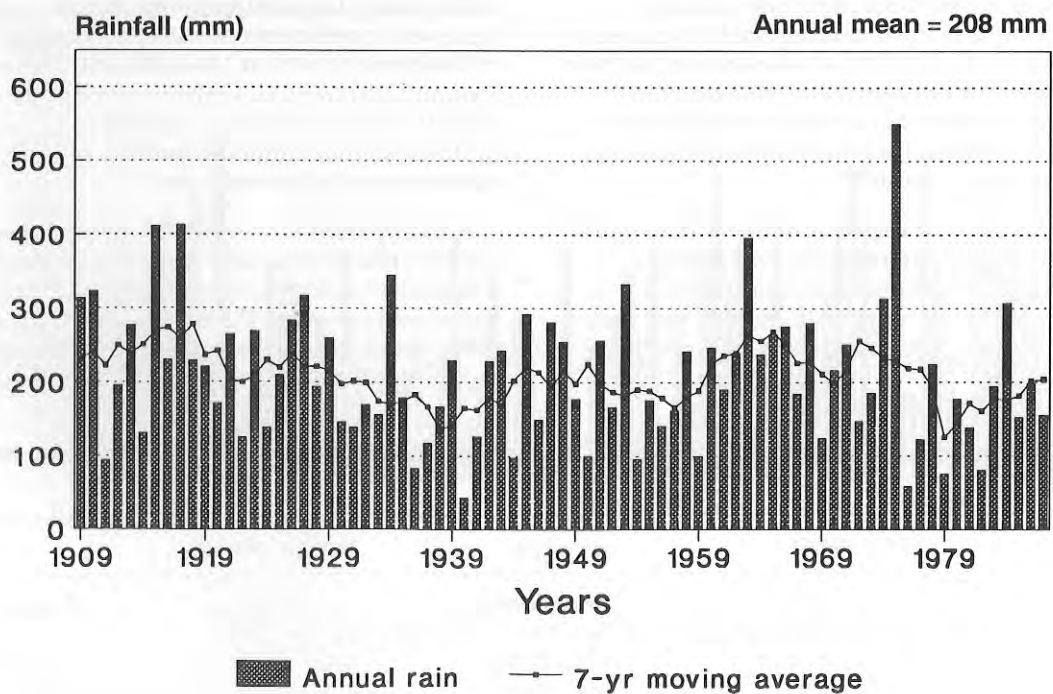


Figure 15. Meeberrie rainfall 1909 to 1987.

Several features are apparent from these long-term annual rainfall totals. Firstly, there has been no significant overall trend in rainfall during the century. The apparent decline in Murchison rainfall since the early 1970s is reflected by a similar general decline over south-western Western Australia. There is also little convincing evidence of regular cycles of annual rainfall, although some well-marked cycles, in the incidence of total annual rainfall have occurred over the years.

The most significant feature is the large inter-annual variation of rainfall. Years of well above average rainfall are often followed by very dry years. The coefficient of variation of annual rainfall for these stations ranges from 44% at Meeberrie to 48% at Mt Magnet and Meekatharra, which implies that annual rainfall at Meeberrie will total a figure within 44% of the long-term average in only 68% of years.

Rainfall and the subsequent availability of soil moisture is the dominating environmental factor determining and limiting plant growth in arid Australia. Arnold (1963) and Wilcox (1972) were among the first to emphasise that rainfall effectiveness arising from combinations of discrete falls, rather than average or total annual rainfall, is the key consideration in determining plant growth and other major ecosystem responses, and the productive basis of a grazing industry dependent on the ecosystem.

To estimate frequency and duration of periods of growth from rainfall records and other known meteorological data, a computer model for predicting soil moisture availability was developed for arid to semi-arid mulga country by Fitzpatrick *et al.* (1967). The model (ARWATBAL) was developed from field observations of soil moisture storage and requires daily rainfall data as its only input variable once the other parameters are set for a particular location. ARWATBAL compares the incoming rainfall against a proportion of the rate of potential evaporation likely at the particular time of the year taking into account some initial water loss from run-off. The balance of moisture stored in the soil is potentially available for plant maintenance and growth.

A growth period in the region is defined as 30 days or more of continuous soil moisture availability, initially requiring over 15 mm of rainfall. Table 2 shows the average length of growth periods and their standard deviations along with the average starting date of a season.



Rainfall sufficient to stimulate significant plant growth falls most frequently in early winter. Perennial shrubs and trees grow new foliage relatively quickly after the event, with ephemeral forbs and 'wildflowers' requiring time to germinate, establish and grow; perennial grasses are inhibited by low temperatures and respond later as temperatures rise.

It is evident from Table 2 that winter is the major growing season throughout the area. This is because lower evaporation during winter permits rainfall to promote plant growth for longer than during summer.

Payne *et al.* (1975) suggests that because growth rates are higher under the warm to hot summer temperatures, a period greater than only 20 consecutive days of available soil moisture constitutes a significant summer growing season.

The length of winter growth periods as estimated by the model is shown in Figures 16-18 for Meekatharra, Mt Magnet and Meeberrie. In common with annual rainfall plotted in Figures 13-15 there is no evidence of regular cycles of seasonal length, nor of a significant trend during the century. Inter-annual variability is high, with coefficients of variation ranging from 47% at Meeberrie to 69% at Meekatharra. This follows the geographical trend described earlier of more winter rainfall, which is also less variable in occurrence, in the south-west, to a higher proportion of more erratic summer rain in the north-east.

Also apparent is the episodic nature of seasonal growth. This is especially apparent at Meeberrie where a sequence of dry years in the 1930s contrasts with above average years during the late 1940s and early 1960s. Similar events are discernible, though less pronounced, at Mt Magnet and Meekatharra, with the

Table 2. Average starting dates and length of growth periods predicted by ARWATBAL analysis of long-term records

Station	Winter season		Summer season	
	Start	Average length	Start	Average length
Byro	June 5 ± 26 days	51 ± 27 days	Feb. 17 ± 21 days	19 ± 27 days
Mileura	June 7 ± 33 days	43 ± 28 days	Feb. 10 ± 24 days	15 ± 16 days
Billabalong	May 28 ± 30 days	69 ± 32 days	Feb. 11 ± 27 days	15 ± 21 days
Mt Magnet	May 33 ± 26 days	62 ± 32 days	Feb. 12 ± 25 days	9 ± 11 days
Meekatharra	May 28 ± 33 days	39 ± 27 days	Feb. 12 ± 26 days	10 ± 10 days

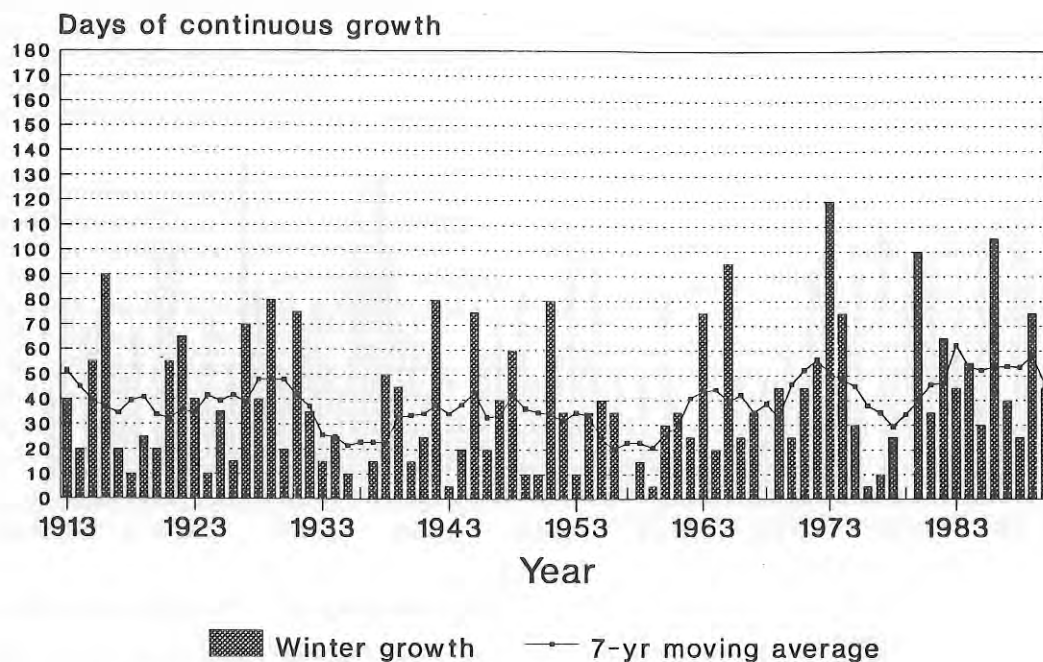


Figure 16. Meekatharra winter season growth periods 1913-1991.

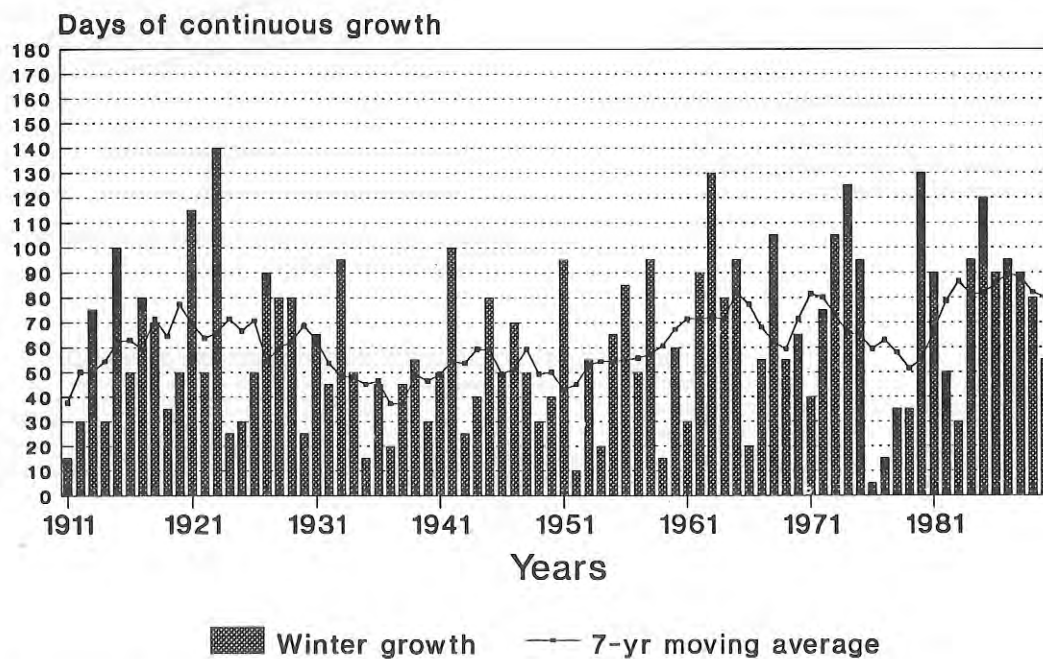


Figure 17. Mt Magnet winter season growth periods 1913-1991.

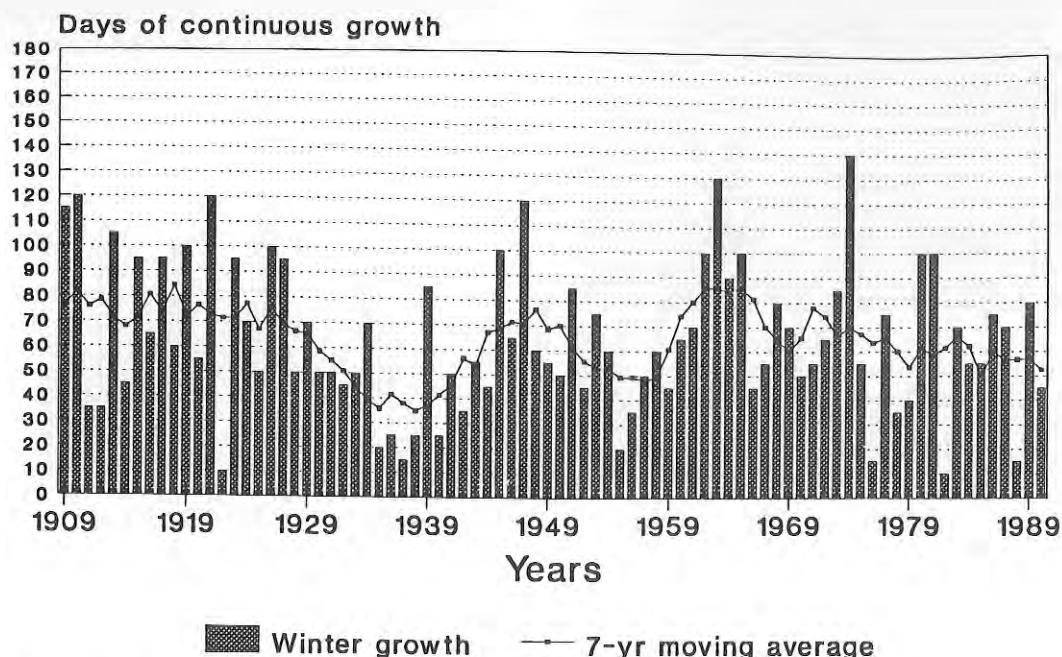


Figure 18. Meeberrie winter season growth periods 1909-1991.

addition of a string of above average years in the early 1980s. The recurrent nature of one or more very dry years has been a feature throughout the century.

Long-term seasonal expectations of soil moisture can be summarised in terms of probabilities (Figure 19). The usefulness of this approach is shown by Figure 20 where the predicted number of days of continuous winter growth is plotted against its probability at Meekatharra, Mt Magnet and Meeberrie. Figure 21 shows the predicted number of days of continuous summer growth plotted against its probability at the same three centres.

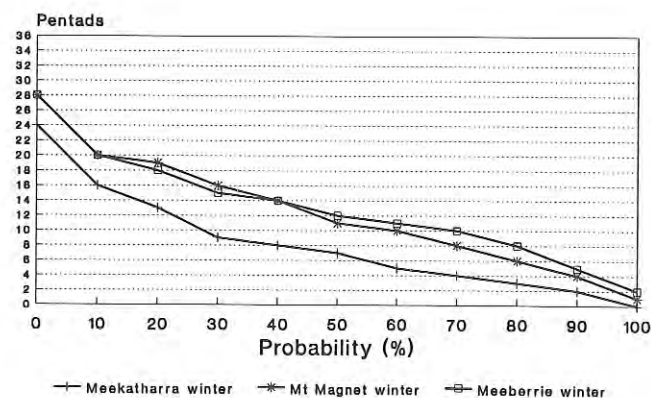


Figure 20. Winter growth probabilities at Meekatharra, Mt Magnet and Meeberrie.

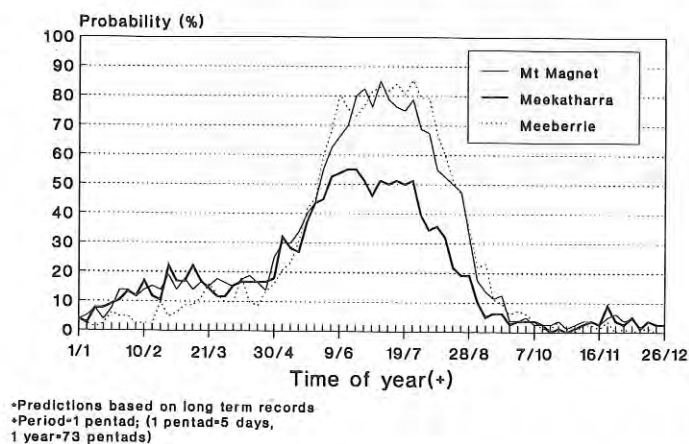


Figure 19. Probability of soil moisture availability during the year at Meekatharra, Mt Magnet and Meeberrie.

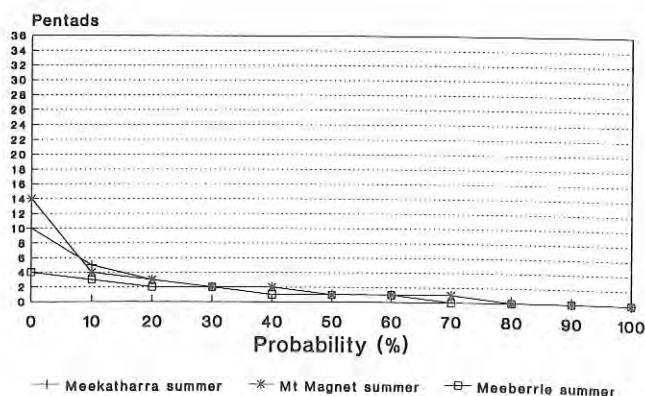


Figure 21. Summer growth probabilities at Meekatharra, Mt Magnet and Meeberrie.

For all three centres, the chances of having growth rise steeply during May, coinciding with the onset of winter rains, and fall rapidly during September as frontal activity declines. There is little likelihood of spring or early summer rains. The occurrence of effective summer rain increases during late summer (autumn) but remains at less than a 20% chance. Billabalong experiences even less effective summer rain.

At Meekatharra there is a 50% chance of having a winter season of more than 35 days, while at Mt Magnet 50% of years will have a winter season of more than 55 days. It can be seen as a further example that there is a 55% chance of having an effective winter season (more than 30 days) at Meekatharra (and therefore a 45% chance of having a failed season). In contrast, Mt Magnet has an 80% chance of having an effective winter season and a 20% chance (one year in five) of having a seasonal failure.

These probabilities are summarised for winter and summer seasons in Table 3.

Management implications for pastoralists

Table 3 has critical implications for pastoral land managers who have to make appropriate decisions with regard to both animal husbandry and land management. For example, because the highest nutritional requirements of grazing animals occurs during late pregnancy and lactation, to achieve maximum lambing percentages the lamb drop should coincide with the time of the year in which new growth is most likely to be available. In the Murchison that time would be during the month of July. This is vital, particularly where the perennial forage available to the animals is not in good condition. If no significant rain has fallen by late July it is highly unlikely to occur (less than 5% probability) during that winter. August and September will require decisions on selling excess stock, and where to retain stock over the next summer on existing forage reserves, whenever a failure of the expected winter season has occurred.

On the other hand, general pasture growth from summer rainfall can be considered an unusual bonus rather than something to rely on in a grazing management strategy appropriate to anywhere in the survey. In the majority of years, short-lived periods of soil moisture available during summer will stimulate foliage growth of perennial shrubs and grasses to some degree, plus some germination of seedlings, but the total effect is much less than that of a general growth period.

Foley (1957) summarised droughts in Australia from the earliest years of settlement to 1955. Comparing annual rainfall to yearly averages, assessments were made of dry times, although early pioneers initial understanding of arid zone conditions may have been limited and therefore assessments of early droughts should be treated with caution. However, with settlement, more extensive records were maintained and drought years for the Murchison region where the most significant in 1935-41, 1943-45, 1976-80, with extended dry spells occurring around 1967 and 1982.

Dry times are relatively common in the area, so land managers need to be aware of the statistics of their incidence and be prepared to plan and practice station management according to prevailing seasons and probabilities. Retaining high stock numbers during dry times has often led to a decline in the resource base affecting future productivity. However, management decisions such as selling off and culling to maintain a high quality nucleus flock structure will maintain or improve animal productivity and preserve the productivity of the rangelands.

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Table 3. Growing season probabilities, Murchison region

Probability (%) of exceeding growing seasons of durations indicated	Winter			Summer		
	Billabalong	Mt Magnet	Meekatharra	Billabalong	Mt Magnet	Meekatharra
Growing season duration (in days)						
100	10	5	5	0	0	0
90	25	20	10	0	0	0
80	40	30	15	0	0	0
70	50	40	20	5	5	5
60	55	50	25	5	5	5
50	60	55	35	5	5	5
40	70	70	40	10	10	10
30	75	80	45	10	10	10
20	90	90	65	15	15	15
10	100	100	80	20	20	25
0	140	140	120	70	70	50

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Geology and hydrogeology

A. Laws

Introduction

This section of the report outlines the geology and hydrogeology of the area. Its purpose is to provide a description of the origin and nature of groundwater resources within the survey area, and a practical guide to where they may be located, their salinity, and general guidelines on how they may be developed. For assistance on the siting of bores or any particular supply, pastoralists and other land users should contact the Director, Geological Survey of Western Australia, Department of Minerals and Energy.

The pastoral industry is one of the major users of groundwater in the area. Because there is a regional water-table, and over more than 60% of the total area the water-table is less than 15 m below ground level, more than 2000 bores and wells have been constructed throughout the area. However, the distribution of stock bores and wells does not reflect solely the availability of groundwater, but also the different pastoral value of the land for stock, and its carrying capacity.

Consequently bores and wells tend to be more concentrated on areas of alluvium rather than in the thinner, topographically higher, colluvial soils, or in areas of bedrock outcrop.

Previous investigations

Detailed comments on previous geological investigations are given in the relevant 1:250,000 Explanatory Notes (Belele-Elias 1982, Byro-Williams I.R. *et al.* 1983, Cue-De La Hunty 1973, Watkins *et al.* 1987, Glenburgh-Williams S.J. *et al.* 1983, Glengarry-Elias *et al.* 1982, Kirkalocka-Baxter *et al.* 1983, Murgoo-Baxter 1974, Robinson Range-Elias *et al.* 1980, Sandstone-Tingey 1985, and Yalgoo-Muhling *et al.* 1977). In 1990 a major report on the geological evolution and mineralisation of the Murchison Province was published (Watkins and Hickman 1990), whilst the adjoining Western Gneiss Terrane was mapped in detail by Gee *et al.* (1981, 1986) and Myers (1988). Summaries of the geology can be obtained from Memoir 3 (Geological Survey of Western Australia 1990).

Apart from brief early reports on water supplies for mines and batteries in the area (Maitland 1908, Clarke 1916, and Ellis 1936a, 1936b, and 1953) and later reports that concentrated on groundwater in the calcrete drainages (Sanders 1969a, 1969b, 1971, 1973a, 1973b) regional reports on groundwater are limited to Berliat (1957); Morgan (1965); and Baxter (1972).

Broadscale regional assessments were made of the groundwater resources of this and surrounding areas as part of the 1975 Review of Australia's Water

Resources (Department of National Resources 1976), the Water 2000 Study (Department of Resources and Energy 1983) and the 1985 Review of Australia's Water Resources (Department of Primary Industries and Energy 1987).

Most other reports on groundwater in the area are unpublished reports covering work carried out to locate water supplies for individual pastoral leases, the Main Roads Department, and town water supplies, operated by the Water Authority of Western Australia. Other unpublished reports review the water supplies for the towns of Mt Magnet, Cue, and Meekatharra.

Physiography

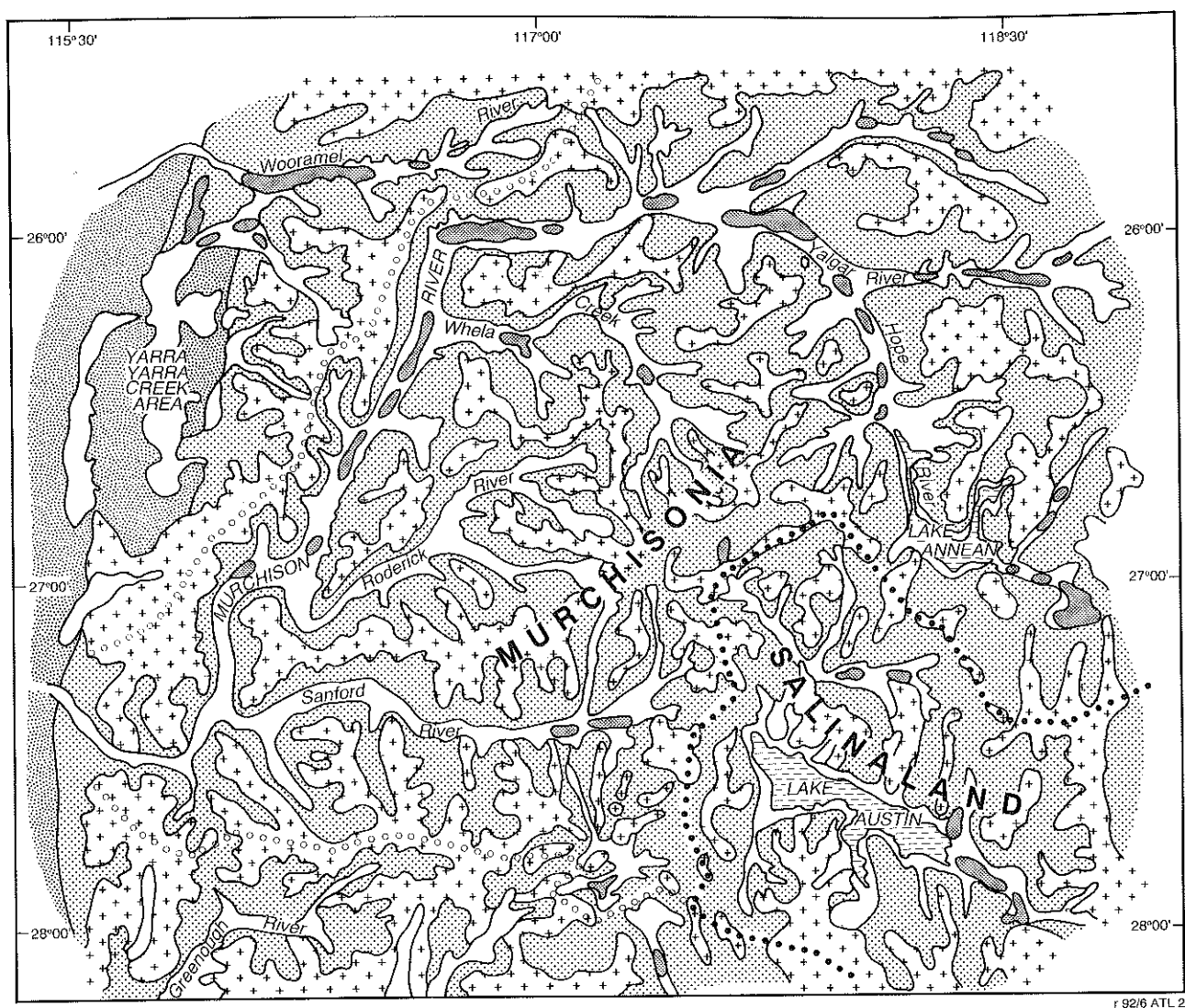
The Upper Murchison River Catchment is part of the drainage basin of the Murchison River, and is situated in the Yilgarn Craton (previously termed the Yilgarn Block) of Western Australia.

The major physiographic features are shown in Figure 22. Most of the drainage in the area covered by this report, falls within the south-east corner of Jutson's (1950) Murchisonia, and drains towards the Indian Ocean. A small, south-eastern part of the area, is in Salinaland, which drains inland into salt lakes, such as Lake Austin.

Within the area of Murchisonia there is a marked difference between the topography formed from bedrock of Phanerozoic and Archaean age. Phanerozoic sedimentary rocks occur in the north-west of the area, and topographically the area is generally monotonous and flat. There are scattered low hills and a few isolated mesas of duricrust, which are more or less overlain and surrounded by sand plains. Dunes and playas occupy a broad palaeodrainage in the Yarra Yarra Creek area (Figure 22). In general, areas of high and low relief are related to structural features within the Phanerozoic bedrock.

The Archaean terrain is characterised by very shallow alluvial 'valleys' which, to an observer on the ground are so broad and so gently inclined as to appear to be flat plains between distant hills. The hill ranges are often flanked by stony pediments which shed run-off onto very broad sheetwash plains. Above the pediments are low rocky hills of bedrock, or breakaways over deeply weathered, duricrust-capped bedrock, which lie on the interfluvies or at the heads of the main drainage lines. The duricrust remnants are all that remain of a once continuous Early Tertiary lateritic surface, which has become eroded during Quaternary times.

The topography over the areas of outcrop varies according to the rock type. The granitoids typically form large monoliths and extensive uplands of flat pavements, whilst basalt generally produces rugged, rounded hills. Prominent strike ridges are formed from outcropping iron formation and metaperidotite, while felsic volcanics tend to produce gently undulating plains.



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







- | | |
|---|---|
|  Sheet calcrete |  Rock outcrops and fringing scree slopes |
|  Main drainage and associated flood plains |  Colluvial and alluvial sheet wash piedmont plains |
|  Saline lakes |  Sand plain |
|  Drainage basin boundary |  Physiographic division |

Figure 22. Physiographic provinces and units in the survey area.

The south-east part of the study area falls within Jutson's Salinaland, and is dominated by a generally flat to gently undulating topography, with sandy surfaced Quaternary plains. Drainage is to the south-east into saline lakes. The physiography of the eastern part of the area, and land further to the east is described in Mabbutt (1963).

Drainage

More than 80% of the drainage in the area is exorheic, draining to the west into the Murchison, Wooramel, and Greenough River catchments, and subsequently to the Indian Ocean. The remainder of the area has an endorheic drainage system to inland salt lake systems.

All drainages are ephemeral. The Murchison River is very intermittent, but may flow for long periods after heavy rainfall. Generally the major drainages have broad flood plains, some of which have been discontinuously incised by narrow channels.

In the western part of the study area, the bed of the Murchison River follows a more deeply incised sinuous course and is probably a fault-controlled subsequent stream along this stretch. Williams I.R. *et al.* (1983) noted the unusual junction of the Roderick and Murchison Rivers and relate this to a fault-controlled dam near the junction of the rivers, which has been subsequently breached. The west-flowing tributaries of the Murchison River and the upper part of the river itself are consequent streams.

Elongate and dissected sheets of valley calcrete occupy parts of the trunk drainages (Figure 22), and some are 1 to 2 m or more above the present ground level, indicating that there has been widespread erosion of the calcrete since its formation. Further to the east the trunk drainages of the Yalgar and Hope Rivers follow probable palaeodrainage lines developed on the duricrust during the early Tertiary (Elias 1982).

To the south-east the palaeodrainage system is represented by saline drainages and salt lakes, with gypsiferous mud flats and small parabolic banks of calcareous and gypsiferous sands, surrounded by sand sheets, salt flats, and sheets of calcrete.

Regional geology

General features

For the purpose of this report the geology has been summarised and simplified, on the basis of its hydrogeological significance (Figure 23).

Most of the area falls within the Murchison Province, which is the westernmost of three granite-greenstone terranes in the Archaean Yilgarn Craton

(Watkins 1990, Watkins and Hickman 1990). To the north, north-west, and west the Murchison Province is in tectonic contact with the Narryer Gneiss Complex of the Western Gneiss Terrane (Myers 1990), whilst to the north-east the granite-greenstone rocks are overlain unconformably by sediments of the Nabberu Basin. In the north-west sediments of the Carnarvon Basin occur (Figure 23). The generalised stratigraphy is summarised in Table 4, and the geology and structure in Figure 24.

Stratigraphy and structure

The area underlain by the Murchison Province consists of a series of greenstone sequences and suites of granitoids. To the north and north-west these abut the Narryer Gneiss Complex, which consists of two groups of gneisses. In the north-east and west, these rocks are overlain by Proterozoic sedimentary rocks, and further to the west are unconformably overlain by Permian sediments.

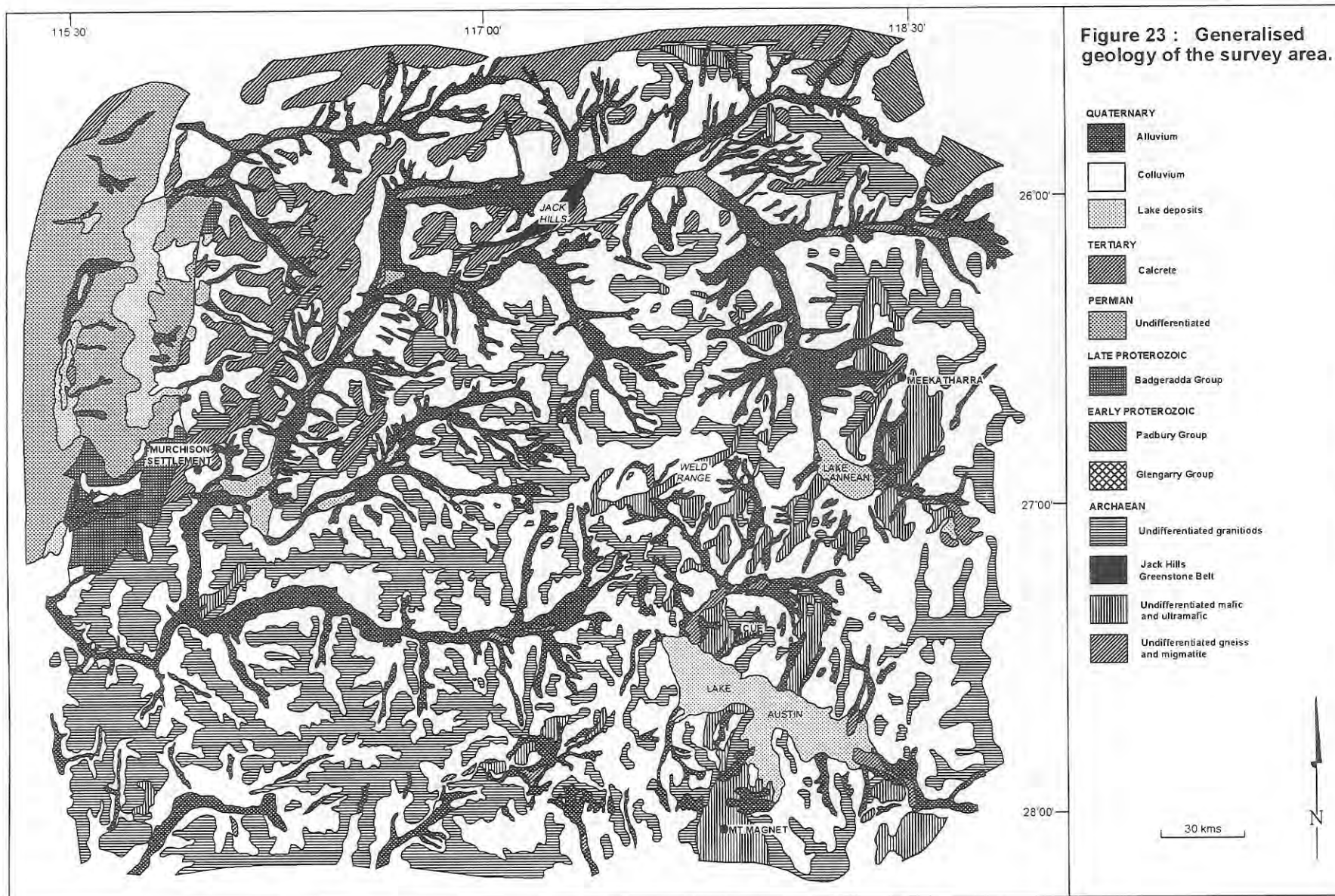
The greenstone belts trend NNW to NNE, and are surrounded by the more extensive granitoid intrusions. They are shown on Figure 23 as undifferentiated mafic and ultramafic rocks, consisting of basalt, amphibolite, gabbro and dolerite. They have been deformed by large scale folding and are dissected by faults. Most of the belts occur in the east and south-east of the study area.

The granitoid rocks show variable composition and texture, and include biotite granite, muscovite granite, tonalite, adamellite, granodiorite, and granophyre. They intrude the greenstone belts and are widespread in the western and central part of the area.

The Narryer Gneiss Complex consist of migmatite, gneiss, schist, and quartzite of Archaean age, and have been derived mainly from granite and, to a lesser extent, metasediments, dykes, sills, and layered intrusions. On the southern boundary of the complex, between the Whela and Murchison Rivers, schist and metasediment of the Jack Hills Group crop out as a prominent linear range.

Lower Proterozoic sediments of the Glengarry Sub-basin of the Nabberu Basin occur in the north-east where they unconformably overlie the Archaean basement, whilst Late Proterozoic sediments of the Badgerrada Group occur as a small intracratonic basin in the western part of the area, overlying Archaean basement, and abutting Permian sediments of the Carnarvon Basin.

The Permian sediments of the Carnarvon Basin consist of a series of sandstone, conglomerate, siltstone, claystone, and carbonaceous shale, and some glacial erratics. The sediments rest unconformably on the Archaean bedrock in a down-faulted synclinal zone known as the Byro Sub-basin.



Cainozoic deposits of Tertiary and Quaternary age overlie much of the area. In Figure 23 the deposits have been simplified and grouped together. These deposits have formed in valley, hill slope, hilltop, and breakaway environments.

Within the valley environment deposits of Tertiary calcrete have been formed by deposition of calcium and magnesium carbonates in solution from water in the lower reaches of the catchments. The margins of the calcrete interfinger with, and are often overlain by alluvium. The Quaternary alluvium is predominantly a fine to coarse grained quartz sand with layers and lenses of silt, conglomerate and clay. Although not differentiated in Figure 23, sand, derived from river alluvium and erosion of older rocks, forms drifts within some of the valleys. Saline alluvium and gypsiferous sands and clays form large claypans and

playas, particularly within the main palaeodrainage systems.

Colluvial and alluvial debris have been grouped together as slope wash deposits in Figure 23. The sediments are erosional products of the bedrock and lateritised duricrust, and grade downslope from scree slopes to broad, gently sloping sheetwash plains. They consist of poorly sorted sand, silt, and rock fragments, and are often ferruginised and partly consolidated to form red-brown hardpan.

Although not shown in Figure 23, laterite and silcrete are often developed as a capping to the weathered profile of bedrock in the area, and are sometimes preserved as mesas and breakaways along the major drainage divides. In many parts of the area they are overlain by sheets of sand.

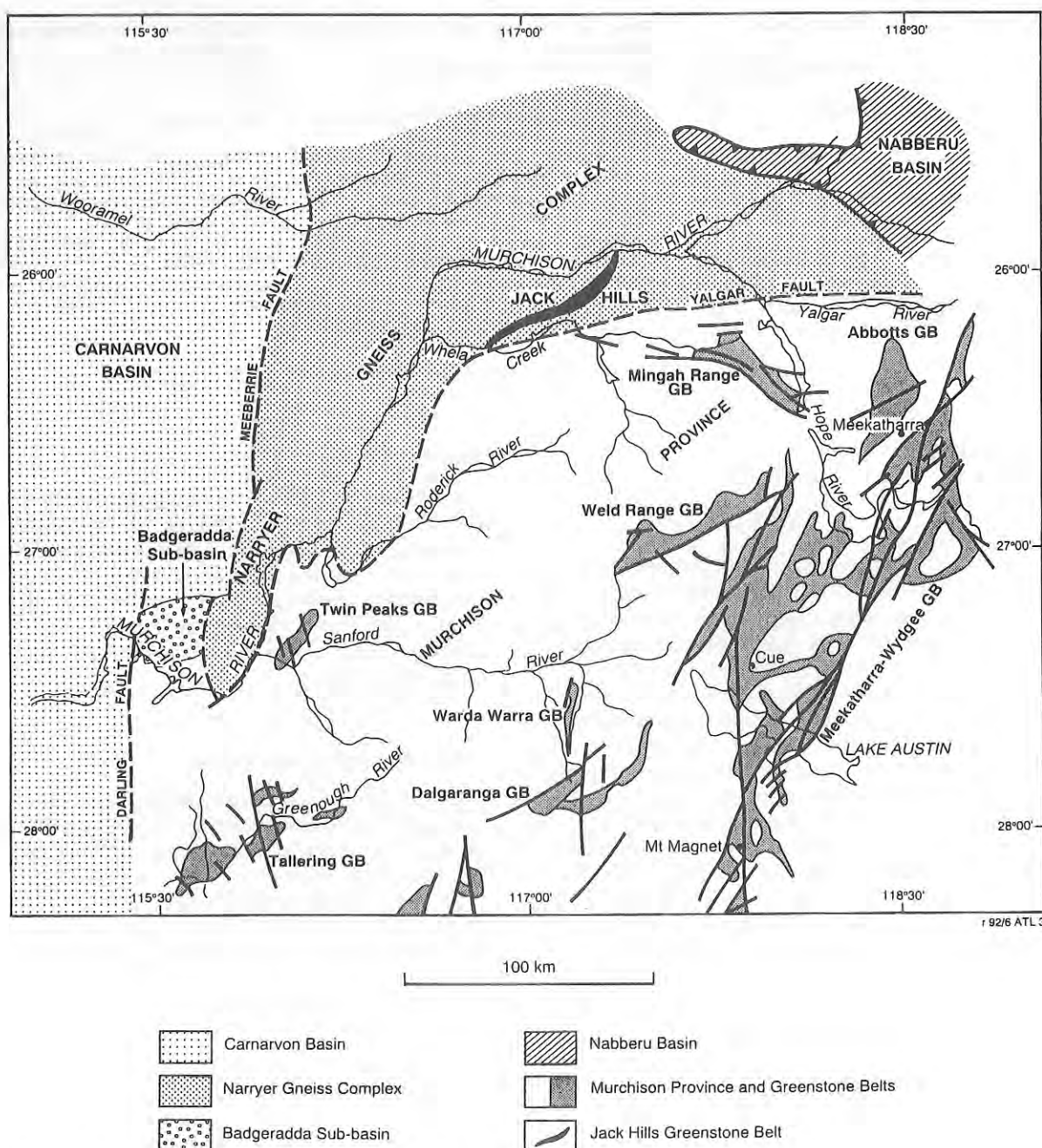


Figure 24. Structural geology of the survey area.

Table 4. Generalised stratigraphy

Age	Name	Lithology	Distribution
Quaternary	Alluvium	Fine to coarse-grained quartz sand, with patches of clay, silt, and conglomerate	Creek beds, and major drainage lines.
	Colluvium	Rock fragments, sand and silt	Scree slopes to outwash plains and flats along rivers.
	Lake deposits	Clay, silt and grit, some saline to gypsiferous; eolian sand banks	Salt lakes and clay pans, with marginal sand banks.
Tertiary	Calcrete	Sheet calcrete	Around lakes and in major drainages.
	Laterite*	Massive and pisolitic duricrust	Capping to granitoid rocks.
	Silcrete*	Siliceous duricrust	Capping to granites and greenstone belts.
Permian	Undifferentiated	Sandstone, siltstone, shale, limestone, and glacial tillites, some coal measures	Sediments of Byro Sub-basin of the Carnarvon Basin.
Late Proterozoic	Badgeradda Group	Siltstone, sandstone and conglomerate	Small intra-cratonic basin, overlying Archaean gneisses.
Early Proterozoic	Padbury Group	Shale, BIF, dolomite, siltstone, phyllite and conglomerate	Unconformable over Glengarry Group in Glengarry Sub-basin.
	Glengarry Group	Quartz arenite, micaceous siltstone	Unconformable over Archaean bedrock.
Archaean	Granitoids	Adamellite, granodiorite, biotite granite, tonalite	Small to large bodies throughout area.
	Jack Hills Greenstone Belt	Quartzite, conglomerate, schist, amphibolite, pyroxenite, and peridotite	Linear outcrop as Jack Hills Range
	Mafic and Ultramafic rocks (Undiff)	Basalt, schist, amphibolite, gabbro, dolerite, serpentinite pyroxenite and peridotite	Forms the major greenstone belts in the south-east of the area.
	Migmatite and gneiss (Undiff)	Biotite gneiss and migmatite, paragneiss, schist, quartzite, and amphibolite	Forms the Narryer Gneiss Complex in west and north-west of area.

* Not shown on Figure 23.

Hydrogeology

General

The area covered by this report places great reliance on groundwater. It is an area of low rainfall with an erratic seasonal distribution, and a high potential evaporation; it has, therefore, a general surface water deficiency. Most of the rivers flow after heavy rains and permanent pools are generally restricted to the Murchison River. Large, semi-permanent pools and waterholes occur along the Roderick, Sanford, Wooramel, Whela, and Yalgar Rivers, and ephemeral water lies for some time after rainfall in many of the larger claypans in the region. Small rock holes, probably originating as weathering cavities, occur on the crests and margins of granitoid domes, and in the breakaway areas, but provide supplies of limited quantity and duration. Before European settlement of the area, the Aboriginal population was evidently heavily reliant on such sites.

Groundwater is now used for many purposes. It is essential for the pastoral industry, but is also used for domestic purposes on each pastoral lease, and provides town water supplies for Mt Magnet, Cue, and Meekatharra. In addition, groundwater of variable quality is extensively used in the mining industry during the processing and washing of ore and tailings.

Source of data

Data have been obtained from the detailed bore censuses carried out during regional geological mapping in the 1970s and 1980s. More than 2000 bores and wells were sampled, and there is a relatively even distribution of bores and wells throughout the area (Figure 25). The available bore data (water levels, depths, yields, and salinities), are held by the Geological Survey.

Groundwater occurrence

Groundwater is generally readily available throughout most of the area, although quality and quantity vary considerably depending on bore or well location. Table 5 summarises the range of bore depths, yields, and groundwater salinities for the various rock types of the three major aquifers i.e. surficial, sedimentary, and fractured rock aquifers. Figure 26 diagrammatically shows the relationship of groundwater within the various rock units, and typical bore locations.

Over most of the area, domestic and stock water requirements are met from small supplies of fresh to brackish groundwater in colluvium, valley-fill alluvium, and calcrete and calcreted alluvium. The extensive wash plains, generally underlain by hardpan, that flank the main trunk drainages, provide

a reliable source of shallow, good quality groundwater, although groundwater salinity tends to increase closer to the main drainage lines. Larger quantities of groundwater are obtainable from the more permeable calcrete, and valley-fill alluvium, in the main trunk drainages.

Further from the drainages, smaller supplies can be obtained from the colluvial hillslope wash, adjacent or marginal, to rock outcrop, and also from the weathered bedrock profile, and from fractures and shear zones within the fresh bedrock. Yields are small, and quality tends to vary in relation to the bedrock

type, with salinities generally being higher in areas of greenstone than in the granitoids.

In the north-east of the area, small supplies of variable, but generally fresh to brackish, water may be obtainable from the Proterozoic sandstones and fractured banded iron-formation (BIF) of the Nabberu Basin. Similar supplies may be obtained from the Proterozoic sediments of the Badgeradda Group in the west. Further to the west and north-west, within the Carnarvon Basin, the sandier sections of the Permian sediments yield reasonable quantity and quality groundwater.

Table 5. General range of depths, salinity, and yields of bores

Aquifer	Bore depths (m)	Water levels (m below ground surface)	Salinity range (mg/L TDS)	Supply range (m ³ /day)
Surficial				
Calcrete	5-30	0-5	250-12,000	50-1,000
Alluvium	5-35	0-5	400-12,000	50- 200
Colluvium	10-30	5-15	800- 6,000	20- 100
Sedimentary rocks				
Permian	> 100	> 80	700- 3,500	50- 250
Late Proterozoic	30-60	5-20	2,000- 9,000	50- 100
Early Proterozoic	30-60	5-15	1,000- 2,000	5- 100
Fractured rocks				
Granitoids	5-45	5-40	500- 4,000	10- 50
Gneisses/migmatites	10-50	5-45	2,000- 7,000	5- 10
Greenstone belts	30-100	20-40	1,000- 4,000	100-2,000

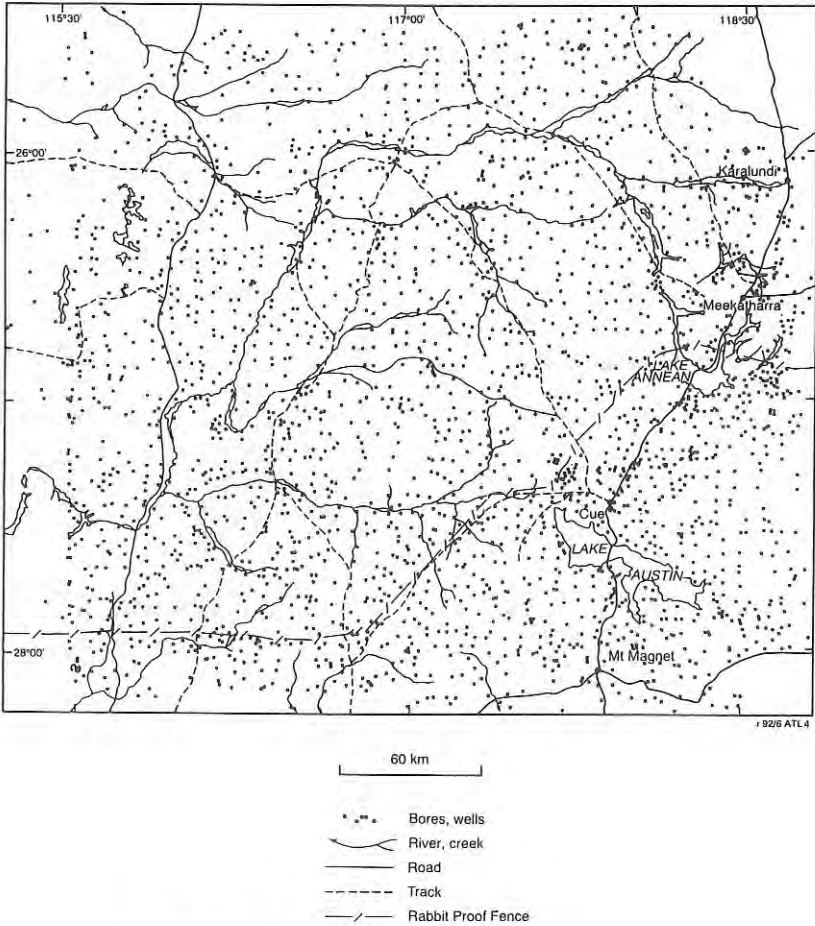


Figure 25. Bores and wells in survey area.

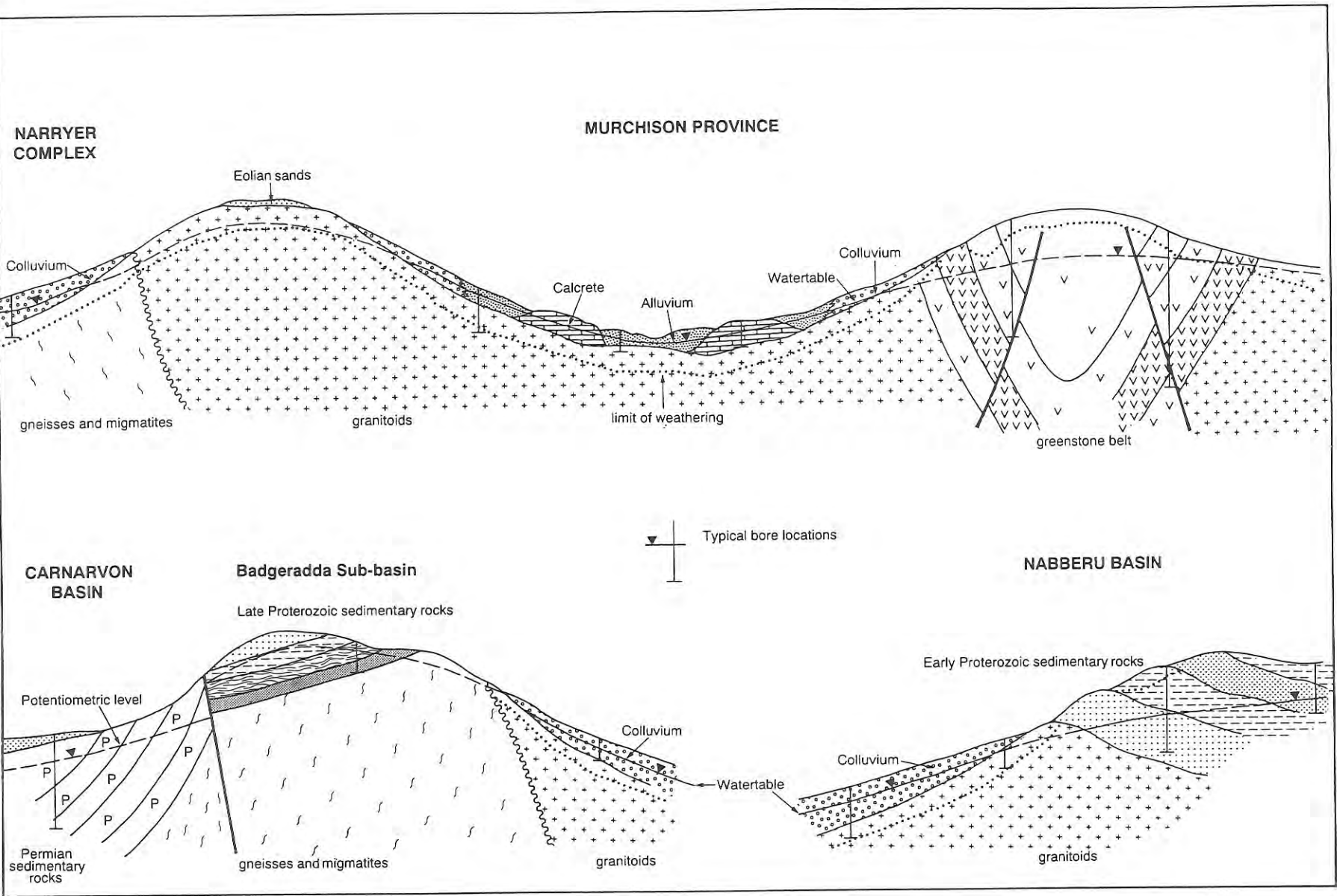


Figure 26. Relationship of groundwater within various rock units and typical bore locations.

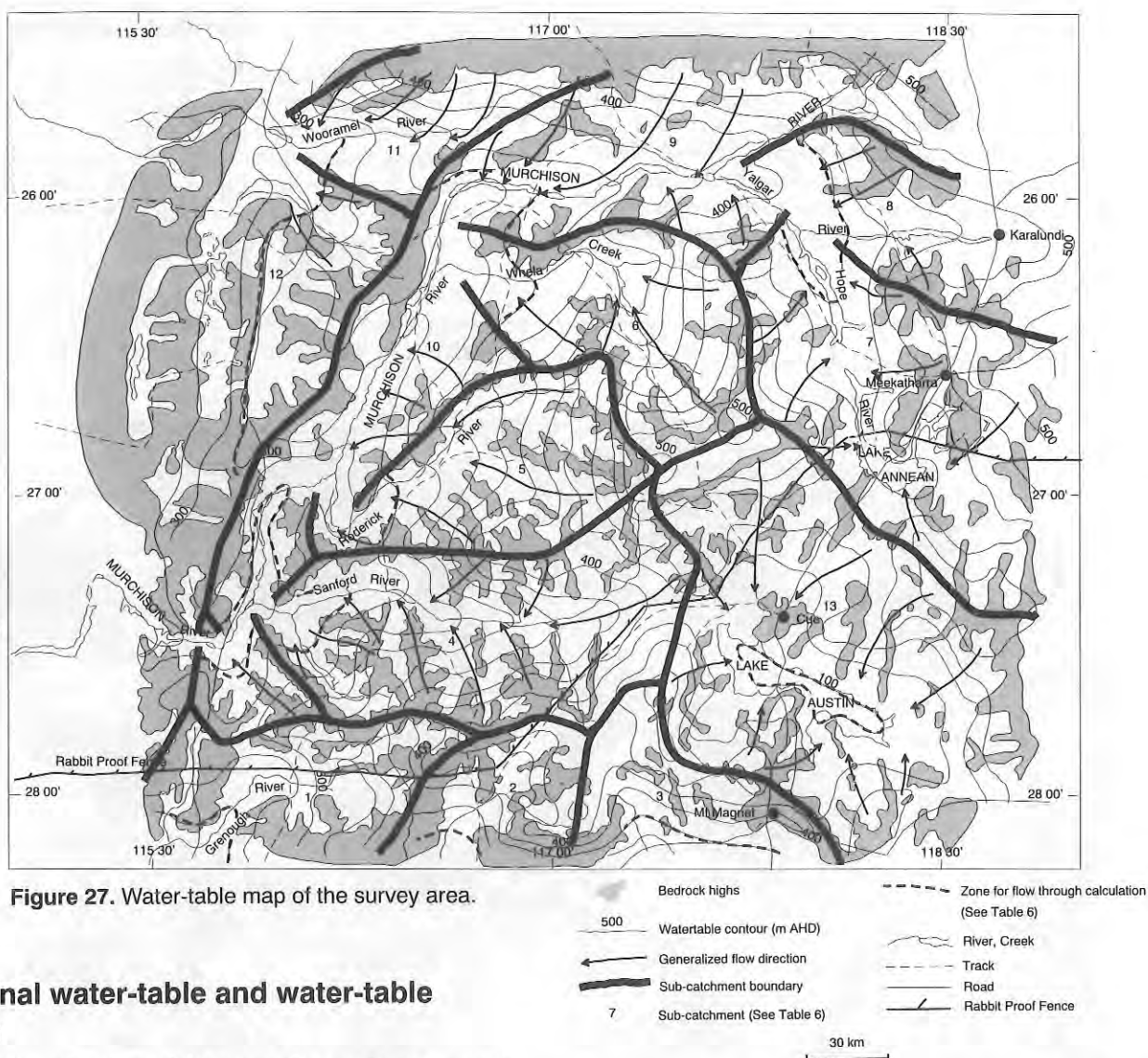


Figure 27. Water-table map of the survey area.

Regional water-table and water-table levels

The determination of the groundwater flow systems in the study area is based on hydrogeological data collected during regional geological mapping, supplemented by data obtained from town water supply investigations, exploration for water supplies for mining purposes, and from bores drilled for road construction water supplies. Consequently the data are non-synoptic.

In addition the bores and wells have not been surveyed to Australian Height Datum and water-table elevations have been calculated from estimates of surface elevation from 1:100,000 topographic series maps.

The water-table map (Figure 27) and the depth-to-water map (Figure 28) are therefore generalised, and should be used with caution for future drilling and groundwater exploration. Salinity has been determined mainly in the field using conductivity measurements, and may also vary seasonally. Consequently the salinity data in Figure 29 are also generalised.

Whilst there are limited water supplies in areas of bedrock outcrop, or near outcrop, it is evident that a regional water-table exists throughout the study area (Figure 27). The height of the water-table ranges from over 500 m AHD on the eastern boundary of the area,

to under 260 m in the west, a drop of more than 240 m in about 300 km, equivalent to a gradient of 1 m per 1250 m.

Interpretation of the water-table contours (Figure 27) shows a series of smaller sub-catchments to the main Murchison River catchment, and other catchments. A total of 13 sub-catchments are shown, 12 exorheic and 1 endorheic (Table 6). Of the 12, 7 are either catchments to tributaries of the Murchison River, or to part of the river itself. Two of the sub-catchments contribute to the Wooramel River catchment in the north-west, one to the Greenough River in the south-west, and two to the Mongers Lake system to the south. The endorheic sub-catchment is centred on Lake Austin in the south-east of the area, into which groundwater drains and discharges by evapotranspiration.

Most of the sub-catchments are linear, with the drainage line forming the main axis. They range in size from less than 2600 km² to more than 13,750 km². Hydraulic gradients along the main axes are very low and range from 0.6 to 2.6 × 10⁻³.

The depth to the water-table (Figure 28) ranges from less than 1 m to over 80 m in the extreme west of the area, in the Carnarvon Basin. In most of the area the

depth to water is generally less than 15 m. All areas with a water-table deeper than 20 m are shown as one subdivision.

The depth to the water-table is closely related to topography, particularly on the Yilgarn Craton. Water levels are deepest beneath the catchment divides where bedrock crops out or is close to the surface, and shallowest in the drainage lines, where groundwater discharges to the sub-surface and pools in the watercourses.

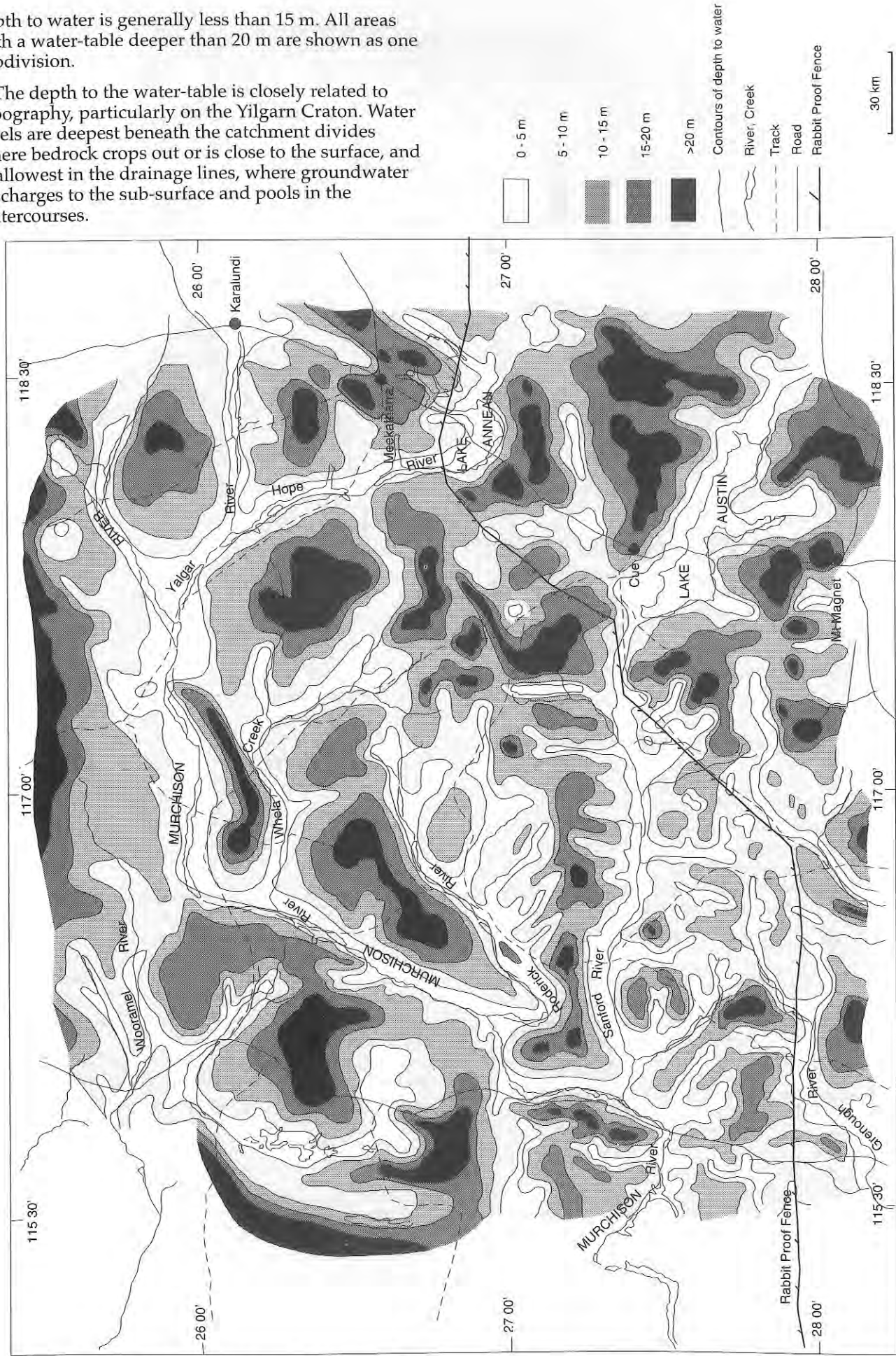


Figure 28. Depth to water-table within the survey area.

Groundwater resources

There are insufficient controlled data to enable a detailed assessment of groundwater resources in the study area. An approximation of the resources can be provided based on a range of estimates of various hydrogeological parameters. Estimates have been made of the likely amount of recharge to the area from rainfall, the amount of groundwater flowing through each sub-catchment (Figure 27), and the amount of groundwater stored in each sub-catchment. The estimates are given in Table 6 and should be regarded as only a guide to the likely amounts of water within the area.

Recharge

Groundwater recharge is from rainfall, which in the study area ranges from 200 to 250 mm per annum. Recharge over the area has been estimated from an established data set (Department of Primary Industries and Energy 1987), on the basis of 0.005% of rainfall for areas underlain by fractured bedrock and related material, and 0.1% for the remainder of the area. Total direct recharge from rainfall averages about $12 \times 10^6 \text{ m}^3$ per annum (Table 6). Recharge may take place over the whole of each catchment, although where the water-table is shallow and in discharge areas with upward heads it may be insignificant.

Similarly, whilst recharge on areas of bedrock outcrop may be small, these areas are nevertheless important in providing run-off concentrating recharge further downslope. Further recharge of the alluvium and calcrete in the drainage lines occurs from stream flows after heavy rains.

The contours in Figure 27 indicate that all of the exorheic sub-catchments discharge to the stream line, whilst the endorheic sub-catchment discharges to Lake Austin.

Throughflow

Calculation of throughflow in the sub-catchments is based on the Darcy equation:

$$Q = Kdil$$

where:

- Q = throughflow (m^3/day);
- K = hydraulic conductivity (m/d);
- d = saturated thickness (m);
- i = hydraulic gradient (dimensionless);
- l = width of throughflow zone (m).

Of these parameters i and l can be measured from the water-table contours in Figure 27, and d can be estimated from bore or well data. However, K is unknown, and can only be estimated on the basis of the rock type.

The throughflow zone will not be a constant thickness across its total width; nor will it have the same hydraulic conductivity. Groundwater flow will be concentrated within the more permeable alluvium and calcrete, and total throughflow will diminish further upslope towards the drainage divides.

Estimates of throughflow, given in Table 6, have been derived by adopting the following assumptions for saturated thickness and hydraulic conductivity. The width of the calcrete/alluvium section of the water-table contour over which the throughflow has been calculated was estimated from Figure 23, and assumed to have a saturated thickness of 20 m and a hydraulic conductivity of 2.5 m/d. The remaining section of the contour, underlain by colluvium and bedrock, was assumed to have an average saturated thickness of 10 m and a hydraulic conductivity of 0.5 m/d. The thicknesses were adopted to allow for the presence of saturated weathered bedrock.

Table 6. Groundwater resources

Sub-catchment		Area (km^2)	Rainfall (mm)	Recharge ($\text{m}^3 \times 10^6/\text{a}$)	Through flow ($\text{m}^3 \times 10^6/\text{a}$)	Evapotranspiration and discharge	Storage
No.	Name					($\text{m}^3 \times 10^6/\text{a}$)	($\text{m}^3 \times 10^9$)
1	Greenough	4,500	250	0.48	0.24	0.24	0.13
2	Mongers 1	2,600	250	0.22	0.11	0.11	0.52
3	Mongers 2	3,540	225	0.57	0.52	0.05	0.10
4	Sanford	9,200	225	1.06	0.39	0.69	0.50
5	Roderick	5,350	225	0.75	0.22	0.52	0.29
6	Whela	6,050	200	0.87	0.36	0.51	0.48
7	Hope	10,540	200	1.21	0.46	0.75	0.84
8	Yalgar	4,425	200	0.63	0.37	0.26	0.24
9	Murchison 1	8,600	200	0.72	0.59	0.13	0.81
10	Murchison 2	7,700	225	1.16	0.82	0.34	0.80
11	Wooramel	3,925	225	0.55	0.42	0.13	0.21
12	Byro S/B	12,200	225	1.96	0.69	0.97	1.87
13	L. Austin	13,750	200	1.97	1.66	0.31	1.43
				12.16	7.05	5.11	8.22

Storage

The estimation of storage is based on an average saturated thickness over each of the subcatchments and a value for the specific yield of the rock types within the catchment. As noted earlier, the average saturated thickness will be greater within the lower parts of the catchments, along the drainage lines, where thicker sequences of alluvium, calcrete, and colluvium have been deposited, and will diminish upslope towards the drainage divides.

In order to derive the figures for storage in Table 6, the area underlain by calcrete and alluvium was estimated from Figure 23 and assumed to have a saturated thickness of 10 m and a specific yield of 5%. The remaining area was assumed to be underlain by colluvium and bedrock with a saturated thickness of 5 m and a specific yield of 0.1%. The saturated thicknesses are less than those taken for the calculation of throughflow, to allow for the thinning of the saturated zone higher in the drainage line and topography. This gives an estimated total groundwater storage of about $8 \times 10^9 \text{ m}^3$ for the study area.

On the basis of these figures, the estimated amount of water stored in the area is considerably more than that discharged from the area, either as throughflow, evapotranspiration, or discharge/abstraction. In the short term, annual fluctuations in recharge from the variable rainfall, are unlikely to affect water-table levels, particularly in the thicker saturated zones. However, extended periods of drought are known to cause a lowering of the regional water-table.

Salinity and quality

During the geological mapping of the 1:250,000 sheets covered by the study area, samples of groundwater were collected from all bores or wells that were operative, and field determination of conductivity was subsequently converted to salinity (as mg/L Total Dissolved Solids - TDS). Some of these samples were also submitted to the Chemistry Centre of Western Australia for detailed analysis. Additional analyses supplementing the field analyses, include the chemical analyses of groundwater from Town Water Supplies and from groundwater exploration by consultants for mining and mineral processing requirements.

The salinity values from these determinations are contoured in Figure 29, which shows the distribution of salinity in the study area. Most of these analyses were determined between 1972 and 1982, and are therefore non-synoptic. However, it is considered that groundwater salinity is unlikely to have changed significantly during the period of the sampling.

Groundwater salinity in the study area is derived from two main sources: cyclic salts from precipitation over the area, and salts leached from bedrock and the lateritic and weathered profiles (Brookfield 1963).

The distribution of groundwater salinity is shown in Figure 29. On a regional scale, salinity increases

towards the drainage lines, particularly the main trunk drainages. The lowest salinity groundwater occurs along drainage divides where bedrock may be closer to the surface, the water-table is deep, and where the groundwater has the shortest residence time. Further down the flow paths, and in the main drainage lines, the water-table is shallower, and there is concentration of salts by evaporation, and transpiration of phreatophytic vegetation.

Although the main drainages generally flow with fresh water after heavy rains, stream salinity rapidly increases, as surface flow diminishes and groundwater discharge becomes more significant.

In areas of internal drainage, such as the Lake Austin sub-catchment, groundwater flow is towards a central lake from which discharge is solely by evapotranspiration. In these areas salinity increases to more than 50,000 mg/L TDS.

Examples of some groundwater analyses from selected rock units are given in Table 7. Groundwater throughout the area is generally a sodium chloride type, reflecting its derivation through precipitation from cyclic salts. Groundwater from calcrete is generally harder than water from other sources although high levels of hardness have been recorded in water from colluvium, alluvium, and Proterozoic sandstones.

In many cases the groundwaters contain high levels of sulphate, which may relate to nearby mineralisation. Nitrate levels are also high throughout the area and beyond the World Health Organisation standards (45 mg/L as NO_3) for human consumption (WHO 1971). The source of the nitrate is probably not pollution, though some may come from animal wastes, but rather nitrate fixation from vegetation or possibly termites (Smith *et al.* 1990). In addition high levels of silica are reported from all sources, although they are not considered harmful.

Groundwater availability

The data in Figures 27 to 29 indicate that groundwater occurs throughout the study area. However, the quantity and quality vary considerably depending on location and the nature of the aquifer and bore/well location (Table 5 and Figure 26). Regional groundwater contours (Figure 27) indicate that groundwater flow is controlled by the surface catchments, with groundwater flow towards, and discharge to, the main drainage line. At the same time the depth to groundwater (Figure 28) decreases to the drainage line, and water quality also decreases (Figure 29) and becomes brackish to saline.

Along the drainage lines, the shallow water-table together with the occurrence of deposits of surficial sediments results in areas of increased storage and throughflow, and consequently areas where yields may be expected to be larger. As a result, the largest groundwater supplies within the region are from such surficial formations, although good supplies of water can be obtained from other rock types depending on local site-specific conditions.

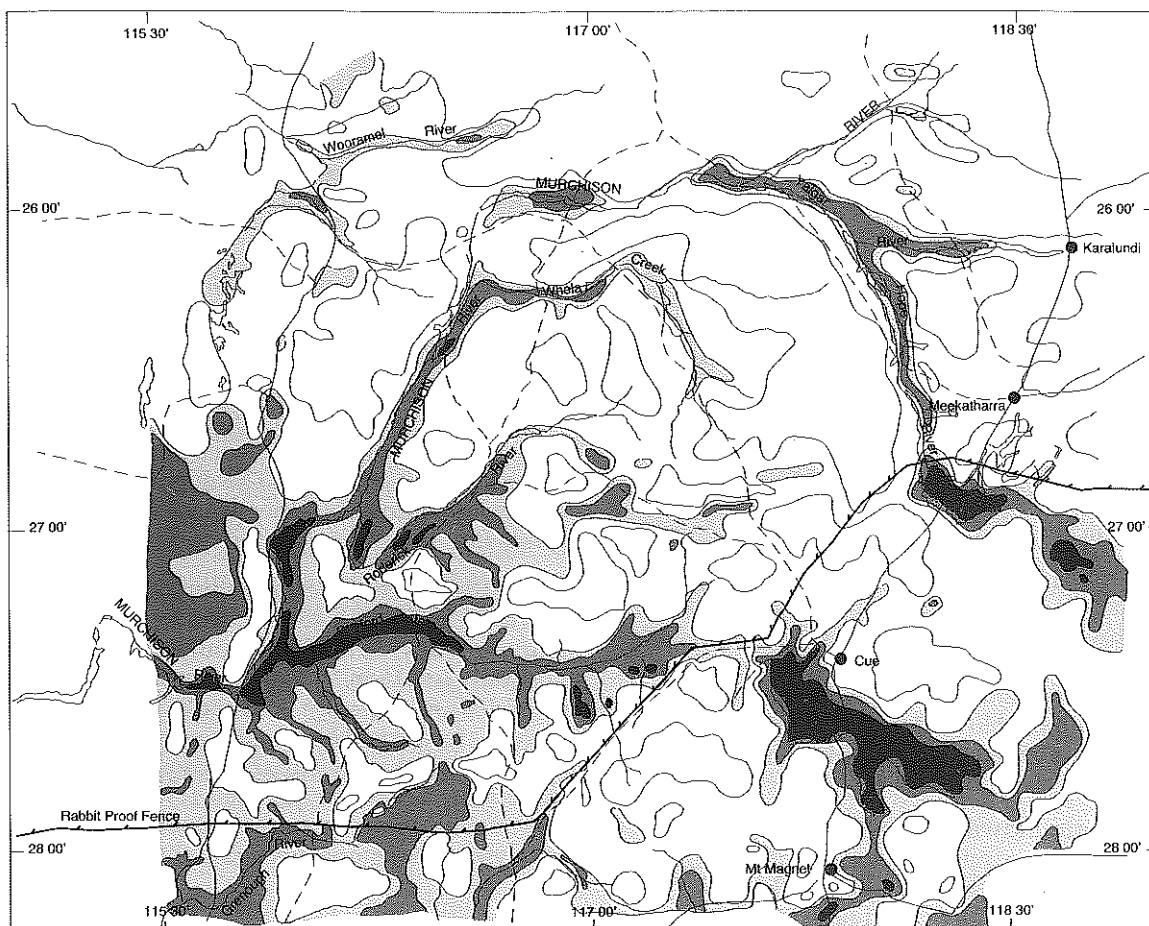
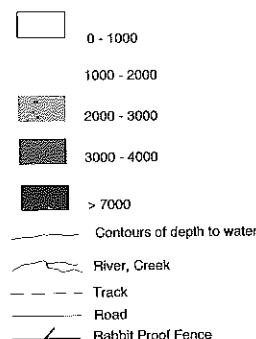


Figure 29. Distribution of groundwater salinity within the survey area.

Salinity (mg/L Total Dissolved Solids)



30 km

Surficial aquifers

The main surficial aquifers comprise the deposits of calcrete, alluvium, and, to a lesser extent, colluvium. Calcrete deposits are restricted to drainage lines and may interfinger with deposits of alluvium, and these in turn grade into, or are overlain by colluvium away from the drainage lines.

Calcrete

Calcrete is a carbonate rock formed by the *in situ* replacement of valley-fill debris by magnesium and calcium carbonate precipitated from percolating carbonate-saturated groundwater (Sanders 1973a). It has a well-developed secondary porosity and high permeability, and forms an excellent aquifer.

It occurs generally along flat reaches of ancestral or existing water courses, and around saline lakes. It crops out as low mounds separated by narrow alluvial drainages.

In areas it is overlain by thin deposits of alluvial wash and eolian sand often showing the development of gilgai structures from carbonate solution and soil collapse.

Generally calcrete can range from less than 5 m thick to in excess of 30 m, and the water-table is often marked by the occurrence of opaline silica, when salinity is in excess of 5000 mg/L TDS. This layer is

often fractured and fissured, and water movement can open up the fissures to more than 0.3 m in width. As a result large cavities can be developed, which can contain considerable volumes of groundwater. Yields in excess of 1000 m³/day can be obtained from properly constructed bores.

In some areas groundwater in calcrete is very fresh, and is used for Cue, Mount Magnet, and Meekatharra town water supplies (AGC 1987a, 1988a, WAWA 1989). In other parts of the study area groundwater quality is poorer, and salinities in excess of 7000 mg/L TDS are obtained. However, the poorer quality water is still suitable for some classes of sheep, for mineral processing and for water supplies for road construction purposes.

The depth to groundwater within calcrete is generally less than 5 m and total depths of bores do not usually exceed 30 to 40 m. Water supplies can best be developed from bores either equipped with slotted casing, or with a suitable bore screen. The often cavernous structure of the material increases the risk of pollution, and care needs to be taken in the location of bores.

Alluvium

Alluvium occurs in all the main drainages and generally consists of a fine-to coarse-grained quartz sand, with layers and lenses of silt, conglomerate and clay. The thickness of the alluvium varies considerably, depending on the size and age of the drainage line, and can range from less than 5 m to about 25 m, and is occasionally thicker (AGC 1987a). Where sand deposits are well developed the alluvium has a high permeability, although the presence of silt and clay reduces both the permeability and bore yields.

Groundwater quality is also variable. Figure 29 indicates that, towards the drainage divides, groundwater salinity is low. However, groundwater in the alluvium is over 7000 mg/L TDS in the lower reaches of the major drainage lines.

The depth to groundwater in the alluvium is generally less than 5 m, and total depths of bores and wells do not usually exceed 25 to 35 m, although depths in excess of 60 m have been noted (AGC 1987b). Water supplies are generally not as large as those obtained from calcrete, but location of bore sites in the deeper sections of alluvium, together with correct bore construction should enable supplies of 50 to 200 m³/day to be obtained.

Bores in the alluvium should be constructed using a suitable stainless steel screen set in the coarsest sand section, and the bore should be adequately developed

to remove any fine sand or silt within the aquifer. If the aquifer consists of very coarse sand or gravel, it may be possible to construct the bore with machine slotted casing, but if the aquifer consists of thin interbeds of sand and silt, a bore can best be constructed using machine slotted casing over the full saturated thickness, and a suitable gravel pack for the annular space.

Colluvium

Colluvial deposits on outwash fans, talus, and scree slope deposits, occur marginal to bedrock and extend downslope to the alluvial-filled drainage lines. The deposits consist of angular rock and quartz fragments in a brown silt and sand. The deposits grade downslope into broad sheetwash. They border or grade into the alluvial deposits.

The thickness of the colluvium ranges from less than 2 m to 15 m. The broad sheetwash plains bordering the alluvium provide a reliable source. The water-table is generally less than 15 m below ground surface, and salinities are generally less than 2000 mg/L, but increase towards the main drainage lines. There may also be some quality variation dependent on the underlying bedrock type. Elias (1982) suggests that more saline water occurs in colluvial deposits overlying greenstone areas rather than granitoid areas.

The colluvial deposits are generally less permeable than the alluvium and calcrete, and consequently water supplies are generally lower. Yields of less than 50 m³/day are common, and supplies are generally better beneath the lower plains than higher on the scree slopes. The poorly sorted nature of the sediments result in considerable variation of permeability, and bores constructed using gravel-packed, fully-slotted casing, or large diameter wells have the best prospects for obtaining water supplies.

Table 7. Chemical analyses (mg/L) of groundwaters from selected rock units

Name	PAT 1 Big Bell G.M. ¹	Limestone Well ²	Tree Well ³	Woolbung Well ⁴	Coolardy Well ⁵	Killer Paddock Well ⁶	Deep Bore ⁷	Homestead Well ⁸	MYP I ⁹	140' Well ¹⁰
Aquifer	Czk	Czk	Qa	Qa	Qc	Qc	SST	Ag	Gab	Gnstne
Depth (m)	18.0	4.7	nr	5.3	4.2	5.6	39.6	32.0	66	42.7
SWL (m)	4.0	4.3	17	4.8	3.2	5.1	16.7	nr	20.5	30.5
pH	7.6	8.2	7.9	7.5	8.1	7.0	8.1	7.9	7.9	7.8
TDS	6,940	4,220	2,465	620	7,680	1,040	2,990	645	1,280	3,140
Hardness	1100	823	nr	204	1495	183	668	nr	289	nr
Alkalinity	2150	170	nr	80	245	35	115	nr	nr	nr
Ca	110	127	102	29	244	29	101	33	23	85
Mg	200	123	113	31	216	27	101	50	57	118
Na	2,150	1,110	525	186	2,139	243	819	108	300	808
K	65	95	50	15	66	21	42	19	7	39
HCO ₃	290	207	119	98	299	43	140	76	310	214
Cl	3,635	1,946	895	303	3,694	409	1,453	180	380	1,220
SO ₄	610	402	340	64	711	80	250	65	100	445
NO ₃	65	32	19	60	47	58	96	21	106	19
SiO ₂	65	65	105	86	75	108	63	58	nr	51

1. Cue sheet
2. New Forest station
3. Glengarry
4. Wooleen station
5. Boolardy station

6. Melangata station
7. New Forest station
8. Sherwood station
9. Belele station
10. Polelle station

- Qa: Alluvium
Qc: Colluvium
Czk: Calcrete
SST: Proterozoic sandstone

- Ag: Granite
Gab Gabbro
Gnstne Greenstone

Sedimentary aquifers

Permian

The main occurrences of sedimentary rocks are in the north-west of the area, where Permian rocks of the Byro Sub-basin occur.

A limited number of bores are drilled into these rocks, but existing bore data indicate that groundwater flow is to the west. The depth to water also increases to the west, and the water-table may be in excess of 80 m. Salinity and quantity vary considerably. Water suitable for stock is generally obtainable from the Moogooloo Sandstone, but parts of the sequence (e.g. Lyons Group) will yield larger supplies of potable quality water (Williams I.R. *et al.* 1983). Allen (1987) reports salinity in the Permian rocks ranging from 860 to 1930 mg/L TDS (Moogooloo Sandstone) and 700 to 3230 mg/L TDS (Lyons Group), and indicates that a complex water-table exists and salinity and yields are highly variable.

Successful bores may need to exceed 100 m in the western part of the area, and drilling may need mud rotary techniques and geophysical logging to locate optimal positions for bore screens to ensure adequate supplies.

Late Proterozoic

In the west, in the Late Proterozoic sedimentary rocks of the Badgeradda Group, groundwater salinities range from about 2000 to 9000 mg/L TDS, with the more saline water derived from shale. Deep Bore (Table 7) is in sandstone and has a salinity of 2990 mg/L TDS.

Depth to water in the Badgeradda Group ranges from less than 5 m to more than 20 m below ground surface, depending on topography and bedrock type. Bore depths may range up to 60 m and future site selections should be aimed at locating drilling targets in sandstone, particularly where strong fracturing and/or jointing occurs, and recharge has been enhanced. The sandstone should be competent enough to allow slotted casing to be used in bore construction, and yields of 50 to 100 m³/day may be obtainable.

Early Proterozoic

The Early Proterozoic sedimentary rocks of the Padbury and Glengarry Groups occur in the extreme north-east of the area.

Limited bore data indicate that the groundwater in this area may be obtained from sandstone and dolomite sequences, and probably from banded iron-formation. The water-table is between 5 m and 15 m below ground surface, and groundwater salinity ranges from 1000 to 2000 mg/L TDS. Bore yields range from 50 to 100 m³/day, although better supplies should be obtainable from fractured sections of the banded iron formation.

It is likely that, as with the Badgeradda Group, the formations should be competent enough to allow slotted bore casing to be used in bore construction.

Fractured rocks

Granitoids

The granitoid basement rocks consist of even-grained to porphyritic granite and adamellite, with some granodiorite and tonalite. In places they are deeply weathered to more than 40 m and small supplies of groundwater may be obtainable from within, or at the base of the weathered profile. Some groundwater may be intersected in exfoliation joints in the upper few metres of the fresh bedrock. However there is little evidence of bores exploiting this zone, and the main source of groundwater appears to be in the weathered profile.

Where groundwater associated with the granitoids is exploited, salinity ranges from 500 to 4000 mg/L TDS, with the lower salinity water occurring along the drainage divides, and increasing in salinity towards the drainage lines. Depths of bores are variable depending on the location of the site within the topography, but can range from 5 to 45 m. However, the higher in the topography the bore, the more likelihood that the supply will be small, and subject to large seasonal variations in the water-table levels.

Gneisses and migmatites

Groundwater generally occurs in the weathered profile, which usually has a high clay content. As a result salinities range from 2000 to 7000 mg/L TDS, though less saline groundwater can be obtained closer to the drainage divides, where salinities may be less than 1000 mg/L TDS. The depth to the water-table ranges from 12 to 15 m, and supplies are usually less than 10 m³/day.

Greenstone belts

Drilling in the search for water for mineral processing, has mainly been on highly fractured and sheared zones in basalts and dolerites, some of which extend more than 100 m below ground level.

Bores have been drilled to depths greater than 100 m in several areas, but in these deep bores, static water levels range from 20 to 40 m. A wide range of yields, between 100 to 1800 m³/day, have been obtained, whilst salinity has generally ranged from 100 to 4000 mg/L TDS, although salinities in excess of 60,000 mg/L TDS have been obtained.

Conclusions

Regionally, the water requirements for the pastoral industry are generally small, and bore yields seldom exceed 10 m³/day, although larger supplies in excess of 20 m³/day are available in areas of calcrete and thick alluvium. Water quality generally poses little problems as water with a salinity up to 7000 mg/L TDS can be utilised by stock. Shallow groundwater with a higher salinity is generally restricted to the main trunk drainages. Domestic supplies on pastoral leases are usually met from wells or bores, or from collection of rainwater from roof catchments.

On the basis of about 2000 bores and wells, with an 80% utilisation rate, pumping at 5 m³/day, groundwater consumption by the pastoral industry is about 2.9 x 10⁶ m³/annum. This is quite small compared with the estimated groundwater storage, and even allowing for groundwater discharge by throughflow and evapotranspiration, there appear to be satisfactory water resources to withstand short periods of drought.

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The Survey

Methods

General approach

This survey adopted the land system approach to resource description and evaluation, as used for previous rangeland resource surveys in Western Australia (Wilcox and McKinnon 1972, Payne *et al.* 1979, 1982, 1987, 1992, Mitchell *et al.* 1979).

The land system approach to the management of rangelands, in Australia and overseas, has withstood the test of time. This approach maps the component lands of extensive arid and semi-arid regions, in a natural classification at the smallest scale which is usefully applicable for planning land use, management and infrastructure design across very broad catchments.

Christian and Stewart (1953, 1968) defined a land system as 'an area or group of areas throughout which there is a recurring pattern of topography, soil and vegetation'. Each land system has characteristic patterns able to be seen on aerial photographs and other forms of remotely sensed images. Discrete areas of a land system mostly occur in areas greater than 5 km² and are therefore of a scale suitable for mapping at 1:250,000. Land systems consist of a number of smaller land units or elements, each of which has a distinctive photographic pattern. The relative proportion of the component units and their arrangement one to another gives the broader three dimensional pattern that characterises the particular land system.

Exhaustive effort was made to maximise the objectivity of the assessment of soil and vegetation resources by adopting a consistent, innovative, quantitative approach.

Field work program

As a preliminary to fieldwork, tentative land systems and their likely boundaries were identified and marked onto the most recently available (mainly) 1:50,000 scale black and white stereo aerial photographs (Table 8). Published background information on geology, landforms, soils, vegetation and land system classifications was available from several sources. These included the Geological Survey of Western Australia (1:250,000 map sheet series), Bettenay *et al.* (1967), Beard (1976), Payne *et al.* (1987), Wilcox *et al.* (1972) and Mabbutt *et al.* (1963). False colour images generated from Landsat (multi-spectral scanner) data were also used to provide broad overviews of the area.

Topographical and pastoral lease infrastructural features such as roads, fences, tracks and watering points were also identified and marked up on the aerial photographs before fieldwork started.

The program of field work was carried out between June 1985 and March 1988, with a total of 32 weeks of fieldwork undertaken by the full team:

Rangeland Advisers	P.J. Curry, A.L. Payne
Staff Surveyor	K.A. Leighton
Navigator/Draftsperson	J. Neil
Soil Technician	P. Hennig (and S.J. Fritz)
Senior Survey Hand	L.J. Merritt
Botanist	R.J. Cranfield (WA Herbarium)

The methodology to achieve consistent coverage and assessment of the whole area was designed after five weeks of reconnaissance surveys. Development of efficient and appropriate field techniques was the focus during this initial stage before beginning systematic coverage in October 1985.

Table 8. Aerial photography used for the survey's mapping

Sheet	Runs	Film no.	Scale	Date flown
AJANA	4	WA 2092	1:50,000	28.09.82
BELELE	1, 13, 14	WA 2308	1:50,000	28.06.85
	2-6	WA 2309	1:50,000	27.06.85
	7-12	WA 2310	1:50,000	28.06.85
BYRO	7	WA 2187	1:65,000	13.12.83
	8-10	WA 2186	1:65,000	13.12.83
CUE	1-4	WA 2015	1:50,000	28.10.81
	5, 6	WA 2027	1:50,000	16.12.81
	7-14	WA 2011	1:50,000	06.10.82
GLENBURGH	8-14	WA 2291	1:50,000	19.03.85
KIRKALOCKA	1-3	WA 1841	1:50,000	22.11.79
MURGOO	1-4	WA 2015	1:50,000	15.12.81
	5-9	WA 2027	1:50,000	17.12.81
	10-14	WA 2028	1:50,000	17.12.81
ROBINSON RANGE	7-11	WA 2304	1:50,000	01.06.85
	12-14	WA 2305	1:50,000	01.06.85
YALGOO	1, 2	WA 2103	1:50,000	05.12.82

A series of 209 pre-planned traverses (see Figure 30) was used, each generally 50 to 150 km long, to obtain lines of ground access and proximity to sampling points and sites in each part of the area.

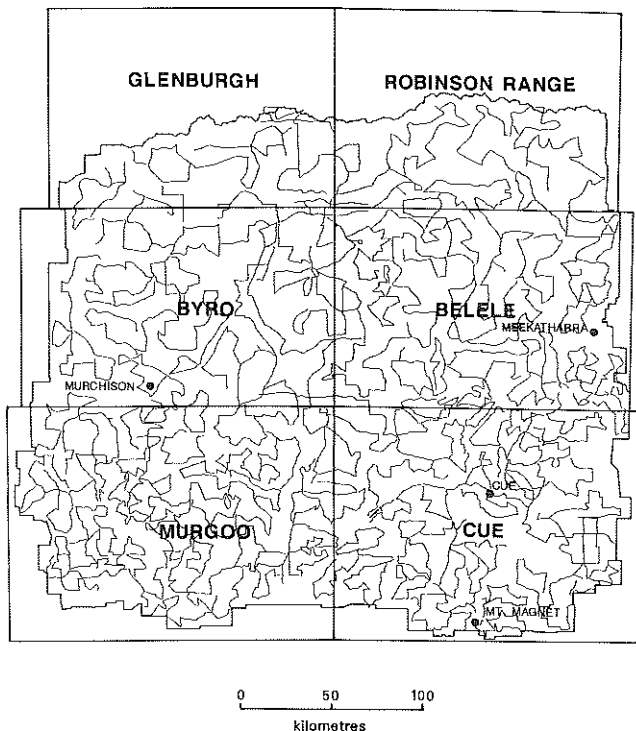


Figure 30. Traverse routes, Murchison rangeland survey.

The total coverage achieved by the main survey program included:

- 13,621 km of traverse and point assessments;
- 679 inventory sites; and
- 1289 condition assessment sites.

Key features of the fieldwork included:

- involvement of station managers/owners wherever possible;
- traverse coverage (point assessments, land system boundary definition and air photography mark-up);
- sampling inventory sites;
- delineation of severely degraded and eroded areas;
- sampling condition sites;
- identification and collection of geological, soil and plant specimens;
- collation of data and *ad hoc* reviews of cumulative progress;
- referral to existing maps and literature;
- maintaining a consistent photographic record.

Involvement of the pastoral community was a vital part of the fieldwork, the total success of which would not have been possible without the continuous support and cooperation of individual pastoral families. In about two-thirds of all instances,

pastoralists accompanied the survey team during some of the fieldwork on their leases and provided current information on aspects of station infrastructure, management, history, ecology and sociology. First hand experience of the local area and of the operational methods and approaches taken by the survey team was exchanged in this way.

Component techniques during fieldwork

Land system mapping

Preliminary, tentative boundaries and designations of land systems were identified and marked on aerial photographs, under stereo, before each traverse and subsequent ground truthing. Boundaries and designations were then modified in the field as necessary. After fieldwork was completed, the land system definitions were finalised and the entire land system classification of the area revised. The boundaries and designations of each land system polygon were revised accordingly and checked twice before mapping started.

Topographical and lease infrastructural updating (for pastoral lease plans)

During the fieldwork the position of station tracks, fences and water points, previously identified on the aerial photographs in the office, were validated wherever possible. Any anomalies were usually resolved in consultation with the pastoralist/manager. New infrastructure developed after the aerial photographs were taken was also positioned and marked on the photographs.

As an adjunct to this rangeland survey, a separate survey program, to identify the boundaries of all leases within the area, was initiated by the Department of Land Administration in 1987. This entailed a thorough research of historical records of previous lease definition and subsequent relocation and resurvey of many of the original survey markers. Leases previously unmarked were also physically defined and it is now possible to relate actual occupational boundaries (i.e. boundary fences) to administrative boundaries for the first time.

Land system and unit description through inventory sites

As a major part of field activities, basic land resource data were compiled from site observations collected at inventory sites. Each inventory site (I site) was pre-selected from aerial photographs as being representative of a particular element of the photo-pattern. Generally, these elements of photo-patterns approximate to land units, or a recognisable part of land units on the ground. Figure 31 shows the location of inventory sites within the survey area.

Sites were selected according to:

- aerial photo-pattern and land unit identification;
- the cumulative coverage of such sites achieved at that time;
- the relative abundance of the type of photo-pattern or land unit within the broader land system; and
- the degree to which the site was likely to have been subjected to grazing pressures, or other known management (or environmental) impacts.

The location of each site was marked on the aerial photograph for future incorporation into the resource map base. The site itself was defined as an area within 100 m radius of the photo-point if the land unit being sampled was > 200 m wide, or if smaller, was bounded by the physical boundaries of the unit. Site data were recorded on standard sheets (Appendix 4).

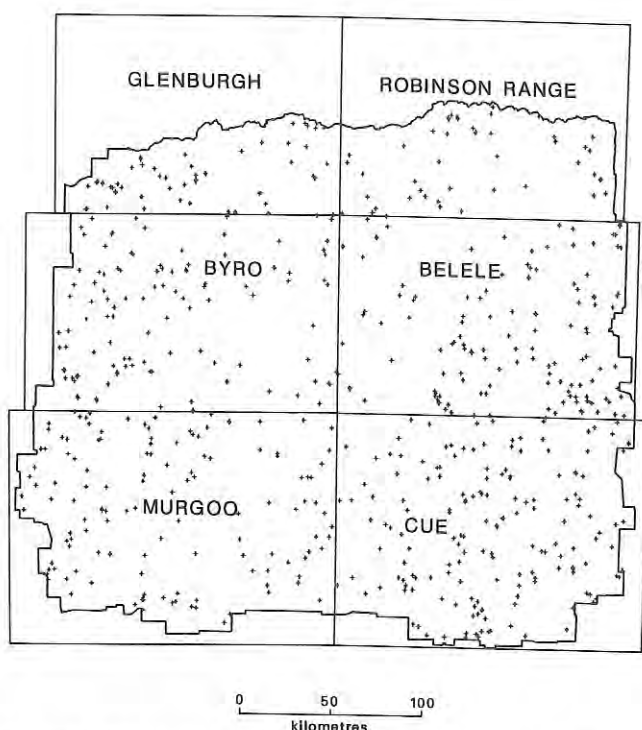


Figure 31. Inventory sites, Murchison rangeland survey.

Technical data collected routinely at inventory sites were as below. Additional notes and sketches of site attributes and special features of interest were also recorded. Such notes enable the recorder to recall (and a reader to appreciate) particular aspects of the sites much more clearly at a later date.

Logistics allowed up to one hour to make an inventory of soil, vegetation and landform at each site.

General

- Aerial photograph: year, map sheet, run and number
- Site number
- Land system and unit

- Pastoral lease name
- Date
- Compass bearing showing direction of oblique ground photograph of site

Physical environment

- Slope (in per cent)
- Geology (according to the 1:250,000 Geological Survey series)
- Site geology - if different to the above
- Surface mantle: abundance, shape, size and type
- Outcrop abundance and type
- Accelerated erosional features and their extent (Table 11)
- Vegetation condition rating (Table 10)

Vegetation

- Vegetation type
- Total projected foliar cover (PFC) by all canopies of perennial shrubs and trees
- The dominant species and order of cover dominance of each stratum of perennial vegetation
- Cover class for perennial grasses
- List of perennial plant species

Soil

In most cases both soil pit and auger observations were used to make profile descriptions. A graduated soil auger of 5 cm diameter was used to retrieve soil to a depth of 1 m or until underlying hard rock or substrate was encountered. In conjunction with the graduated auger, a pit up to 50 cm deep allowed boundaries for the upper layers of the soil to be described.

Soil profiles were described using the techniques and standards given in the Australian Soil and Land Survey Field Handbook (McDonald *et al.* 1984) and by Northcote (1979).

Soil textures were determined for the fine earth (< 2 mm) fraction after sieving out the coarse fragments. The sieved fraction was moistened and the behaviour of the kneaded soil recorded. Soil textures were determined throughout the soil profile and used to characterise the different layers. Data recorded included:

- Principal profile form (Northcote 1979)
- Total soil depth
- Soil substrate
- Soil surface type
- Observation method

- Horizon designation
- Depth
- Texture
- Colour (Munsell 1954)
- Moisture
- Consistence
- Fabric
- Structure
- Ped shape
- Boundary distinction
- Carbonate detection (by effervescence with dilute hydrochloric acid)
- pH (by field colorimetric method after Raupach and Tucker 1959)
- Details relating to coarse fragments/soft segregations

Point assessments of soil and vegetation condition during traverses

The method involved continuous accurate positioning of the traverse vehicle while travelling along a mapped course, usually a station track, but where necessary across country or along a road. At intervals of 1 km the land title (lease name), paddock name (if known), particular land unit and land system being crossed at the time was identified and noted. The soil stability or erosion status and vegetation condition was then assessed over an area of up to

100 m either side of the kilometre point. It was sometimes necessary to stop the vehicle and inspect the site on foot.

Where traverses ran along fencelines, assessments were made for the paddock adjacent to the track rather than across the fence. Two assessors were present to resolve difficulties in assigning ratings to difficult or unusual sites.

The definitions and numerical ratings for soil erosion and vegetation condition are shown in Tables 9 and 10 respectively.



Fenceline effects observed during traverses provided many invaluable examples of the impacts of different grazing management pressures and past events related to pastoral management. Here, a river saltbush community (near side of fence) has been succeeded by unpalatable shrubs such as prickly wattle (*Acacia victoriae*), desert hakea (*Hakea arida*) and poverty bushes (*Eremophila* spp.). Note the degraded, unproductive soil surfaces conspicuous between the 'woody weed' tall shrubs in the background.

Table 9. Criteria for erosion ratings

Severity	Rating	Comment
Wind erosion		
Nil	0	No erosion.
Minor	1	Litter redistribution and small scalds. Small isolated scalds on which the surface shows some degree of polishing. Redistribution of soil to the margins of the scald, or minor build up of soil material around obstacles.
Moderate	2	Large isolated scalds and hummocks. Stripping of the soil surface and build up against obstacles associated with large but generally discontinuous scalds; or numerous small scalds scattered throughout the site.
Severe	3	Major deflation of soil surface. Active stripping resulting in large continuous scalds with polished and sealed surfaces. Frequent large hummocks against obstacles. Major dune drift in sandy systems. Plant cover very sparse to absent.
Water erosion		
Nil	0	No erosion.
Minor	1	Rilling or thin sheeting. Patchy rilling and small gullies affecting small areas or thin sheeting (1 to 2 cm) and breaking of the surface seal on parts on the site. Some redistribution of soil and litter downslope. Much undisturbed ground between affected areas.
Moderate	2	Gullies and/or sheeting. Gullying on the lower slopes or more susceptible parts of the site, these being capable of extension to less susceptible areas. The gullies may be associated with extensive but discontinuous disturbance of the soil surface by sheet erosion and redistribution of soil material.
Severe	3	Terracing or extensive gullies. Severe sheeting or terracing affecting nearly all of the site. Redistribution of soil and exposure of subsoil or rock material. The sheeting may be associated with or replaced by very extensive gullying over most of the site.

Table 10. Criteria for vegetation condition ratings

Rating	Condition indicators
1	Excellent or very good. For the land unit-vegetation type, the site's cover, structure and composition of shrubs, perennial herbs and grasses is near optimal, free of obvious reduction in palatable species or increases in unpalatable species.
2	Good. Perennials present include all or most of the palatable species expected; some less palatable or unpalatable species may have increased, but total perennial cover is not very different from the optimal.
3	Fair. Moderate losses of palatable perennials and/or increases in unpalatable shrubs or grasses, but most palatable species and stability desirables still present; foliar cover is less than on comparable sites rated 1 or 2 unless unpalatable species have increased.
4	Poor. Conspicuous losses of palatable perennials; foliar cover is either decreased through a general loss of perennials or is increased by invasion of unpalatable species.
5	Very poor. Few palatable perennials remain; cover is either greatly reduced, with a loss of the normal structural community and much bare ground arising from loss of stability desirables, or has become dominated by a proliferation of unpalatable species.

Traverse assessment symbols on the 1:250,000 maps

Map symbols depicting both vegetation condition and soil erosion status were devised to depict land resource conditions simply and visually across the maps of the area.

The design of the circular symbol (Figure 32) was based on the central part of the symbol representing perennial vegetation and the outer part of the symbol representing the soil.

Traverse points with vegetation in good condition are represented by a small filled inner circle. Where soil surfaces were also in good condition, i.e. with no evidence of accelerated erosion, the outer zone of the circle is also filled, making the resulting symbol appear as a larger, circular spot. At the opposite end of the condition spectrum, vegetation in poor condition (unfilled inner circle) is associated with lost (severely eroded) soil surfaces, which are depicted by a disintegration of the outer circle.

The intermediate states of condition for both vegetation and soil surfaces are thus depicted as part-filled inner and outer circles, in accordance with the combinations of condition status indicated by the two-way table in the map key.

TRAVERSE ASSESSMENT SYMBOLS

VEGETATION CONDITION

Good Fair Poor

SOIL EROSION

Nil

Minor

Moderate

Severe



The more filled the symbol, the better the condition

Figure 32. Traverse assessment symbols, Murchison rangeland survey.

Assessment of vegetation and soil condition at preselected 'condition sites'

The quantitative approach used for such assessments represents a departure from previous regional rangeland surveys. Quantitative data were collected at pre-selected sampling sites (C sites, a standard recording sheet is attached as Appendix 4) throughout the survey area (see Figure 33), in order to characterise the full pattern of condition states and management-related changes within the major, productive land units. A further aim was to elucidate the most powerful indicators of soil and vegetation status. Indicators, whether qualitative or quantitative in nature, would be of value in the diagnosis of successful land conservation (in the absence of change) on the one hand and in the evaluation of change (towards desirable objectives in recovery from degraded states) on the other.

The condition site approach was designed during the reconnaissance survey fieldwork to investigate various site attributes which could be reasonably hypothesised as likely key variables of cumulative pastoral management impact, and to reflect states of condition in the long term (rather than seasonal) sense. Major considerations in the design of the field methods were:

1. time-efficiency to enable reasonable samples of equivalent sites to be accumulated over the course of the major survey;
2. stratification in relation to pastoral management infrastructure, in order that particular null hypotheses (e.g. no difference in an attribute in relation to grazing distance from a stock watering point) could be tested to elucidate effects related to pastoral management impacts; and
3. addressing the scale of within-site environmental patterning realistically, so that quantitative data collected would be truly representative of the vegetation type and land unit in that part of a paddock or other management unit.

Five quantitative methods were developed to investigate specific vegetation types. Many vegetation types were sampled during the survey, with great disparities in the numbers of sites eventually sampled for each type. Summary quantitative data are

presented for 14 of the major vegetation types for which useful sets of data and condition states have been characterised.

Each condition site was preselected on aerial photographs to provide a sample of a well-developed major land unit at which an internally consistent example of a major and pastorally productive vegetation type could be expected. All sites were selected at controlled distances from the nearest accessible stock water point (1, 2, 4 km \pm 10% or > 5 km). Water points included those which were in one way or another malfunctioning, turned off, disused or derelict at the time they were encountered as well as those actually delivering water to stock. All developed water points were therefore considered to have had the capacity to have been focal points for grazing use.

Other data collected at all sites included the following.

(i) *General*

Aerial photograph: year, map sheet, run and number.
AMG coordinates.

Land system and unit.

Pastoral lease name.

Pasture (= vegetation type).

Paddock name.

Quadrant of paddock (NW, NE, SE, SW).

Site method (A-E, see below).

Quadrat area sampled (for methods C and D).

Total projected foliar cover (PFC) by all canopies of perennial shrubs and trees.

The dominant species and relative cover dominance of each stratum of perennial vegetation.

(ii) *Vegetation assessment*

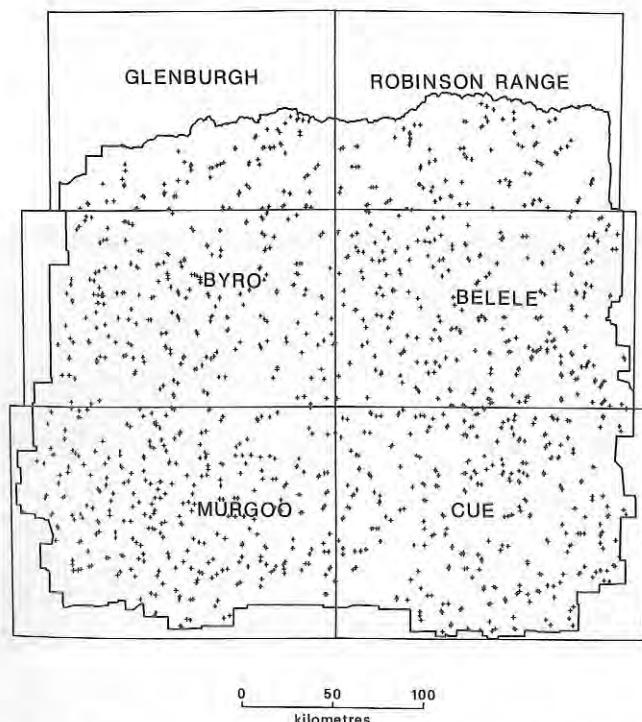


Figure 33. Condition assessment sites, Murchison rangeland survey.

Method A - Aggregated understorey communities
(for vegetation type Stony Snakewood Shrubland)

Ten canopies of tall shrubs/low trees were sampled (along a line of nearest neighbours) across the very scattered to scattered tall shrub landscape. Understorey shrubs and perennial herbs under each canopy were counted and recorded, and any presence of palatable perennials in inter-canopy areas was noted.

Method B - Chenopod steppes

For vegetation types:

- Saltbush Shrubland;
- Bluebush Shrubland;
- Mixed Halophyte Shrubland;
- Samphire Shrubland; and
- Mulga Chenopod Shrubland (part).

A plotless cover ranking of species, whereby the shrub species contributing the highest amount of cover (as PFC) was allocated a ranked score of 1.0, the next most prominent species 2.0 and so on. Species with similar cover contribution which could not be easily discriminated on the ordinal scale of ranks were scored as being equal and afforded values that were arithmetically equal in sum to what those ranks would have totalled if scored without ties. For example, two co-dominant species score 1.5 each; three equal 'runners up' behind a clearly dominant species (score 1.0) would each score 3.0 [(2 + 3 + 4) ÷ 3]. Score values up to 9.5 were recorded where applicable.

Method C - Very sparse shrub communities

For vegetation types:

- Stony Mulga Mixed Shrubland;
- Hardpan Mulga Shrubland (minority of sites); and
- Mulga Chenopod Shrubland (minority of sites).

A belt transect census technique was used whereby a 10 m rope was stretched out and carried by two observers for 100 m in a set direction (i.e. along a transect line from the photo point) and again along a parallel line on return. The transect area sampled was thus normally 2000 m² by this technique, which was able to address the composition of very scattered and/or irregularly clumped non-halophytic shrublands. In practice, a third observer walking behind the rope identified and scored all perennial plants in the transect area, with the assistance of both rope carriers. Transect length was verified by a cotton thread measuring device.

Method D - 'Mulga communities'

For vegetation types:

- Hardpan Mulga Shrubland;
- Granitic (and other) Mulga Shrubland;
- Mulga Chenopod Shrubland;

- Riverine Mixed Shrubland; and
- Sandplain Acacia Shrubland.

A two-plot quadrat census technique was used to sample two square patches of vegetation (each 500 m²), one positioned to be representative of less dense or inter-clump vegetation and the other to be representative of higher cover patches within 100 m of the site photo point. In this way the effect of plot position in communities exhibiting some degree of tall shrub patterning or groving could be minimised. The total area of the quadrats used (1000 m²) was standardised after reconnaissance survey and construction of a species-area curve for sites in 'fair to good' condition (Figure 34).

Method E - 'Perennial grasslands'

For vegetation types:

- Calcrete Shrubby Grassland;
- Non-calcareous Shrubby Grassland;
- Alluvial Tussock Grassland;
- Wanderrie Bank Grassy Shrubland; and
- Sandplain Wanderrie Grassy Shrubland.



Quantitative sampling methods were devised for the major vegetation types.

Low-density shrublands required large transects (0.1-0.2 ha) either marked for width using a 10 m length of rope, or as pegged census plots (below).

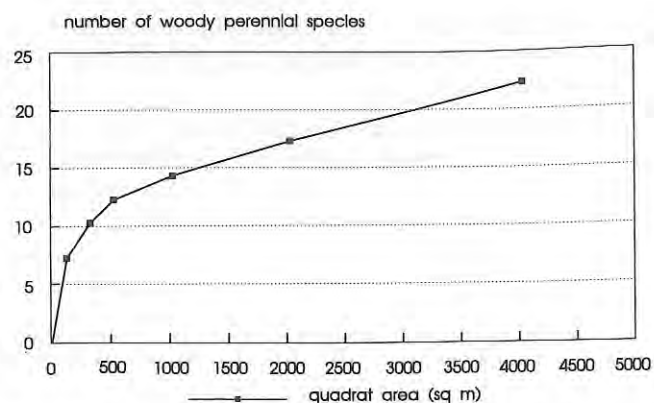


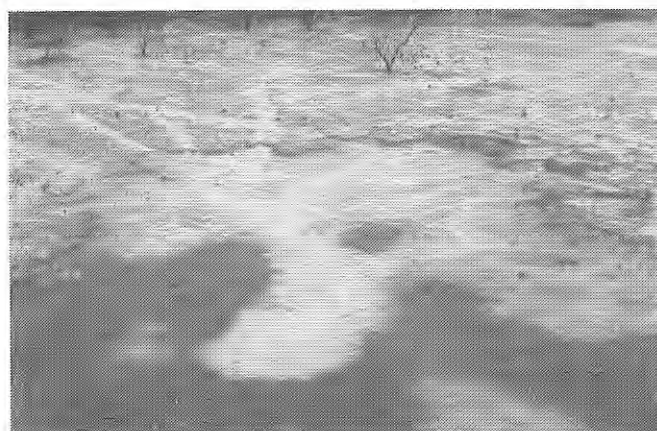
Figure 34. Calibration of quadrat sampling areas by species area curve for Hardpan Mulga Shrubland (HPMS) in 'fair to good' condition.

A plotless cover-rank technique was used. The total cover of perennial grasses on the site was assessed by photographic reference class. As with method B for chenopod steppes, a plotless cover ranking of species was scored by the cover rank score method.

(iii) Soil condition assessment

Any soil surface degradation and evidence of erosion encountered at each site was assessed by the combined type intensity scale (after Anon. 1988) detailed in Table 11.

The scale combines an assessment of the proportional area of a site affected by surface degradation and soil redistribution with alternative criteria for the type of erosion observed at each level of areal intensity. More than one sub-class could be recorded for any particular site, but by definition only under one areal intensity class. In this way, the sites provided a spot sampling record of the area of land surface affected and the major symptoms, features and types of erosion encountered.



The incidence, type and areal severity of soil erosion encountered throughout the survey was assessed by the type intensity scale at every site sampled. Another, simpler system of erosion assessment was used to record observations during each vehicular traverse.

Table 11. Combined type intensity ratings for wind and water erosion

Type intensity combination	Rating
No accelerated erosion present	00
Slight erosion (< 10% of site affected)	
Slight accumulation of wind blown soil around plant bases and other obstacles and/or	11
Removal of finer soil particles evident but soil crust is largely intact and/or	12
Occasional rills (< 300 mm deep) evident and/or	13
A few scalds present, usually less than 2 m in diameter	14
Minor erosion (10-25% of site affected)	
Accumulation of soil around plant bases with plant mounds noticeably enlarged and/or	21
Evidence of pedestalling but soil loss minor and plant bases not greatly elevated and/or	22
Breaking of surface crust with small erosion faces and some redistribution of soil and/or	23
Rilling evident but no gully development and/or	24
Scalding evident but scalds relatively small and discontinuous	25
Moderate erosion (25-50% of site affected)	
Wind piling around plant bases and other obstacles is common but no plants completely covered and/or	31
Pedestalling apparent with plant bases distinctly raised and with obvious soil loss and/or	32
Rilling common or gulying present on parts of site and/or	33
Surface sheeting with erosion faces, (and/or microterracing) and active redistribution of soil and/or	34
Wind scalds common	35
Severe erosion (50-75% of site affected)	
Extreme hummocking around plants and other obstacles: some plants completely covered and/or	41
Severe pedestalling with plant bases greatly elevated and major soil loss and/or	42
Widespread rilling or major gulying and/or	43
Scalding extensive, smaller scalds have coalesced to form large, more or less continuous scalded areas and/or	44
Surface sheeting with extensive exposure of subsoil or parent material; erosion faces (and/or microterracing) and active redistribution of soil and/or	45
Much of surface generally unstable with ripple mark formation	46
Extreme erosion (75-100% of site affected)	
General surface movement, total surface area bare with formation of shifting dunes and/or	51
Surface sheeting and/or scalding complete with exposure of subsoil or parent material and/or	52
Extensive gulying	53

Delineation of areas of severe degradation and erosion

In most instances, eroded soil surfaces on the red soil types are highly reflective in the red end of the visible spectrum. Where the particular patch or 'cell' of erosion is sufficiently large (> 5 ha), it was usually conspicuous and distinctive on aerial photography, especially where the erosive process leaves laminar-shaped sandy residuals and sinuous scour lines across broadly scalded and sheet-deflated areas. In some instances, extensive mantling of lag gravels and other surface features served to mask the visibility of eroded areas, on both aerial photographs and satellite images. Elsewhere, unusually reflective uneroded surfaces (e.g. quartz-mantled plains) mimic the signatures of eroded areas, particularly where the perennial vegetation is degraded or mainly lost.

More than 90% of areas indicated as being severely degraded and eroded by air photographic evidence were visited on the ground to verify the finding and to delineate actual boundaries of the affected area. Confirmation of the state of a few unseen areas was given by managers and other people with local knowledge. In this way, the total depiction of major severely degraded and eroded areas presented on the map series attempts to present a complete picture for the region, rather than a sampling approach.

Analysis of the field data

Inventory site data

The inventory site data were sorted and summarised on a land unit, land system, vegetation and soil basis using the INFO9 data base system on

Table 12. Example condition statement, derived from traverse records, for one land system on one station

	No. of records	Wind erosion (%)			Water erosion (%)			Total erosion (%)			Vegetation condition (%)			
		Nil	Min	Mod	Sev	Nil	Min	Mod	Sev	Very good	Good	Fair	Poor	Very poor
Land system Belele														
Unit Sandy bank	32	100	0	0	0	100	0	0	0	3	25	56	16	0
Unit Drainage floor	8	87	13	0	0	49	25	13	13	0	0	25	38	37
Unit Stony plain	1	100	0	0	0	100	0	0	0	0	0	0	100	0
Unit Hardpan plain	78	100	0	0	0	86	9	5	0	1	9	41	45	4
Unit Low rise	1	100	0	0	0	100	0	0	0	0	0	0	100	0
Summary for system	120	99	1	0	0	87	8	4	1	2	13	43	37	5

the Prime computer and various database packages on personal computers at the Department of Agriculture. This information was used to draw up detailed land unit, land system, soil type and vegetation descriptions which are presented later in this report.

Condition site data

Data obtained from condition sites were sorted and analysed by several different methods on PRIME and personal computers. A small number of sites were reclassified for vegetation type after critical re-examination of their biophysical attributes. In a few cases, where site attributes were inconsistent with those of initially allocated vegetation types, or land unit definitions, they were excluded from subsequent analysis and summaries of key criteria. Such sites are indicated by the suffix 'x' on the vegetation type designation (see Appendix 5).

Traverse record

Data recorded as hard copy in the field were checked and re-checked against final land system delineations and individual point locations on aerial photographs. Hard copy records were then entered and verified in a database, from which summaries and sortings of condition assessments were obtained for each:

- land system, unit by unit;
- lease and land system/unit within each lease;
- and for the whole survey area.

Where accelerated erosion had been recorded from observation of wind or water erosion symptoms, total erosion was derived by combining the wind and water erosion traverse recordings into one figure, with default to the higher recording. Table 12 shows an example condition statement derived from traverse records for one land system (and its component units) on one station.

Map preparation

Appendix 6 of this report consists of six 1:250,000 scale maps which graphically illustrate the various components of the survey. These types of maps are generally referred to as thematic maps meaning that they are designed to depict a particular theme or themes and are therefore not necessarily fully comprehensive in showing all data relevant to the survey area. For instance they do not show all topographic detail such as fences and minor tracks. The limitations of scale therefore should be considered whenever the maps are used. Other, more specific map series are available from various sources which will complement this series.

As a compromise between scale and the amount of detail that could have been shown on the 1:250,000 maps a format was devised that would reasonably accommodate as much of the survey data as was necessary to convey a regional perspective of the area.

The traverse assessments have been shown on the maps as a series of symbols derived from the traverse data.

The maps depict the following major themes.

Cultural data

- Cadastral or property boundaries and identifiers.
- Topographic infrastructure - roads, watering points, towns, homesteads.
- Topographic features - lakes, rivers, creeks and ranges.

Resource data

- Land systems and land types.
- Severely degraded and eroded areas (sde).
- Inventory sites.
- Condition sites.
- Point traverse assessments.

These and other components are permanently archived on various levels within a computer (digital) mapping system and therefore allow great flexibility in the manipulation of this data to produce specific plans tailored for selective applications. A pastoral lease map for each station has been prepared at a scale of 1:100,000 and contains all the information shown on the published 1:250,000 scale series but with more detail of hydrological features and station infrastructure.

The major advantage of computer mapping is that changes and updates can be readily made. This facility also enables changes to station infrastructure (such as re-positioning of fences and mills) to be modelled and the management implications of the changes to be assessed.

Presentation of preliminary findings for the survey to the Murchison pastoral community

In recognition of the fact that the pastoral community needed to have early access to, and awareness of, the main patterns of survey findings, a preliminary presentation of results was made at a public meeting hosted by the Murchison Land Conservation District (and attended by members of the Meekatharra, Yalgoo, Cue and Mount Magnet LCDCs) on 11 May 1989. The meeting made a series of resolutions concerning ways to use the survey information and combat land degradation through management.

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Land systems

A final classification of 74 land systems is described here, to comprise the entire land surface of the survey area. Thirty of the land systems are described for the first time; the remaining 44 have been described previously in adjacent areas. Those systems previously described are indicated by a letter (the report name) following the name in the general description and are as follows:

- (W) - Wiluna-Meekatharra survey (Mabbutt *et al.* 1963) to the east: 25 land systems in common.
- (G) - Gascoyne catchment survey (Wilcox and McKinnon 1972) to the north: 16 systems.
- (CB) - Carnarvon Basin survey (Payne *et al.* 1987) to the west: 3 systems.

In all cases, the descriptions focus on the best available information on regional patterns in vegetation composition, geological formations (some changes in their classification or estimated antiquity in accordance with more up-to-date findings) or in the proportions of the component land units actually encountered in the survey area.

A summary description of each system's major features precedes the more detailed accounts of the units that comprise each system. The format and conventions used for the summary descriptions are as follows.

- Land system name (and reference to past reports), area and the percentage of the survey area.
- The land type as mapped on the accompanying 1:250,000 map series.
- Pastoral potential (in good condition) on a regional scale of relativities.
- A brief encapsulation of the system's predominant landform(s) and vegetation features.
- The major geological formations or land surface types, listed according to stratigraphic development.
- An indication of the system's pastoral value and limitations on a regional scale of relativities; particular reference is made to the productive potential of the system under continuous grazing, susceptibility to erosion and special considerations or management requirements.
- **Estimated over summer (November-April) carrying capacity assuming good range condition and a preceding effective winter season**, expressed as ha/dry sheep equivalent (dse).
- A statement of the observed condition of the soil surfaces and perennial vegetation of the land system. This is expressed as; (a) the percentage of active erosion scores according to severity; (b) the percentage of vegetation assessments according to standard criteria for vegetation

condition. For land systems with few observations (< 20), the scores may not be representative; for example, often only the lower, more accessible parts of hill systems were traversed or sampled by sites.

- A locality map indicating distribution of the system throughout the region and the map sheet(s) on which it occurs.
- A listing of the component land units normally comprising the system numbered in sequence from the highest to the lowest units.
- A perspective diagram or plan view depicting the physical features of the system.

The tabulated descriptions of the land units summarise the biophysical component patterns and their normal variation. An approximate guide to the proportion of each unit within the system is given, based on interpretation of aerial photo information and field observation. The units are described under three category headings.

Landform and soils: the salient features of the unit's landform - its type, usual dimensions, slopes, relief, surface features and relationship with other units or systems. The nature of the soil profile and its normal range of variation is summarised in terms of surface colour, surface features and texture, basic profile textures, surface pH and soil reaction trend through the profile, depth and underlying material.

Vegetation, formations and major species: a measure of the areal cover (projected foliar cover) comprised by the whole (woody) perennial plant community, the predominant formation type (tall shrubland, low woodland, tussock grassland, etc.) encountered, followed by the species which predominate in the total perennial cover of individual sites. Species listed are those found to be most abundant and/or widespread on the unit. Where sufficiently distinctive, rather than variants on a theme, two or more different associations commonly encountered are described separately under (a), (b), etc.

Comments and condition indicators: the predominant regional vegetation type(s) to which the particular association(s) can be ascribed are indicated. This is generally followed by a short list of key palatable perennial species which confer seasonal resilience under grazing usage. These species can generally be used as indicators, being those with vulnerable populations which successful management of the land unit will benefit. Under unresponsive management these species tend to decrease and eventually disappear (from vegetation in poor condition). A second short list of increaser (unpalatable) species, to which the converse applies in pastoral management, indicates species which may tend to predominate on degraded sites of the particular land unit. Pastoral use limitations are those major factors of risk of degradation, or constraints otherwise limiting usefulness of the land for livestock, which need to be constantly borne in mind.

Finally, where observations are sufficient, a summary of soil and vegetation condition (derived from survey traverse records) is presented for the individual unit; VG/G = very good / good, F = fair, P / VP = poor / very poor, for definitions see under 'survey methods'.

Development of land system definition on the Belele map sheet

Examination of the Belele map sheet as re-mapped by the present survey reveals a number of features which differ from those shown by the CSIRO map of Mabbutt *et al.* (1963).

While the overall identification and distribution of particular land systems is predominantly similar, there are several general points to note on the new map.

1. Spatial discrimination and delineations between adjacent system polygons are more accurate (less 'rounding' error).
2. The relative positions of wash systems, tributary and river drainage systems now reflect the reality of an ordered sequence in the landscape. For example, Beringarra l.s. never lies above adjacent Ero l.s., nor is it encountered surrounding 'islands' of non-saline wash plains, e.g. Yandil l.s. Yandil is not found occupying the lower, concentrated drainage plains off broad wash systems such as Yanganoo. Such areas of concentrated drainage are invariably more or less saline, with some development of duplex soils and are more accurately mapped as Ero. Ero l.s. as mapped and defined within the

present report is more restricted than that originally described, to reflect the conclusion that most of the original upper units 1, 2 and 3 are more accurately mapped and described as parts of adjacent non-saline wash systems, e.g. Yanganoo or Belele. Some large areas previously mapped as Belele l.s. show such poor and intermittent development of wanderrie banks that they have been re-mapped as Yanganoo l.s. Areas previously mapped as Trennaman l.s. are more consistent with Jundee l.s. on the ground and have been redesignated accordingly, so Trennaman l.s. has been deleted from the Belele sheet.

3. Lower areas of the original delineation of Mindura l.s. are indistinguishable from Koonmarra and have been re-mapped accordingly.
4. There has been improved definition of Wiluna l.s. and more consistent discrimination from Violet l.s. and adjacent low 'greenstone' hills which lack the distinctive remnants of Old Plateau surfaces. Such hills are re-mapped as Gabanintha l.s., which now includes most Yagahong l.s. and the Edenhope l.s. in its entirety (where it has not been otherwise redesignated on the sheet).

Land system summary

Table 13 indicates the area of each land system and the intensity of sampling on each system in the survey area. Summary data on the condition status of each system is presented in the 'Condition of the land resource' section of this report (Tables 61 and 62).

Table 13. Land system areas and sampling intensity

Land system	Area (km ²)	Per cent of total area	No. of inventory sites	No. of condition sites	Traverse sampling intensity		
					No. of ratings	Density index	Sq km per rating
Agamemnon	423	0.49	1	0	6	0.09	71
Augustus	83	0.10	0	0	Not traversed	0.00	0
Austin	155	0.18	14	5	57	2.32	3
Badgeradda	124	0.14	4	1	16	0.81	8
Bayou	491	0.57	17	12	177	2.27	3
Beasley	138	0.16	1	0	8	0.37	17
Belele	4,701	5.47	9	73	773	1.04	6
Beringarra	2,629	3.06	32	68	626	1.50	4
Bidgemia	221	0.26	4	3	25	0.71	9
Boulder	832	0.97	11	20	146	1.11	6
Breberle	115	0.13	3	0	27	1.48	4
Bullimore	67	0.08	3	3	21	1.98	3
Bunny	485	0.56	8	6	108	1.40	4
Byro	497	0.58	12	10	94	1.19	5
Carnegie	1,281	1.49	22	5	107	0.53	12
Challenge	5,159	6.01	21	80	834	1.02	6
Channel	94	0.11	1	0	12	0.80	8
Cole	1,196	1.39	2	13	151	0.80	8
Coolabulla	50	0.06	3	1	12	1.51	4
Cunyu	1,083	1.26	26	14	234	1.36	5
Ero	1,589	1.85	25	39	518	2.06	3
Eurardy	195	0.23	2	0	17	0.55	11
Farmer	81	0.09	3	0	19	1.48	4
Flood	439	0.51	3	11	60	0.86	7
Frederick	36	0.04	0	0	3	0.53	12
Gabanintha	962	1.12	11	9	133	0.87	7
Holmwood	355	0.41	5	3	27	0.48	13
Horseshoe	204	0.24	5	1	30	0.93	7
Jimba	36	0.04	0	0	Not traversed	0.00	0

Table 13—continued

Land system	Area (km ²)	Per cent of total area	No. of inventory sites	No. of condition sites	Traverse sampling intensity		
					No. of ratings	Density index	Sq km per rating
Jundee	1,346	1.57	13	32	328	1.54	4
Kalli	6,097	7.10	23	70	704	0.73	9
Koonmarra	5,335	6.21	17	91	696	0.82	8
Liver	752	0.88	8	9	91	0.76	8
Mantle	155	0.18	4	0	6	0.24	26
Merbla	76	0.09	4	3	19	1.58	4
Mileura	1,007	1.17	37	35	301	1.88	3
Millex	500	0.58	19	7	87	1.10	6
Millrose	535	0.62	7	7	95	1.12	6
Mindura	3,661	4.26	16	31	322	0.55	11
Mongolia	456	0.53	6	8	72	0.99	6
Moogooloo	20	0.02	0	0	Not traversed	0.00	0
Naluthanna	26	0.03	3	0	10	2.43	3
Narryer	2,510	2.92	16	39	300	0.75	8
Nerramyne	848	0.99	12	10	146	1.09	6
Nerren	110	0.13	3	0	Not traversed	0.00	0
Norie	1,321	1.54	11	4	71	0.34	19
Outcamp	44	0.05	2	3	12	1.72	4
Peak Hill	503	0.59	1	0	2	0.03	252
Pells	4	< 0.01	0	0	Not traversed	0.00	0
Roderick	407	0.47	8	6	74	1.15	6
Sandiman	347	0.40	5	4	33	0.60	11
Sandplain	2,884	3.36	7	16	209	0.46	14
Sherwood	4,839	5.63	38	64	762	0.99	6
Siberia	43	0.05	3	0	19	2.79	2
Thomas	458	0.53	6	2	31	0.43	15
Tindalarra	3,091	3.60	17	64	741	1.51	4
Trillbar	131	0.15	10	3	56	2.70	2
Violet	1,078	1.26	15	23	260	1.52	4
Waguin	748	0.87	6	6	102	0.86	7
Weenyung	153	0.18	3	4	33	1.36	5
Weld	350	0.41	7	0	59	1.06	6
Wiluna	1,294	1.51	15	15	253	1.23	5
Wolarry	368	0.43	9	7	78	1.34	5
Wongong	317	0.37	3	11	62	1.23	5
Woodline	2,932	3.41	10	44	542	1.17	5
Woodrarrung	371	0.43	6	0	15	0.25	25
Wooleen	55	0.06	2	0	11	1.26	5
Wooramei	56	0.07	0	0	Not traversed	0.00	0
Yagahong	141	0.16	3	0	8	0.36	18
Yalbalgo	127	0.15	2	0	16	0.79	8
Yandil	3,402	3.96	16	60	610	1.13	6
Yanganoo	12,433	14.48	18	217	1,976	1.00	6
Yarrameedie	519	0.60	7	9	98	1.19	5
Yewin	316	0.37	13	8	70	1.40	5
Total	85,887*	100.00	679	1,289	13,621	1.00	6

* Does not include some vacant Crown land which occurs in the survey area.

+ Sampling density index: measure of sampling intensity relative to the mean (1.0) of the survey area.

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- Payne, A.L., Curry, P.J. and Spencer, G.F. (1987). An inventory and condition survey of rangelands in the Carnarvon Basin, Western Australia. Department of Agriculture, Western Australia, Technical Bulletin No. 73.
- Wilcox, D.G. and McKinnon, E.A. (undated, circa 1972). A report on the condition of the Gascoyne catchment. Department of Agriculture, Western Australia.



Land type 1. Rough hills with acacia shrublands; greenstone ranges of the Weld land system, Glen station.



Land type 1. Rough hills with acacia shrublands; granite domes, Norie land system, Jingemarra station.



Land type 2. Hills and plains with mulga, snakewood - halophyte shrublands: Sandiman land system, Innouendy station.



Land type 3. Low hills and quartz strewn plains with mulga shrublands: Mindura land system, Beringarra station.



Land type 4. Breakaways, stony plains and sandy surfaced plains on granite with mulga and halophytic shrublands: Challenge land system in very good condition, Meka station.



Land type 5. Plains with mulga-snakewood-halophyte shrublands: Byro land system, Curbur station.



Land type 6. Stony plains and rises with patchy shrublands: Boulder land system, Curbur station.



Land type 7. Irregular plains on laterite and parent rock, with mulga, bowgada and halophytic shrublands: Waguin land system, Jingemarra station.



Land type 8. Saline stony plains with halophytic shrublands: Austin land system, Austin Downs station.



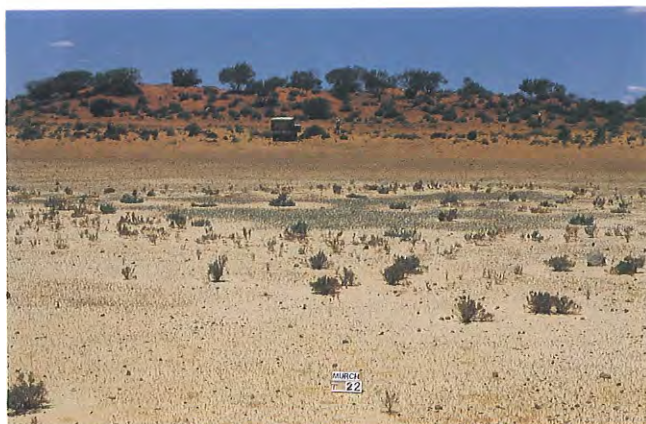
Land type 9. Sand plains with acacia - mallee shrublands and hard spinifex: Bullimore land system, Wondinong station.



Land type 10. Sandplains with grassy shrublands: Kalli land system, Woolgorong station.



Land type 11. Sandplains with acacia - mallee shrublands: Eurardy land system, Bullardoo station.



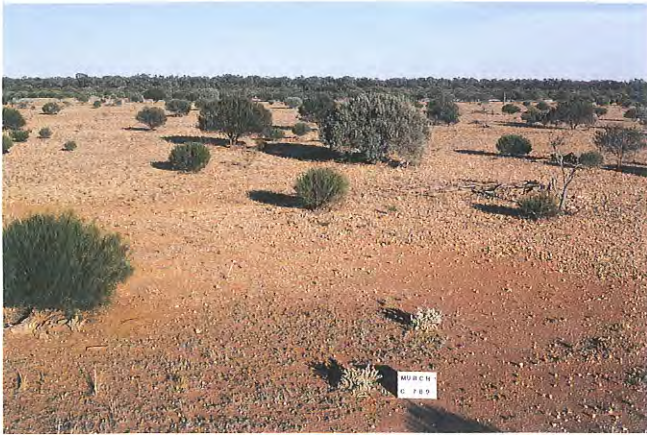
Land type 12. Sandplains and drainage floors with grassy and halophytic shrublands: Liver land system, Curbur station.



Land type 13. Wash plains and sandy banks on hardpan, with wanderrie and mulga shrublands: Yanganoo land system, Coodardy station.



Land type 14. Wash plains on hardpan with mulga shrublands: Woodline land system, Wynyangoo station.



Land type 15. Calcreted river plains with grassy shrublands: Cunyu land system, Nallan station.



Land type 16. River plains with bluebush, saltbush and other shrublands: Roderick land system, Twin Peaks station.



Land type 17. Alluvial plains and salt lakes with halophytic shrublands: Carnegie land system, Yarraquin station.



Land type 18. Clay plains with bluebush and saltbush shrublands and grasslands: Merbla land system, Wondinong station.



Land type 19. Lake beds with halophytic shrublands and grasslands: Wooleen land system, Wooleen station.

Agamemnon land system (G) 423 km² (0.49% of survey area)

Land type: 1; Pastoral potential: very low.

Rugged hills with peaks and ridges above extensive stony slopes supporting scattered tall shrublands of mulga and other *Acacia* spp.

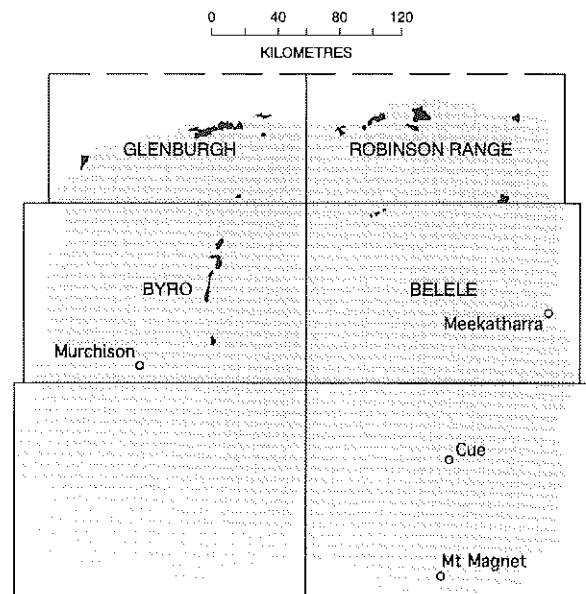
Geology: Proterozoic gneiss, schist, and quartzite mainly of the Morrissey metamorphic suite.

Geomorphology: Erosional surfaces, mainly low rough hills, with gneissic outcrops, peaks and ridges to 60 m, with pebble strewn footslopes draining across short flats with duplex soils into channelled tributaries with sandy bedloads.

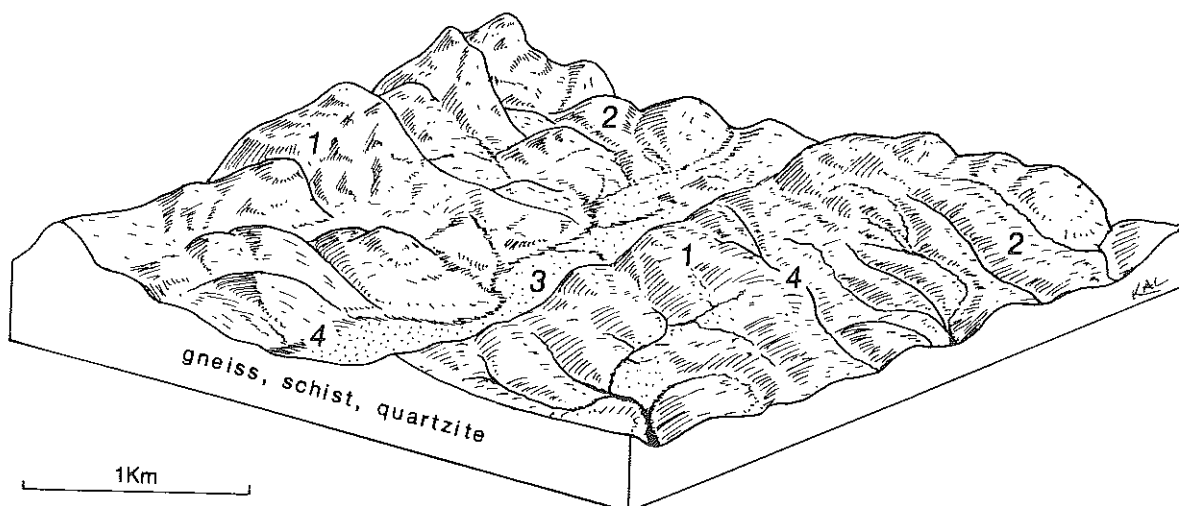
Vegetation and pastoral use: Mainly unproductive Rocky Hill Mixed Shrubland with large areas poorly accessible to stock; the lower units 3 and 4 are more productive and accessible but are susceptible to degradation and water erosion through overgrazing; units 1 and 2 are not prone to erosion owing to protective mantles.

Estimated carrying capacity, good condition: 30 ha/dse.

Range condition summary (6 traverse observations): Insufficient data are available, but general condition can be expected to be similar to that in adjacent areas of the Gascoyne catchment, where Wilcox and McKinnon (1972) reported the higher major units to be in mainly good condition but the small lower units (3 and 4) were often degraded and eroded.



- Unit: 1. Peaks, outcrops and ridges.
 2. Rounded summits and stony slopes.
 3. Drainage flats.
 4. Narrow drainage floors and channels.



Agamemnon I.s. (adapted from Payne *et al.* 1987)

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Peaks, outcrops and ridges (35%) Rocky hills to 75 m with strike ridges of schist and quartzite with occasional gneissic outcrops; locally heavily strewn with boulders. Soils are limited to isolated pockets of lithosols.	Partly unvegetated, isolated low shrubs mainly <i>Eremophila exilifolia</i> and <i>E. freelingii</i> .	Pasture type: Rocky Hill Mixed Shrubland. Pastoral use limitations: Mainly inaccessible to stock.
Unit 2: Rounded summits and stony slopes (50%) Rounded hilltops and concave slopes, with grades to 10% relief up to 40 m, lightly to moderately strewn with quartzite pebbles. Soils are shallow dark red fine sandy loams, pH 6.5 with a neutral trend. Principal profile form: Uc1.43.	Very scattered (PFC < 10%) shrublands dominated by <i>Acacia aneura</i> , <i>A. xiphophylla</i> or <i>Eremophila</i> spp. Trees or tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. xiphophylla</i> , <i>A. victoriae</i> , <i>A. tetragonophylla</i> , <i>Eremophila freelingii</i> , <i>E. macmillaniana</i> , <i>Solanum lasiophyllum</i> , <i>Scaevola spinescens</i> , <i>Rhagodia</i> sp. Perennial grass: <i>Cymbopogon ambiguus</i> .	1 site inventory and traversed Vegetation type: Rocky Hill Mixed Shrubland. Palatable perennials include: <i>Maireana</i> spp., <i>Ptilotus obovatus</i> , <i>Scaevola spinescens</i> . Pastoral use limitations: Local inaccessibility to stock.
Unit 3: Drainage flats (5%) Very restricted alluvial fans and drainage plains, slopes up to 4%. Soils are dark red duplex types, loamy sands or sandy loams grading to sandy clay loams and sandy clays, > 1 m deep, pH 6.5-7.5. Principal profile form: Dr4.12.	Scattered (PFC 10-20%) shrublands dominated by <i>Acacia aneura</i> or <i>A. victoriae</i> and <i>Frankenia</i> spp. on saline sites.	Traversed Vegetation type: Mulga Chenopod Shrubland. Palatable perennials include: <i>Frankenia</i> spp., <i>Maireana</i> spp. Pastoral use limitations: Moderate susceptibility to water erosion if perennial vegetation is degraded.
Unit 4: Narrow drainage floors and channels (10%) Drainage zones of moderate intensity, radially dendritic around isolated ridges, trellised or rectangular elsewhere. Soils are dark red duplex (as unit 3) bordering the channels while the bedloads are of sands, pebbles and cobbles.	Moderately close (PFC 20-50%) to close tall shrublands dominated by <i>Acacia aneura</i> , <i>A. tetragonophylla</i> and patchy perennial grasses. Trees and tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. tetragonophylla</i> , <i>A. kempeana</i> , <i>A. victoriae</i> , <i>Hakea suberea</i> . Low shrubs (< 2 m): <i>Cassia helmsii</i> , <i>Corchorus walcottii</i> , <i>Abutilon</i> spp., <i>Ptilotus obovatus</i> , <i>Rhagodia eremaea</i> . Perennial grass: <i>Chrysopogon fallax</i> .	Traversed Vegetation type: Creekline Grassy Shrubland. Palatable perennials include: <i>Chrysopogon fallax</i> , <i>Ptilotus obovatus</i> , <i>Scaevola spinescens</i> . Pastoral use limitations: Slight susceptibility to erosion when degraded.

Augustus land system (G) 83 km² (0.10% of survey area)

Land type: 1; Pastoral potential: very low.

Rugged ranges of hills, ridges and plateaux with skeletal soils supporting tall acacia shrublands.

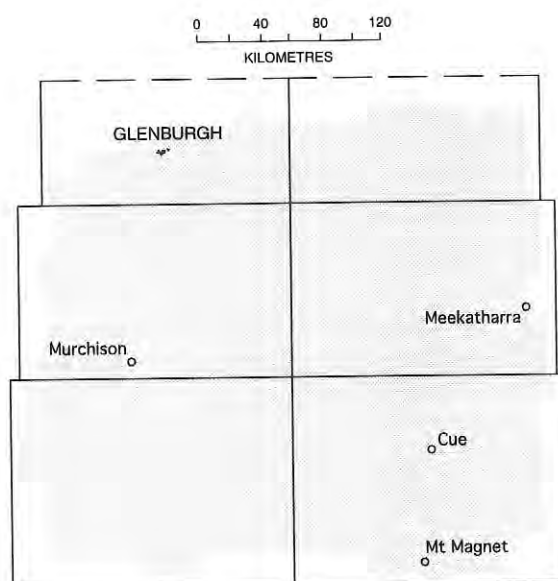
Geology: Middle to late Proterozoic metamorphosed sandstone, quartzite, dolerite, shale or conglomerates of the Bangemall and Mt James formations.

Geomorphology: Ranges and hills with steep escarpments and upper slopes; erosional surfaces: restricted lower slopes, valley plains and narrow drainage floors; dendritic and rectangular drainage patterns of moderate density; relief mainly 100 to 200 m.

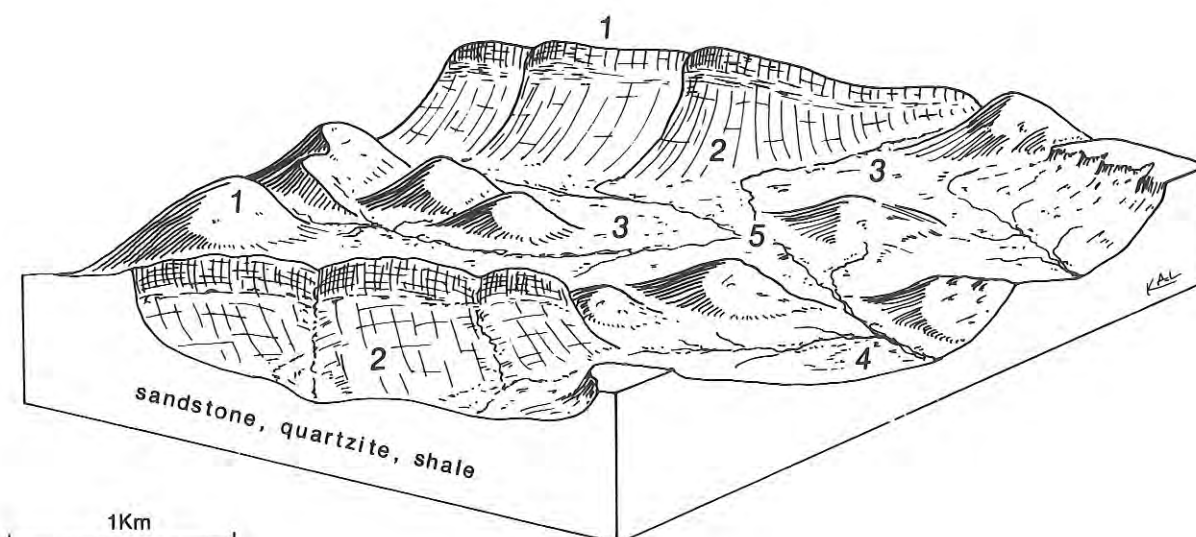
Vegetation and pastoral use: The sparsely vegetated uplands of unit 1 are largely inaccessible to domestic stock; mainly Rocky Hill Mixed Shrubland with many annual species; the lower units are more accessible but lack drought reserves owing to a paucity of perennial forage species.

Estimated carrying capacity, good condition: 30 ha/dse.

Range condition summary: Not traversed, of very minor occurrence within the survey area, presumably in fair to good condition owing to inaccessibility.



- Unit: 1. Summits, ridges and rocky uplands.
2. Lower footslopes.
3. Stony undulations and interfluves.
4. Drainage floors.
5. Channels and creeks.



Augustus I.s. (adapted from Payne *et al.* 1987)

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Summits, ridges and rocky uplands (65%) Rugged sandstone summits and hilltops of up to 300 m relief. Soils are confined to isolated pockets of lithosols.	Very scattered to scattered (PFC < 20%) tall shrublands dominated by <i>Acacia aneura</i> or <i>A. grasbyi</i> . Low shrubs include <i>Cassia</i> spp., <i>Ptilotus</i> spp. and <i>Eremophila</i> spp.	Vegetation type: Rocky Hill Mixed Shrubland. Pastoral use limitations: Limited accessibility to stock, low productivity and lack of drought durability.
Unit 2: Lower footslopes (20%) Concave slopes up to 5% with boulder outcrops and locally abundant mantles of loose rocks. Soils are lithosols.	Very scattered (PFC < 10%) tall shrublands dominated by <i>Acacia aneura</i> . Low shrubs: <i>Eremophila freelingii</i> , <i>Solanum</i> spp.	Vegetation type: Rocky Hill Mixed Shrubland. Pastoral use limitations: Grazing productivity mainly from annuals only.
Unit 3: Stony undulations and interfluves (10%) Undulating rocky surfaces, slopes up to 4%, with locally abundant mantles of cobbles and pebbles; marginal dissections are mostly narrow. Soils are shallow red loams over parent rock or hardpan. Principal profile form: probably Um6.24.	Very scattered (PFC < 10%) tall shrublands dominated by <i>Acacia</i> spp., denser in the dissections receiving run-on.	Vegetation type: Rocky Hill Mixed Shrubland. Sparse perennials augmented by annual grasses and forbs in favourable seasons. Pastoral use limitations: Grazing productivity mainly from annuals only.
Unit 4: Drainage floors (2%) Angular to rectangular drainage zones, slopes < 0.3%. Soils are variable alluvial sands or loams, locally saline.	Tall shrublands or low woodlands dominated by <i>Acacia citrinoviridis</i> , <i>A. kempeana</i> and <i>A. aneura</i> . Low shrubs: <i>Eremophila forrestii</i> , <i>Maireana</i> spp.	Vegetation type: Creekline Shrubland. Pastoral use limitations: None under controlled grazing.
Unit 5: Channels and creeks (3%) Irregular incised watercourses, soils are mainly unsorted coarse sands to pebbles, more loamy at margins.	Fringing woodlands dominated by <i>Eucalyptus camaldulensis</i> , <i>Acacia aneura</i> and <i>A. citrinoviridis</i> . Low shrubs: <i>Eremophila margarethae</i> , <i>E. freelingii</i> and <i>Solanum</i> spp.	Vegetation type: Creekline Shrubland. Pastoral use limitations: None under controlled grazing.

Austin land system 155 km² (0.18% of survey area)

Land type: 8; Pastoral potential: high.

Saline stony plains with low rises and drainage foci supporting low halophytic shrublands with scattered mulga; occurs mainly adjacent to lakes Austin and Annean, below greenstone hill systems.

Geology: Quaternary colluvium and alluvium with isolated Precambrian greenstone intrusives and Archaean granitic outcrops.

Geomorphology: Mainly erosional surfaces: gently undulating saline stony plains with scattered drainage foci and associated internal sluggish drainage lines; low rises and ridges up to 20 m high, but usually 5 to 10 m.

Vegetation and pastoral use: Bluebush and Stony Snakewood Shrublands; palatable saline perennials of moderate quantity provide the bulk of the forage on the larger units; scattered mixed *Acacia* and *Eremophila* spp. are prominent on units 1, 3 and 5. Preferential over-grazing of unit 5 can lead to increased erosion.

Estimated carrying capacity, good condition: 7 ha/dse.

Range condition summary (57 traverse observations):

(a) Erosion status (%)

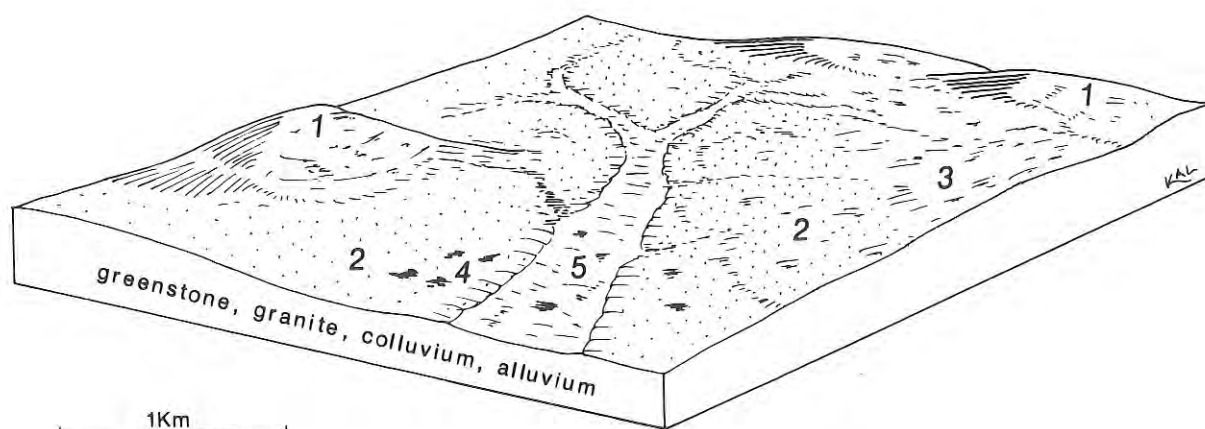
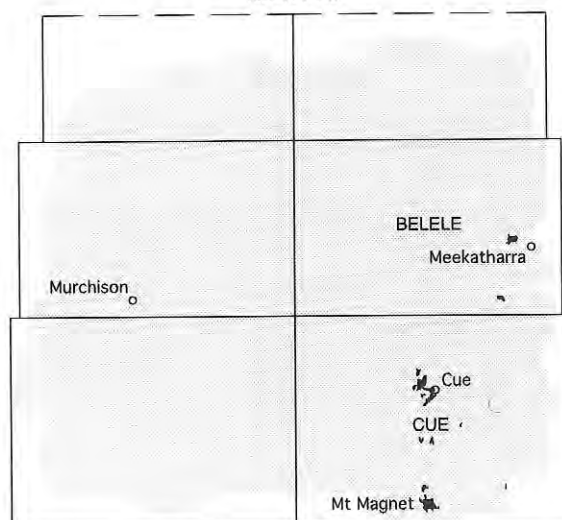
Nil	Min.	Mod.	Sev.
73	18	9	0

(b) Vegetation condition (%)

Good	Fair	Poor
34	41	25

- Unit: 1. Low ridges and rises.
 2. Saline stony plains.
 3. Non saline stony plains.
 4. Drainage foci.
 5. Drainage tracts.

0 40 80 120
KILOMETRES



Austin I.s.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Low ridges and rises (5%) Stony rises and low ridges of outcropping granite, quartz or greenstone, up to 800 m long relief 2-25 m and short footslopes with abundant mantles of cobbles and pebbles. Soils are shallow alkaline red earths and hard-setting duplex types; principal profile forms: Uc1.33, Dr2.53.	Scattered shrublands or woodlands usually dominated by <i>Acacia aneura</i> with low shrubs <i>Ptilotus obovatus</i> , <i>Cassia</i> spp., occasionally <i>Maireana</i> spp.	2 inventory sites and traversed Vegetation type: Mainly Rocky Hill Mixed Shrubland. Pastoral use limitations: None under controlled grazing.
Unit 2: Saline stony plains (80%) Flat to gently sloping (< 1%) plains extending up to 3 km with scattered small (generally < 20 m in diameter) drainage foci in parts, commonly with moderately dense to very dense mantles of quartz or ironstone gravel and pebbles. Soils are predominantly shallow, hard-setting duplex types as sandy loams over light clays, pH 6.5-8.5 with neutral or alkaline reaction trends; also clays in lower parts or shallow earthy sands over greenstones. Principal profile forms: Dr2.12, 2.13, 2.53, Uf6.31, Uc1.43.	Very scattered to scattered low shrublands (PFC < 20%) dominated by <i>Maireana</i> spp. Trees (occasional, 2-5 m): <i>Acacia aneura</i> ; Tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. victoriae</i> , <i>A. tetragonophylla</i> , <i>Hakea preissii</i> ; Low shrubs (< 1 m): <i>Maireana pyramidata</i> , <i>M. platycarpa</i> , <i>M. georgei</i> , <i>M. atkinsiana</i> , <i>M. glomerifolia</i> , <i>M. triptera</i> , <i>Atriplex vesicaria</i> , <i>Rhagodia eremaea</i> , <i>Halosarcia</i> spp., <i>Frankenia</i> spp., <i>Ptilotus obovatus</i> . Perennial grass: (occasional) <i>Eragrostis setifolia</i> .	8 inventory sites, 2 condition sites and traversed Vegetation type: Bluebush Shrubland. Palatable perennials include: <i>Maireana pyramidata</i> , <i>M. platycarpa</i> , <i>M. georgei</i> , <i>M. atkinsiana</i> , <i>Atriplex vesicaria</i> , <i>Frankenia</i> spp. Pastoral use limitations: High salinity levels of pasture plants and mild susceptibility to erosion where perennial vegetation is degraded. Vegetation condition %: VG/G 40, F 39, PVP 21. Erosion incidence %: min 15, mod 6. 33 obs.
Unit 3: Non saline stony plains (10%) Flat to gently sloping (< 1%) plains on granite within, or above, unit 2; mantles of quartz and granite and occasional granite outcrop. Soils are shallow, dark red, sandy loams and sandy clay loams over granite, pH 7.0 with neutral reaction trends. Principal profile forms: Uc5.21, Um5.51.	Very scattered to scattered low shrublands (PFC < 20%). Tall shrubs (> 2 m): <i>Acacia aneura</i> , <i>A. sp.</i> , <i>A. tetragonophylla</i> ; Low shrubs (< 1 m): <i>Ptilotus obovatus</i> , <i>P. schwartzii</i> , <i>Eremophila pumila</i> , <i>E. exilifolia</i> , <i>Solanum lasiophyllum</i> , <i>Maireana convexa</i> , <i>M. triptera</i> , <i>Sida calyxhymentia</i> , <i>Spartothamnella teucriflora</i> .	2 inventory sites and traversed Vegetation type: Granitic Mulga Shrubland. Palatable perennials include: <i>Ptilotus schwartzii</i> , <i>Maireana convexa</i> , <i>Sida calyxhymentia</i> , <i>Spartothamnella teucriflora</i> . Pastoral use limitations: None under controlled grazing.
Unit 4: Drainage foci (< 1%) Small, discrete foci (10-50 m in diameter) occurring sparsely within units 2 and 5. Soils are dark red clays of variable depth over hardpan or parent rock, pH 6.0 with neutral reaction trends. Principal profile form: Uf6.71.	Moderately close or close woodland or tall shrubland (PFC 20-50%) usually dominated by <i>Acacia aneura</i> or <i>A. tetragonophylla</i> . Trees (4-8 m): <i>A. aneura</i> ; Tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. tetragonophylla</i> ; Mid and low shrubs: <i>A. tetragonophylla</i> , <i>Eremophila youngii</i> , <i>E. forrestii</i> , <i>E. longifolia</i> , <i>Ptilotus obovatus</i> , <i>Maireana pyramidata</i> , <i>Scaevola spinescens</i> , <i>Cassia desolata</i> , <i>Enchylaena tomentosa</i> , <i>Rhagodia eremaea</i> , <i>Sida calyxhymentia</i> .	1 inventory site Vegetation type: Mulga Grove Woodland. Palatable perennials include: <i>Maireana pyramidata</i> , <i>Enchylaena tomentosa</i> , <i>Rhagodia eremaea</i> . Pastoral use limitations: None under controlled grazing.
Unit 5: Drainage tracts (5%) Gently sloping linear drainage tracts, mostly unchannelled but occasionally incised with rills, gutters and shallow gullies; variable mantles of ironstone and quartz. Soils are red earths and probably also duplex types. Principal profile form: Um5.52.	Very scattered low woodland or tall shrubland (PFC < 10%) dominated by <i>Acacia aneura</i> .	1 inventory site and traversed Vegetation type: Hardpan Mulga Shrubland or Bluebush Shrubland. Palatable perennials include: <i>Eremophila latrobei</i> , <i>Enchylaena tomentosa</i> , <i>Rhagodia eremaea</i> , <i>Maireana</i> spp. Pastoral use limitations: Susceptible to erosion if perennial vegetation is degraded.

Badgeradda land system 124 km² (0.14% of survey area)

Land type: 2; Pastoral potential: low.

Hills and ridges, often with benched slopes mantled by flat cobbles, and stony plains on siltstone and silty sandstone; supports moderately saline shrublands but otherwise similar to Woodrarrung land system.

Geology: Late Proterozoic siltstone and sandstone; mostly of the Yarrawolya and Coomberarie formations of the Badgeradda group; also Quaternary colluvium and alluvium.

Geomorphology: Erosional surfaces; low hills, ridges and associated benched slopes formed through weathering of old plateau; lower slopes and plains of similar origin but with colluvial and aeolian sand accumulations; alluvial drainage zones to several hundred metres wide; overall relief mainly about 50 m.

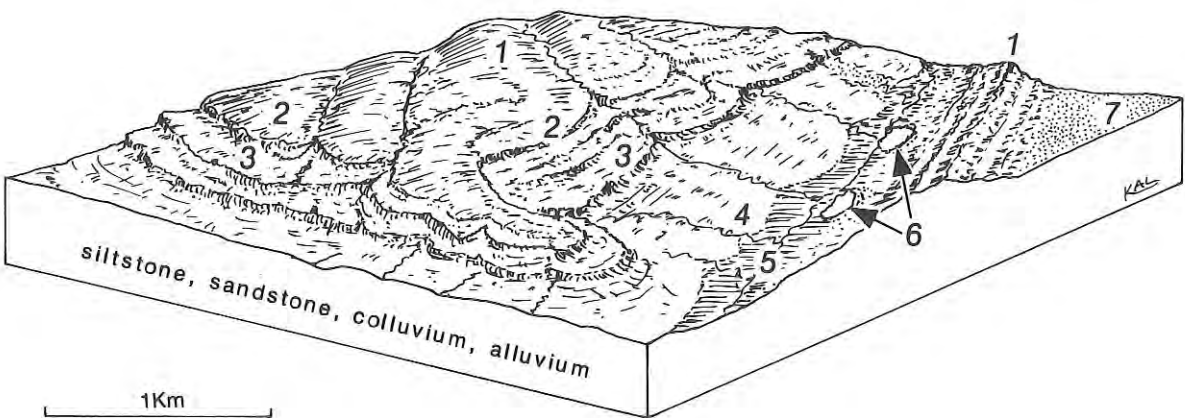
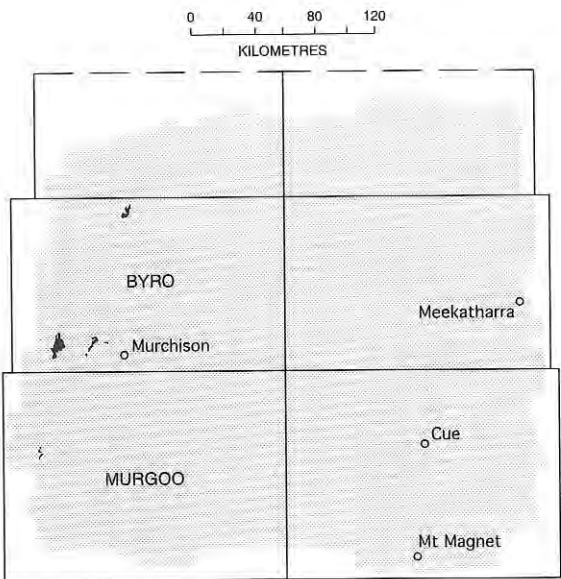
Vegetation and pastoral use: Stony Snakewood Shrublands on upper slopes, hills and ridges, poorly accessible to stock, and of limited use. Also supports saltbush and other saline shrublands on lower plains and drainage floors, productive when in reasonable condition; minor susceptibility to erosion on exposed duplex soils.

Estimated carrying capacity, good condition: 20 ha/dse.

Range condition summary (16 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
81	6	13	0	37	25	38

- Unit: 1. Stony hills and ridges.
2. Hill footslopes.
3. Benched lower slopes.
4. Stony plains.
5. Drainage zones.
6. Claypans.
7. Sand sheets.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Stony hills and ridges (40%) Hills and low escarpments, undulating crests and crest-like ridges with up to 50 m relief, with abundant platy siltstone mantles. Soils are probably shallow red duplex types over siltstone, or lithosol loams.	Scattered (PFC 10-20%) shrublands dominated by <i>Acacia xiphophylla</i> and <i>Maireana pyramidata</i> . Tall shrubs (> 2 m): <i>A. xiphophylla</i> , <i>A. aneura</i> . Mid shrubs (1-2 m): <i>Lycium australe</i> , <i>A. tetragonophylla</i> , <i>Scaevola spinescens</i> , <i>A. microcalyx</i> , <i>Cassia phyllodinea</i> , <i>Eremophila longifolia</i> . Low shrubs (< 1 m): <i>Maireana pyramidata</i> , <i>M. georgei</i> , <i>Ptilotus obovatus</i> , <i>P. polakii</i> , <i>M. triptera</i> , <i>M. tomentosa</i> , <i>Enchylaena tomentosa</i> , <i>Eremophila compacta</i> , <i>Halosarcia</i> sp.	1 inventory site and traversed Vegetation type: Stony Snakewood Shrubland. Palatable perennials include: <i>Maireana pyramidata</i> , <i>M. georgei</i> , <i>Atriplex bunburyana</i> , <i>Enchylaena tomentosa</i> . Pastoral use limitations: Upper parts of unit poorly accessible to stock.
Unit 2: Hill footslopes (10%) Slopes around 10% flanking unit 1, abundantly mantled with siltstone or fine sandstone cobbles and angular flagstones. Soils are probably shallow red duplex types over parent rock.	Scattered (PFC 10-20%) shrublands dominated by <i>Acacia xiphophylla</i> , <i>A. cuthbertsonii</i> and <i>Maireana pyramidata</i> , similar to unit 1.	Traversed Vegetation type: Stony Snakewood Shrubland as unit 1.
Unit 3: Benched lower slopes (20%) Benched slopes around 1% below steeper footslopes and breakaway escarpment faces, abundantly mantled by platy siltstone fragments. Soils are shallow to moderately deep hard-setting duplexes, pH 7.0 with a neutral soil reaction trend. Principal profile form: Dr2.52.	Very scattered (PFC < 10%) shrublands dominated by <i>Acacia aneura</i> and <i>A. cuthbertsonii</i> , with understorey halophytic shrubs. Mid shrubs: <i>A. tetragonophylla</i> , <i>Cassia nemophila</i> , <i>Eremophila lachnocalyx</i> . Low shrubs (< 1 m): <i>Maireana triptera</i> , <i>M. planifolia</i> , <i>M. tomentosa</i> , <i>Ptilotus polakii</i> , <i>P. obovatus</i> , <i>Enchylaena tomentosa</i> , <i>Atriplex bunburyana</i> , <i>A. vesicaria</i> .	1 condition site and traversed Vegetation type: Mulga Chenopod Shrubland. Palatable perennials include: <i>Atriplex</i> spp., <i>Maireana</i> spp., <i>Ptilotus</i> spp. Pastoral use limitations: None under controlled grazing.
Unit 4: Stony plains (25%) Lower plains, moderately or abundantly mantled by rock fragments and with saline or non-saline loamy soils over colluvium.	Very scattered (PFC < 10%) shrublands, either dominated by <i>Acacia</i> spp. and <i>Ptilotus obovatus</i> , with other non-saline browse shrubs or <i>Halosarcia</i> and <i>Maireana</i> spp. on saline sites.	2 inventory sites and traversed Vegetation type: Samphire Shrubland. Palatable perennials include: <i>Maireana</i> spp., <i>Ptilotus obovatus</i> . Pastoral use limitations: High salinity levels in pasture plants.
Unit 5: Drainage zones (< 5%) Restricted drainage tracts with very gentle slopes (< 0.5%) and small channels incised to < 1 m; sandy hummocks to 1 m common. Soils are shallow crusted duplexes to 60 cm; pH 7.5-8.0 with neutral trend. Principal profile form: Dr1.55.	Very scattered (PFC < 10%) low shrublands dominated by <i>Atriplex bunburyana</i> . Tall shrubs (< 2 m): <i>Acacia victoriae</i> . Mid shrubs (1-2 m): <i>Hakea preissii</i> , <i>A. sclerosperma</i> , <i>A. victoriae</i> . Low shrubs (< 1 m): <i>Atriplex bunburyana</i> , <i>Enchylaena tomentosa</i> , <i>Maireana integra</i> , <i>M. tomentosa</i> , <i>Chenopodium gaudichaudianum</i> . Perennial grass: <i>Enteropogon acicularis</i> .	1 inventory site and traversed Vegetation type: Saltbush Shrubland. Palatable perennials include: <i>Atriplex bunburyana</i> , <i>Chenopodium gaudichaudianum</i> , <i>Enchylaena tomentosa</i> , <i>Maireana integra</i> , <i>M. pyramidata</i> , <i>M. tomentosa</i> , <i>Enteropogon acicularis</i> . Increaser species include: <i>Acacia victoriae</i> , <i>Hakea preissii</i> . Pastoral use limitations: Soils are susceptible to erosion if disturbed or overgrazed.
Unit 6: Claypans (< 1%) Small pans, some stony, mainly unvegetated.		
Unit 7: Sand sheets (< 1%) Marginal sandy plains.		

Bayou land system 491 km² (0.57% of survey area)

Land type: 16; Pastoral potential: high.

Saline alluvial meander plains and river floodplains with anastomosing river channels supporting halophytic shrublands with overstorey shrubs and *Eucalyptus* trees.

Geology: Quaternary alluvium with areas of recent deposition; also minor aeolian sand.

Geomorphology: Depositional surfaces; flat riverine alluvial plains with low sandy banks over minor hardpans tracts on system margins; strongly saline plains 2 to 5 km wide flanking undulating 'bayou' deposits on channel margins; some alluvial surfaces with hummocky redistributed juvenile soils; large meandering channels with eroding banks and sandy bedloads; total system relief < 3 m.

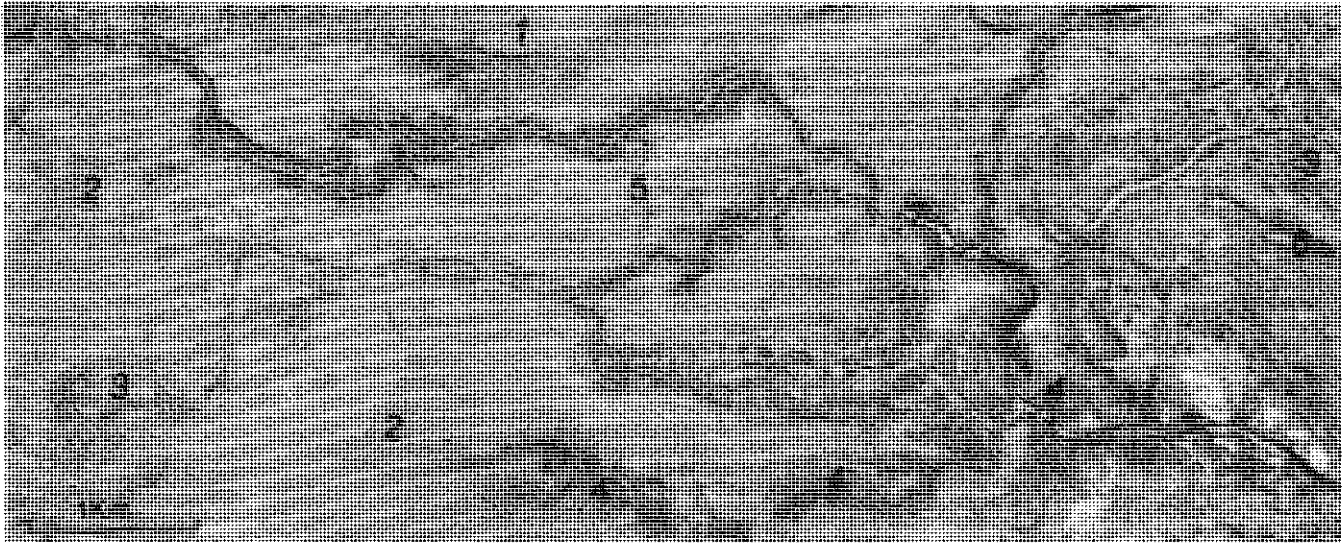
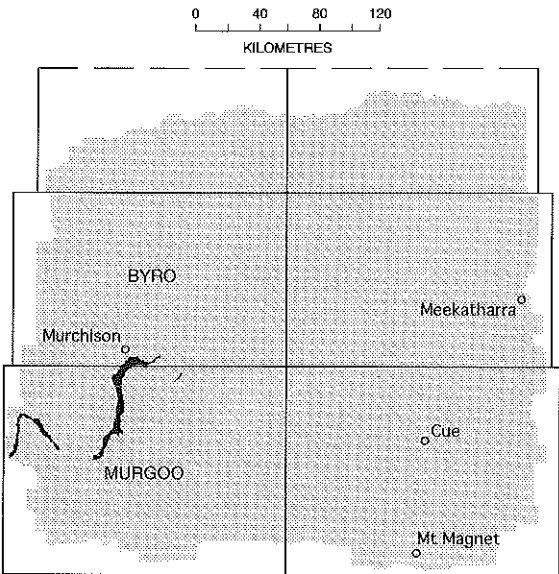
Vegetation and pastoral use: Saltbush and Bluebush Shrublands succeeded in parts by increasing *Acacia*, *Eremophila* and *Hakea* spp.; saline shrublands highly productive in areas with access to fresh water; erodible nature of exposed duplex soils is accentuated by regular flood events and preferential grazing of dominant species. Unit 2 is highly susceptible to continuing water erosion following the depletion of halophytic perennials.

Estimated carrying capacity, good condition: 7 ha/dse.

Range condition summary (177 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
50	33	14	3	26	25	49

- Unit: 1. Sandy banks.
2. Alluvial plains.
3. Alluvial meander plains.
4. Floodplains.
5. Saline alluvial plains.
6. Ephemeral swamps
7. Major channels.



Bayou I.s.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Sandy banks (5%) Sand banks and low dunes up to 80 m wide and raised up to 2 m above adjacent unit 2. Soils are deep earthy sands or duplex loamy sands over sandy clay loam > 1 m deep. Principal profile form: Dr2.52.	Scattered (PFC 10-20%) shrublands dominated by <i>Hakea preissii</i> . Tall shrubs (> 2 m): <i>Acacia sclerosperma</i> , <i>Hakea preissii</i> , <i>Exocarpus aphyllus</i> . Mid and low shrubs (< 2 m): <i>Atriplex amnicola</i> , <i>Gunnopsis quadrifida</i> , <i>Scaevola spinescens</i> , <i>Cassia phyllodinea</i> , <i>Enchylaena tomentosa</i> , <i>Sida</i> aff. <i>calyxhymenia</i> .	1 inventory site and traversed Vegetation type: Saltbush/Sand Dune Shrubland. Palatable perennials include: <i>Atriplex amnicola</i> , <i>Enchylaena tomentosa</i> . Pastoral use limitations: Susceptible to wind erosion if perennial cover lost.
Unit 2: Alluvial plains (50%) Flat to gently sloping (< 0.5%) alluvial plains subject to periodic flooding from river. Soils are deep crusted and hard-setting duplexes, occasionally with hardpan at shallow depth. pH 6.0-9.0 with alkaline or neutral reaction trends. Principal profile forms: Dr1.12, Dr1.23, Dr1.52, Dr2.23, Dr2.52.	Scattered to moderately close (PFC 10-30%) shrublands with occasional trees. Trees: (6-10 m) <i>Eucalyptus coolabah</i> . Tall shrubs (> 2 m): <i>Hakea preissii</i> , <i>Acacia xiphophylla</i> . Mid shrubs (1-2 m): <i>Eremophila pterocarpa</i> , <i>Acacia microcalyx</i> , <i>A. sp.</i> , <i>Cassia phyllodinea</i> , <i>C. sturtii</i> . Low shrubs (< 1 m): <i>Atriplex vesicaria</i> , <i>Cratystylis subspinescens</i> , <i>Maireana platycarpa</i> , <i>M. pyramidata</i> . Perennial grass: <i>Stipa elegantissima</i> .	6 inventory sites, 8 condition sites and traversed Vegetation type: Saltbush/Bluebush Shrubland. Palatable perennials include: <i>Atriplex vesicaria</i> , <i>Cratystylis subspinescens</i> , <i>Maireana platycarpa</i> , <i>M. pyramidata</i> . Increaser species include: <i>Hakea preissii</i> , <i>Eremophila pterocarpa</i> . Pastoral use limitations: moderately to highly susceptible to shrub invasion and accelerated erosion where perennials are degraded. Vegetation condition %: VG/G 20, F 29, P/VP 51. Erosion incidence %: min 46, mod 26, sev 4. 82 obs.
Unit 3: Alluvial meander plains (10%) Alluvial deposits in ox-bow or bayou formations receiving regular channel overflow, little or no slope, sandy hummocks to 1-2 m above surrounding plain. Soils are deep, reddish-brown alluvial types, generally loamy or clayey sands with an alkaline reaction trend at depth. Principal profile forms: Uc5.21, Um5.12.	Moderately close (PFC 20-30%) mixed shrublands. dominated by <i>Hakea preissii</i> and <i>Acacia sclerosperma</i> . Trees: <i>Eucalyptus coolabah</i> . Tall shrubs (> 2 m): <i>Acacia sclerosperma</i> , <i>Hakea preissii</i> . Mid shrubs (1-2 m): <i>A. sclerosperma</i> , <i>A. victoriae</i> , <i>Scaevola spinescens</i> , <i>Rhagodia eremaea</i> . Low shrubs (< 1 m): <i>Atriplex amnicola</i> , <i>A. bunburyana</i> , <i>Enchylaena tomentosa</i> .	3 inventory sites and traversed Vegetation type: Saltbush Shrubland. Palatable perennials include: <i>Atriplex amnicola</i> , <i>A. bunburyana</i> , <i>Rhagodia eremaea</i> , <i>Enchylaena tomentosa</i> , <i>Chenopodium gaudichaudianum</i> . Increaser species include: <i>Hakea preissii</i> . Pastoral use limitations: None under controlled grazing.
Unit 4: Flood plains (20%) Plains marginally lower than units 2 and 3, subject to fairly regular flooding. Soils are > 1 m deep, yellowish-red clayey loams or clays, pH 7.0-9.0 with alkaline reaction trends. Principal profile forms: Uf6.71, Uf6.12, Uf6.31.	Scattered shrublands (PFC 10-20%) with some sites very dense with low to medium shrubs (PFC > 50%). Trees (6-10 m): <i>Eucalyptus coolabah</i> . Tall shrubs (> 2 m): <i>Eremophila youngii</i> , <i>Acacia aneura</i> , <i>A. victoriae</i> , <i>A. tetragonophylla</i> . Mid shrubs (1-2 m): <i>A. microcalyx</i> , <i>A. victoriae</i> , <i>Scaevola spinescens</i> , <i>A. victoriae</i> , <i>Atriplex amnicola</i> . Low shrubs (< 1 m): <i>Atriplex amnicola</i> , <i>Cassia sturtii</i> , <i>Eremophila maculata</i> , <i>Ptilotus lazaridis</i> .	5 inventory sites, 4 condition sites and traversed Vegetation type: Saltbush/Riverine Mixed Shrubland. Palatable perennials include: <i>Atriplex amnicola</i> , <i>Scaevola spinescens</i> , <i>Ptilotus lazaridis</i> . Pastoral use limitations: None with controlled grazing.
Unit 5: Saline alluvial plains (10%) Flat, highly saline plains marginally lower than units 2 and 3. Soils are uniform yellowish-red clayey loams with an alkaline reaction trend. Principal profile form: Uf6.12.	Scattered (PFC 10-20%) low shrublands dominated by <i>Halosarcia doleiformis</i> , <i>Frankenia</i> spp. or <i>Cratystylis subspinescens</i> . Occasional <i>Acacia victoriae</i> and <i>Atriplex amnicola</i> .	1 inventory site and traversed Vegetation type: Samphire Shrubland/Mixed Halophytic Shrubland. Pastoral use limitations: High salt content of dominant species.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 6: Ephemeral swamps (< 1%)</p> <p>Rounded drainage foci within units 4 and 5. Soils are clayey types.</p>	<p>Close or closed shrublands dominated by <i>Melaleuca uncinata</i> and <i>Atriplex amnicola</i>.</p>	
<p>Unit 7: Major channels (5%)</p> <p>Major river beds and secondary channels to 5 m deep and > 50 m wide. Sandy channel beds often fringed by clayey terraces. Soils are mostly deep alluvial types.</p>	<p>Scattered trees, shrubs and rushes (PFC 10-20%). Beds are generally bare of vegetation, banks and terraces are frequently dominated by <i>Juncus aridicola</i> and <i>Eucalyptus coolabah</i>. Trees: (8-10 m) <i>Eucalyptus coolabah</i>. Tall shrubs (> 2 m): <i>Melaleuca</i> aff. <i>leiocarpa</i>, <i>Acacia sclerosperma</i>. Mid shrubs (1-2 m): <i>Muehlenbeckia cunninghamii</i>, <i>Hakea preissii</i>. Low shrubs (< 1 m): <i>Atriplex amnicola</i>, <i>Frankenia</i> spp., <i>Halosarcia</i> spp., <i>Ptilotus divaricatus</i>.</p>	<p>1 inventory site and traversed</p> <p>Vegetation type: Riverine Mixed Shrubland or unvegetated. Palatable perennials include: <i>Atriplex amnicola</i>, <i>Ptilotus divaricatus</i>, <i>Frankenia</i> spp. Pastoral use limitations: Channel banks and margins are highly susceptible to accelerated erosion if vegetation degraded.</p>

Beasley land system (G) 138 km² (0.16% of survey area)

Land type: 2; Pastoral potential: low.

Low ridges, hills and lateritised residuals above stony footslopes and broad, stony lower plains supporting scattered mulga and snakewood-dominated shrublands.

Geology: Lower Proterozoic metamorphic rocks of the Padbury group: hematite shale, banded ironstone, arenite and sandstone; also Tertiary laterite and Quaternary colluvium.

Geomorphology: Erosional surfaces; low ridges, mesas, hills, stripped surfaces and outcrops with stony footslopes and gently sloping stony lower plains and interfluvies; moderately spaced tributary drainage patterns; relief mostly < 50 m.

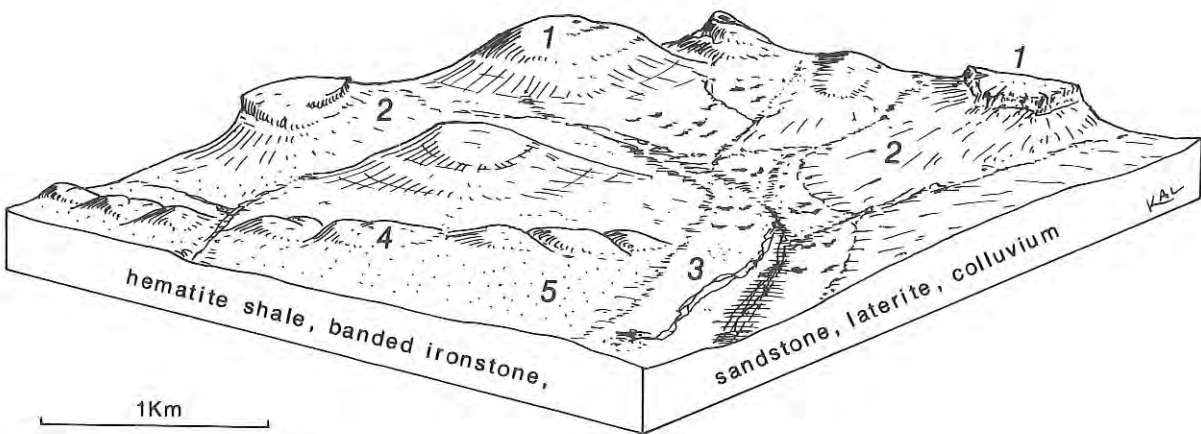
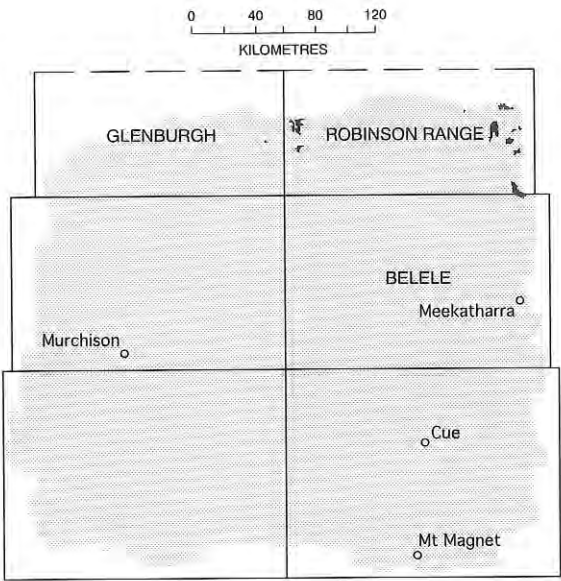
Vegetation and pastoral use: Rocky Hill Mixed Shrubland with more productive Stony Snakewood Shrubland on lower units; mostly resistant to erosion owing to stony mantles; minor erosion is possible on unit 3.

Estimated carrying capacity, good condition: 20 ha/dse.

Range condition summary (8 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
100	0	0	0	25	75	0

- Unit: 1. Crests and hills.
2. Stony slopes and interfluvial plains.
3. Drainage tracts with groves.
4. Stony rises.
5. Stony plains.



Beasley I.s. (adapted from Wilcox and M'Kinnon, 1972)

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Crests and hills (35%) Rough, discontinuous ridges with frequent quartz intrusions extending up to 2 km long with peaks to 60 m or more; rounded lateritised summits and low hills to 30 m occurring in clusters up to 3 km in extent; usually mantled with ironstone, quartz or shale fragments. Soils are lithosols confined to small pockets of dark red loamy or clayey sands < 30 cm deep with a mostly neutral trend.	Very scattered (PFC < 10%) mixed shrublands dominated by <i>Acacia aneura</i> . Tall and mid shrubs (> 1 m): <i>A. aneura</i> , <i>Cassia desolata</i> , <i>Eremophila freelingii</i> , <i>Baeckea</i> sp., <i>Micromyrtus</i> sp. Low shrubs (< 1 m): <i>Ptilotus obovatus</i> , <i>Solanum lasiophyllum</i> .	Traversed Vegetation type: Rocky Hill Mixed Shrubland. Pastoral use limitations: Poorly accessible to domestic stock; generally very low pastoral value throughout.
Unit 2: Stony slopes and interfluvial plains (40%) Slopes and rounded interfluvies with slopes < 10% in upper parts and extending up to 1 km wide below unit 1 grading into flatter stony drainage plains dissected by unit 3, moderately to abundantly mantled by fragments of shale and manganiferous ironstones. Soils are reddish-brown clay loams or light clays over hardpan, usually < 1 m; duplex profiles probably common on lower plains.	Scattered to moderately close (PFC 10-30%) tall <i>Acacia aneura</i> shrubland with halophytes on lower drainage plains. Trees and tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. grasbyi</i> , <i>A. ramulosa</i> , <i>A. aff. citrinoviridis</i> , <i>A. pruinocarpa</i> , <i>A. cuthbertsonii</i> . Mid shrubs (1-2 m): <i>Cassia desolata</i> , <i>C. pruinosa</i> , <i>C. sturtii</i> , <i>Eremophila glutinosa</i> , <i>E. freelingii</i> , <i>E. lanata</i> . Low shrubs (< 1 m): <i>E. compacta</i> , <i>Maireana georgei</i> , <i>M. triptera</i> , <i>M. thesioides</i> , <i>Ptilotus obovatus</i> , <i>P. schwartzii</i> .	1 inventory site and traversed Vegetation type: Rocky Hill Mixed Shrubland or Stony Mulga Mixed Shrubland. Palatable perennials include: <i>Maireana</i> spp., <i>Eremophila compacta</i> , <i>Ptilotus</i> spp. Pastoral use limitations: None under controlled grazing.
Unit 3: Drainage tracts with groves (10%) Broad disorganised flow zones with irregular grove formations grading into more concentrated drainage tracts to 100 m wide with small channels incised to 1 m deep and 10 m wide. Soils are red-brown sandy clays to 1 m deep in flow zones; intergroves are < 1 m deep over hardpan.	Groves: Moderately close to close (PFC 20 - > 50%) <i>Acacia aneura</i> woodland. Trees and tall shrubs (2-8 m): <i>A. aneura</i> , <i>A. pruinocarpa</i> , <i>A. tetragonophylla</i> . Mid shrubs (1-2 m): <i>Cassia desolata</i> , <i>C. pruinosa</i> , <i>C. sturtii</i> , <i>Eremophila glutinosa</i> , <i>E. freelingii</i> , <i>E. lanata</i> , <i>E. latrobei</i> . Low shrubs (< 1 m): <i>E. compacta</i> , <i>Ptilotus obovatus</i> . Intergroves: very scattered shrublands of similar composition.	Traversed Vegetation type: Mulga Grove Woodland or Creekline Shrubland. Palatable perennials include: <i>Eremophila compacta</i> , <i>E. latrobei</i> , <i>Ptilotus</i> spp. Pastoral use limitations: None with controlled grazing.
Unit 4: Stony rises (5%) Low rises with minor outcrops of parent rock, 1-5 m above surrounding plains (units 3 and 5). Soils are lithosols.	Very scattered (PFC < 10%) shrublands dominated by <i>Acacia aneura</i> .	Vegetation type: Rocky Hill Mixed Shrubland. Palatable perennials include: <i>Ptilotus obovatus</i> . Pastoral use limitations: None under controlled grazing.
Unit 5: Stony plains (10%) Lower plains mantled with quartz and ironstone. Soils are shallow hardpan loams or red clays.	Very scattered to scattered (PFC < 20%) shrublands dominated by <i>Acacia xiphophylla</i> .	Vegetation type: Stony Snakewood Shrubland. Palatable perennials include: <i>Maireana</i> spp., <i>Rhagodia eremaea</i> , <i>Enchylaena tomentosa</i> . Pastoral use limitations: None under controlled grazing.

Belele land system (W) 4701 km² (5.47% of survey area)

Land type: 13; Pastoral potential: moderate.

Hardpan wash plains interspersed by low sandy (wanderrie) banks supporting tall shrublands of mulga with understorey shrubs on the hardpan plains and non-saline shrubs with perennial grasses on the banks.

Geology: Quaternary cemented alluvium and aeolian sand.

Geomorphology: Depositional surfaces, almost flat alluvial plains with water and wind-modified broad banks of aeolian sand; hardpan plains subject to sheet wash passing around the wanderrie banks and sand patches which are mainly transverse to direction of flow but also oblique or elongate downslope and forming connected patterns locally; central drainage tracts receiving more concentrated flow; most banks < 1 m and total relief is generally < 5 m.

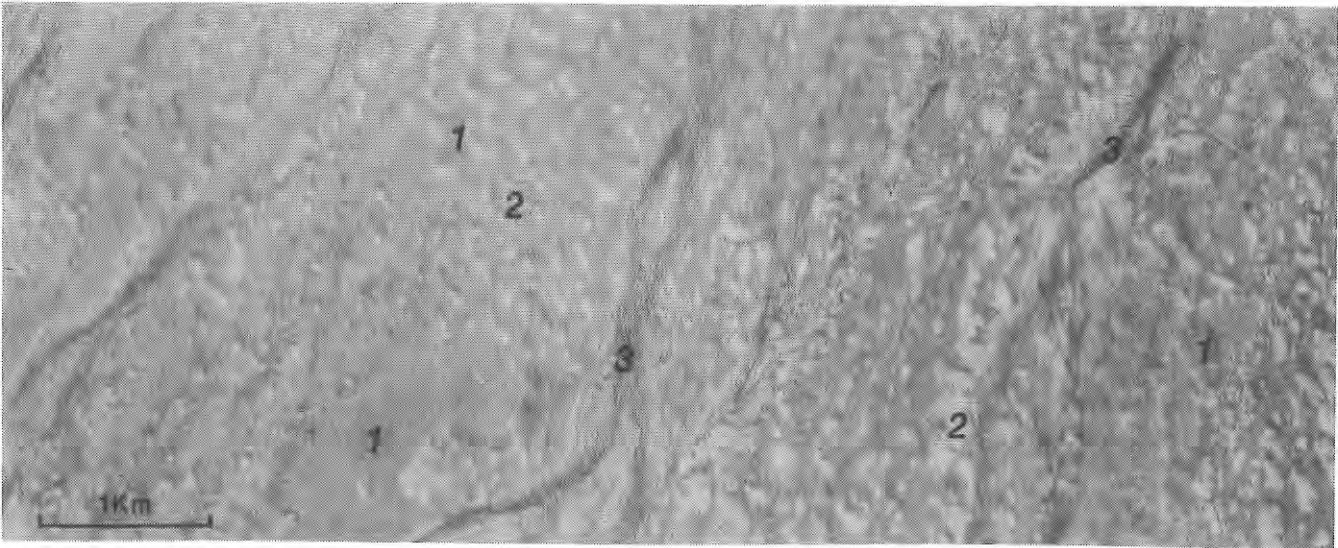
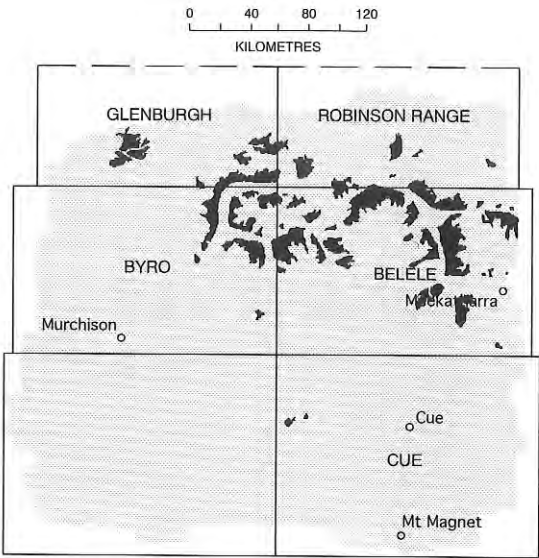
Vegetation and pastoral use: Hardpan Mulga Shrublands of moderate value and Wanderrie Bank Grassy Shrubland with reasonable drought durability but susceptible to invasion by unpalatable shrubs when degraded; vegetation on units 2 and 3 frequently degraded, minor susceptibility to soil erosion when degraded.

Estimated carrying capacity, good condition: 12 ha / dse.

Range condition summary (773 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
90	7	3	0	20	36	44

- Unit: 1. Wanderrie banks and sand sheets.
2. Hardpan plain and interbank areas.
3. Drainage tracts.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Wanderrie banks and sand sheets (35%) Sandy banks to 400 m wide and 3 km long, 0.5 to 1 m above unit 2, mostly arranged transverse to the direction of slope but also reticulate and elongate downslope; occasional larger patches of sand sheet. Soils are red earthy sands, usually > 1 m deep. pH 6.0-7.0 with neutral reaction trend. Principal profile form: Uc5.21.	Tall or mixed shrublands with tussock grasses or shrubby grasslands (shrub PFC > 20%). Trees: <i>Acacia aneura</i> ; Tall shrubs (> 2 m) <i>A. aneura</i> , <i>A. ramulosa</i> , <i>Grevillea</i> sp.; Low shrubs (< 1 m): <i>Eremophila margarethae</i> , <i>E. forrestii</i> , <i>E. aff. foliosissima</i> , <i>Cassia desolata</i> , <i>C. sturtii</i> , <i>Ptilotus obovatus</i> , <i>Solanum lasiophyllum</i> , <i>Rhagodia eremaea</i> . Perennial grasses: <i>Monachather paradoxa</i> , <i>Eragrostis eriopoda</i> , <i>E. lanipes</i> , <i>Eriachne helmsii</i> .	6 inventory sites, 35 condition sites and traversed Vegetation type: Wanderrie Bank Grassy Shrubland or Sandplain Wanderrie Grassy Shrubland. Palatable perennials include: <i>Eremophila forrestii</i> , <i>E. latrobei</i> , <i>Rhagodia eremaea</i> , <i>Grevillea deflexa</i> , <i>Monachather paradoxa</i> , <i>Eragrostis eriopoda</i> , <i>E. lanipes</i> , <i>Thyridolepis multiculmis</i> . Pastoral use limitations: None under controlled grazing. Vegetation condition %: VG/G 37, F 40, P/VP 23. 219 obs.
Unit 2: Hardpan plains and interbank areas (40%) Plains and flats (slopes mostly < 0.3%) subject to sheet flow. Soils are mostly 20-50 cm deep, dark red sandy clay loams over hardpan. pH 5.5-6.5 with neutral or acidic reaction trends. Principal profile form: Um5.31.	Scattered tall or mixed shrublands (PFC 10-20%) sometimes weakly groved. Trees (4-6 m): <i>Acacia aneura</i> , <i>A. pruinocarpa</i> . Tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. aff. quadrimarginea</i> , <i>A. kempeana</i> , Mid and low shrubs (< 2 m): <i>A. tetragonophylla</i> , <i>Cassia desolata</i> , <i>Ptilotus obovatus</i> , <i>P. schwartzii</i> , <i>Eremophila forrestii</i> , <i>E. fraseri</i> , <i>Rhagodia eremaea</i> , <i>Maireana planifolia</i> , <i>Solanum lasiophyllum</i> .	3 inventory sites, 37 condition sites and traversed Vegetation type: Hardpan Mulga Shrubland. Palatable perennials include: <i>Ptilotus obovatus</i> , <i>P. schwartzii</i> , <i>Eremophila latrobei</i> , <i>E. compacta</i> , <i>Rhagodia eremaea</i> , <i>Maireana planifolia</i> , <i>M. convexa</i> , <i>Sida calythymenia</i> . Pastoral use limitations: None under controlled grazing. Vegetation condition %: VG/G 13, F 35, P/VP 51. Erosion incidence %: min 7, mod 3. 467 obs.
Unit 3: Drainage tracts (25%) Alluvial drainage tracts up to 750 m wide receiving more concentrated through flow than unit 2, locally with deposited sealed surfaces or with shallow runnels and incised channels with hardpan exposures in parts. Soils are red sandy clay loams over hardpan at shallow depth. Principal profile form: Um5.31.	Shrublands very similar to those on unit 2, with more <i>Cassia desolata</i> , <i>C. helmsii</i> and <i>Eremophila</i> spp.	1 condition site and traversed Vegetation type: Hardpan Mulga Shrubland. Palatable perennials as for unit 2. Pastoral use limitations: Moderate susceptibility to accelerated water erosion when degraded. Vegetation condition %: VG/G 8, F 32, P/VP 60. Erosion incidence %: min 35, mod 8, sev 5. 40 obs.

Beringarra land system (W) 2629 km² (3.06% of survey area)

Land type: 16; **Pastoral potential:** high.

Major riverine plains with active lower floodplains flanking channelled watercourses; supports mostly halophytic shrublands and mixed acacia shrublands and low woodlands with minor perennial grasses; severely degraded and eroded in many areas.

Geology: Quaternary alluvium, partly cemented.

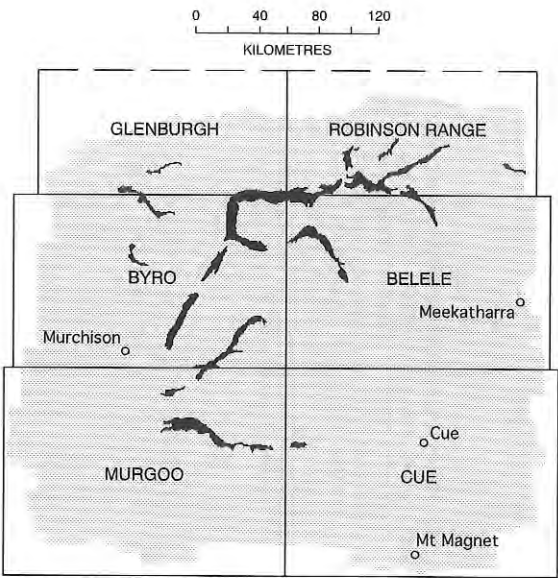
Geomorphology: Depositional alluvial surfaces over variable underlying materials including extensive red-brown hardpan, clays and calcreted gravels; flat alluvial plains, often with windblown scalds and hummocks and/or active water erosion; river floodplains carrying regional drainage to 16 km wide, with major channel development; river channels (with isolated semi-permanent pools) to 200 m wide and 6 m deep; otherwise relief < 3 m.

Vegetation and pastoral use: Bluebush and Saltbush Shrublands, Riverine Mixed Shrubland and minor Alluvial Tussock Grassland, widely invaded by *Acacia*, *Cassia* and *Hakea* species on major units, particularly those with duplex soils. Elsewhere, duplex plains, drainage tracts and floodplains with clay soils are highly productive with diverse and abundant perennial forage plants. Widespread historical overuse and erodible soils have resulted in large areas being degraded and eroded : 37% of the system area traversed showed moderate to severe erosion.

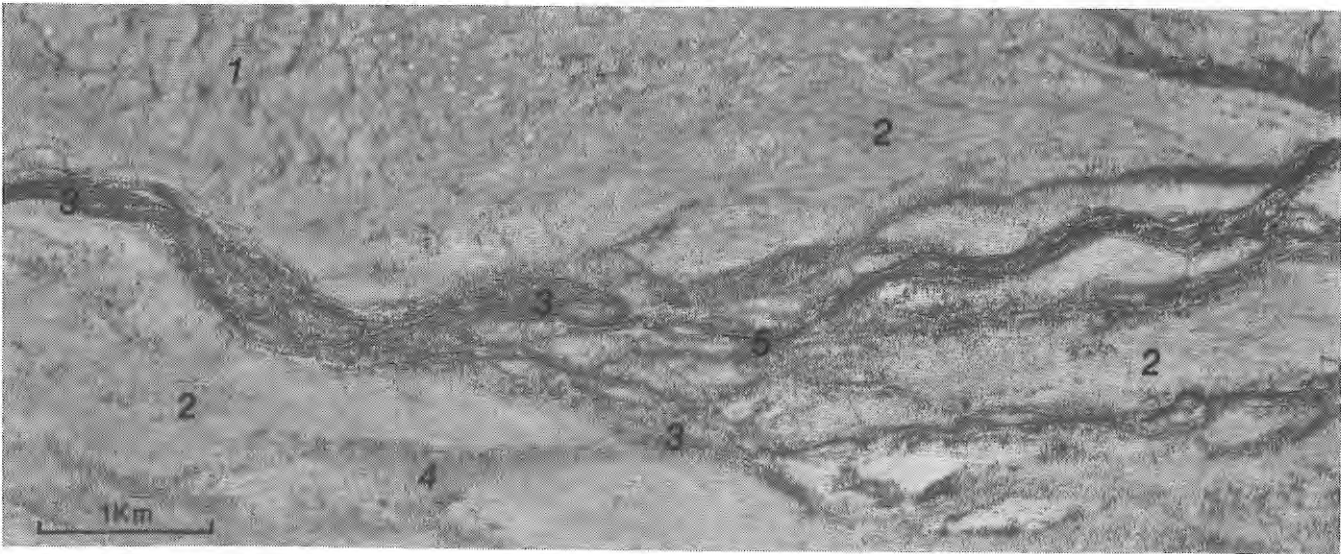
Estimated carrying capacity, good condition: 7 ha/dse.

Range condition summary (626 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
31	32	31	6	7	18	75



- Unit: 1. Hardpan plains.
2. Alluvial plains.
3. Floodplains.
4. Wide drainage floors.
5. Channels.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Hardpan plains (30%) Almost flat (< 0.3%) alluvial plains on margins of system. Soils are hardpan loams and red earths (0.35 to 1 m) over hardpan. Principal profile forms: Um5.31, Gn2.16.	Scattered to moderately close (PFC 10-30%) mixed shrublands dominated by <i>Acacia aneura</i> and lower storey shrubs. Trees: <i>Acacia aneura</i> . Tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. victoriae</i> . Mid shrubs (1-2 m): <i>A. tetragonophylla</i> , <i>A. kempeana</i> , <i>Cassia helmsii</i> , <i>Eremophila fraseri</i> . Low shrubs (< 1 m): <i>C. helmsii</i> , <i>C. desolata</i> , <i>Ptilotus obovatus</i> , <i>Rhagodia eremaea</i> , <i>Maireana</i> aff. <i>tomentosa</i> .	3 inventory sites, 13 condition sites and traversed Vegetation type: Mulga Hardpan Shrubland. Palatable perennials include: <i>Ptilotus obovatus</i> , <i>Rhagodia eremaea</i> . Pastoral use limitations: Susceptible to increase in unpalatable shrubs and moderate susceptibility to accelerated erosion when perennials degraded. Vegetation condition %: VG/G 1, F 29, P/VP 70. Erosion incidence %: min 35, mod 10, sev 1. 135 obs.
Unit 2: Alluvial plains (40%) Very gently sloping (0.5%) saline alluvial plains receiving run-on via adjacent unit 1 and subject to periodic flooding from river. Soils are generally deep (to 1 m) crusted or hard-setting duplexes with occasional red earths and clays with alkaline reaction trends. Principal profile forms: Dr1.16, Dr1.13, Dr1.33, Dr2.53, Dr2.52, Dr2.13, Gn2.13, Db3, Db3.3, Db1.33, Uf3, Uf6.71.	Patchy (PFC 10-20%) mixed shrublands, often dominated by <i>Acacia victoriae</i> , <i>Cassia desolata</i> , <i>Eremophila pterocarpa</i> or <i>Hakea preissii</i> . Trees: <i>Eucalyptus coolabah</i> , <i>Acacia aneura</i> , <i>A. distans</i> , <i>A. sibulans</i> , <i>Hakea preissii</i> . Tall shrubs (> 2 m): <i>A. sclerosperma</i> , <i>A. aneura</i> , <i>A. victoriae</i> , <i>H. preissii</i> , <i>A. tetragonophylla</i> , <i>A. sibulans</i> . Mid shrubs (1-2 m): <i>Eremophila pterocarpa</i> , <i>Cassia helmsii</i> , <i>C. desolata</i> , <i>A. victoriae</i> , <i>Scaevola spinescens</i> . Low shrubs (< 1 m): <i>Maireana pyramidata</i> , <i>Eremophila maculata</i> , <i>Ptilotus beardii</i> , <i>P. obovatus</i> , <i>Solanum lasiophyllum</i> , <i>Frankenia</i> aff. <i>magnifica</i> , <i>Atriplex amnicola</i> , <i>A. bunburyana</i> . Perennial grasses: <i>Eragrostis falcata</i> , <i>E. spp.</i>	14 inventory sites, 43 condition sites and traversed Vegetation type: Bluebush, Saltbush and Mixed Halophyte Shrubland. Palatable perennials include: <i>Atriplex amnicola</i> , <i>A. bunburyana</i> , <i>Maireana pyramidata</i> , <i>M. platycarpa</i> , <i>Scaevola spinescens</i> , <i>Frankenia</i> spp., <i>Eremophila maculata</i> . Increaser species include: <i>Hakea preissii</i> , <i>Acacia victoriae</i> , <i>Cassia desolata</i> , <i>Eremophila pterocarpa</i> . Pastoral use limitations: Highly susceptible to sheet deflation, rilling, gully and scalding and unpalatable shrub invasions when perennials are degraded. Vegetation condition %: VG/G 6, F 10, P/VP 84. Erosion incidence %: min 32, mod 44, sev 9. 389 obs.
Unit 3: Flood plains and inter-channel zones (20%) Almost flat, active flood plains with locally cracking or gilgai surfaces, relief to 1 m; traversed by shallow channels and subject to regular flooding. Soils are variable crusted duplexes and yellowish-red to brown clays, pH 6.5-7.5 with alkaline or neutral reaction trends. Depth mostly > 1 m, although some sites have calcrete at shallow depth. Principal profile forms: Uf6.12, Uf6.71, Db1.33, Dr1.73.	Moderately close to closed (PFC 20- > 50%) woodlands with upper storey of <i>Acacia distans</i> or low shrublands dominated by <i>Atriplex amnicola</i> and <i>Maireana pyramidata</i> . Trees (8-10 m): <i>Acacia sibulans</i> , <i>A. distans</i> , <i>Eucalyptus coolabah</i> , <i>Grevillea striata</i> . Tall shrubs (> 2 m): <i>A. tetragonophylla</i> , <i>Eremophila lanata</i> , <i>E. sp.</i> , <i>Hakea preissii</i> . Mid shrubs (1-2 m): <i>Cratystylis subspinescens</i> , <i>Scaevola spinescens</i> , <i>Acacia victoriae</i> , <i>A. wiseana</i> , <i>A. tetragonophylla</i> . Low shrubs (< 1 m): <i>Atriplex amnicola</i> , <i>Cassia helmsii</i> , <i>Maireana pyramidata</i> , <i>Scaevola spinescens</i> . Perennial grasses: <i>Fimbristylis</i> sp., <i>Eriachne flaccida</i> , <i>Eragrostis setifolia</i> , <i>Stipa elegantissima</i> .	6 inventory sites, 11 condition sites and traversed Vegetation type: Saltbush, Riverine Mixed Shrubland and Non-Calcareous Shrubby Grassland. Palatable perennials include: <i>Atriplex amnicola</i> , <i>Cratystylis subspinescens</i> , <i>Maireana pyramidata</i> , <i>Scaevola spinescens</i> , <i>Eriachne flaccida</i> , <i>Eragrostis setifolia</i> . Pastoral use limitations: Locally highly susceptible to accelerated erosion when perennials are degraded. Vegetation condition %: VG/G 41, F 28, P/VP 31. Erosion incidence: min 38, mod 3. 29 obs.
Unit 4: Wide drainage floors (5%) Flat drainage zones, with occasional anastomosing channels. Soils are yellowish-red to brown clays and duplex types; sandy loams or fine sandy loams over loamy clays, with an alkaline reaction trend. Depth is to 1 m with some sites over calcrete. Principal profile forms: Dr5.53, Uf6.71, Uf6.12.	Moderately close (PFC 20-30%) woodlands and tall shrublands. Trees (6-8 m): <i>Acacia distans</i> , <i>A. aneura</i> , <i>Eucalyptus coolabah</i> . Tall shrubs (> 2 m): <i>A. tetragonophylla</i> , <i>A. victoriae</i> , <i>Eremophila fraseri</i> , <i>E. lanata</i> . Mid shrubs (1-2 m): <i>E. fraseri</i> , <i>Scaevola spinescens</i> . Low shrubs (< 1 m): <i>E. fraseri</i> , <i>Ptilotus lazardis</i> , <i>Grevillea deflexa</i> . Perennial grasses: <i>Eriachne flaccida</i> , <i>Stipa elegantissima</i> .	5 inventory sites, 1 condition site and traversed Vegetation type: Riverine Mixed Shrubland, Non-Calcareous Shrubby Grassland. Palatable perennials include: <i>Scaevola spinescens</i> , <i>Ptilotus lazardis</i> , <i>Eriachne flaccida</i> . Pastoral use limitations: Mild susceptibility to accelerated erosion when perennials are degraded. Vegetation condition %: VG/G 14, F 42, P/VP 44. Erosion incidence: min 29. 29 obs.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 5: Channels (5%)</p> <p>Riverbeds and seasonal watercourses up to 100 m wide and incised to 3 m. Channels carry bedloads of coarse sand, with exposed red-brown hardpan and salt encrustations. Soils on banks are reddish-brown alluvial silty clays and fine sandy loams, pH 7.0-8.5 mostly with neutral reaction trends.</p>	<p>Major channel beds unvegetated, otherwise moderately close to closed (PFC 20-> 50%) mixed woodlands with dense under shrubs on banks of major channels and floors of minor channels. Trees (6-8 m): <i>Casuarina obesa</i>, <i>Eucalyptus camaldulensis</i>, <i>E. coolabah</i>, <i>Hakea suberea</i>, <i>Acacia distans</i>. Tall shrubs (> 2 m): <i>Acacia tetragonophylla</i>, <i>A. cyperophylla</i>, <i>Melaleuca</i> spp. Mid shrubs (1-2 m): <i>Scaevola spinescens</i>, <i>Cassia desolata</i>, <i>A. sclerosperma</i>. Low shrubs (< 1 m): <i>Atriplex amnicola</i>, <i>Mirbella viminalis</i>, <i>Halosarcia</i> spp., <i>Frankenia</i> spp. Perennial grasses: <i>Eriachne</i> sp., <i>Chrysopogon fallax</i>.</p>	<p>4 inventory sites and traversed</p> <p>Vegetation type: Saltbush Shrubland or Creekline Grassy Shrubland.</p> <p>Palatable perennials include: <i>Atriplex amnicola</i>, <i>Scaevola spinescens</i>, <i>Cratystylis subspinescens</i>, <i>Enchylaena tomentosa</i>, <i>Frankenia</i> sp.</p> <p>Pastoral use limitations: Unconsolidated banks susceptible to trampling and damage if stock concentrate on river banks.</p>

Bidgemia land system (G) 221 km² (0.26% of survey area)

Land type: 12; Pastoral potential: moderate.

Alluvial drainage plains with minor linear sand dunes and sandy banks, supporting patchy halophytic and tall acacia shrublands.

Geology: Quaternary (Pleistocene and more recent) dune and playa deposits of clay, silt, sand and gravel.

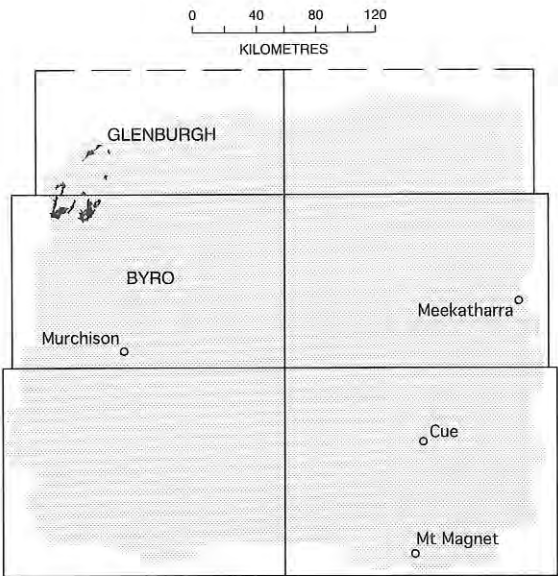
Geomorphology: Depositional surfaces: level or gently undulating alluvial plains with internal drainage patterns interspersed with elliptical or longitudinal dunes and sandy banks lying approximately parallel to direction of flow; relief between dunes and drainage floors rarely exceeds 4 m.

Vegetation and pastoral use: Moderately productive Bluebush and Saltbush Shrublands on alluvial plains and drainage floors; favoured parts near to water tend to be somewhat overgrazed with desirable shrubs succeeded by invading *Acacia* and *Eremophila* spp., alluvial units (3 and 4) are slightly prone to erosion under these circumstances. Also Sand Dune or Wanderrie Bank Shrubland with a moderate complement of halophytes on units 1 and 2 which are not usually susceptible to erosion.

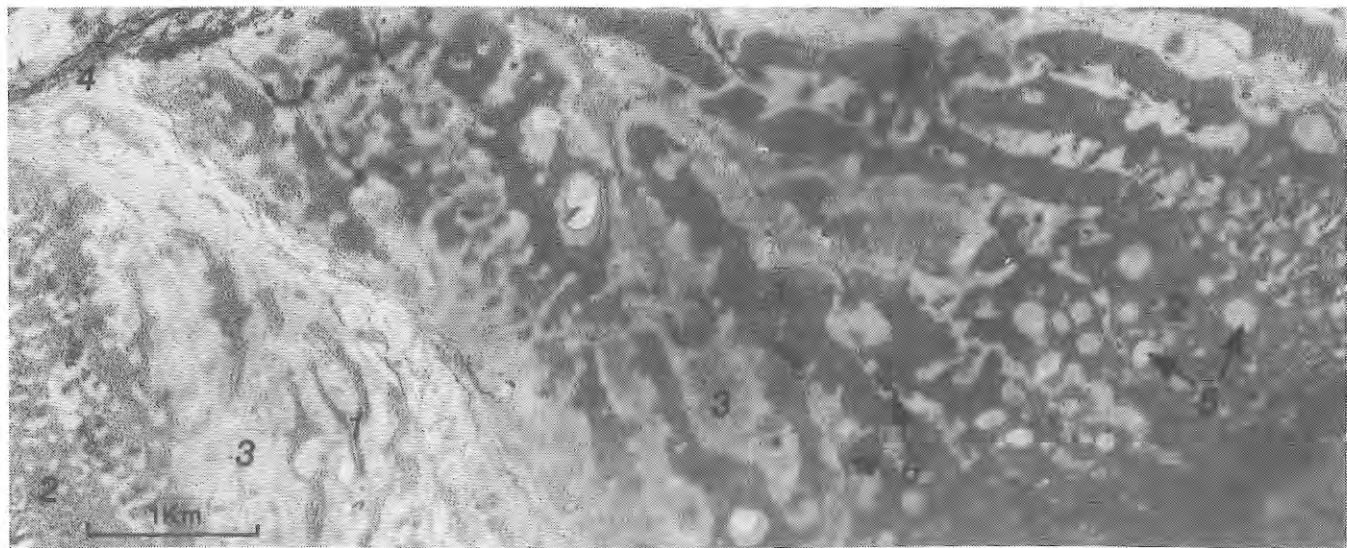
Estimated carrying, good condition: 12 ha/dse.

Range condition summary (25 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
80	16	4	0	48	40	12



- Unit: 1. Sand dunes.
2. Sandy banks.
3. Alluvial plains.
4. Wide drainage floors.
5. Claypans.
6. Drainage foci and small swamps.



Bidgemia I.s.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Sand dunes (30%) Linear and reticulate dunes arranged mostly longitudinal to direction of sheet water flow; mostly < 1 km long and up to 4 m above adjacent units 2 and 3. Soils are deep dark red sands.	Moderately close (PFC 20-30%) tall shrubland of <i>Acacia ramulosa</i> . Tall shrubs (> 2 m): <i>A. ramulosa</i> , <i>A. sclerosperma</i> , <i>A. tetragonophylla</i> . Mid shrubs (1-2 m): <i>Eremophila forrestii</i> , <i>E. granitica</i> , <i>E. maitlandii</i> , <i>Rhagodia</i> spp. Low shrubs (< 1 m): <i>Cassia</i> spp., <i>Corchorus walcottii</i> . Perennial grass: <i>Eriachne helmsii</i> .	Traversed Vegetation type: Sand Dune Shrubland. Palatable perennials include: <i>Eremophila forrestii</i> , <i>Rhagodia</i> spp. Pastoral use limitations: None under controlled grazing.
Unit 2: Sandy banks (30%) Gently sloping or undulating (slopes < 1%) sand banks to 2 m above surrounding unit 3, and extending to 2 km down slope on unit 3. Soils are dark red clayey sands > 1 m deep; pH 6.5-7.5 with a neutral trend. Principal profile form: Uc5.21.	Moderately close (PFC 20-30%) mixed shrubland dominated by <i>Acacia ramulosa</i> . Tall shrubs (> 2 m): <i>A. ramulosa</i> , <i>A. sclerosperma</i> . Mid shrubs (1-2 m): <i>Cassia desolata</i> , <i>C. helmsii</i> , <i>Maireana lanosa</i> , <i>M. pyramidata</i> , <i>Scaevola spinescens</i> , <i>S. tomentosa</i> , <i>Pimelia microcephala</i> , <i>Eriachne helmsii</i> .	1 inventory site and traversed Vegetation type: Wanderrie Bank Grassy Shrubland. Palatable perennials include: <i>Maireana lanosa</i> , <i>M. pyramidata</i> , <i>Scaevola spinescens</i> , <i>S. tomentosa</i> . Pastoral use limitations: None under controlled grazing.
Unit 3: Alluvial plains (30%) Gently sloping (< 0.3%), interdunal plains to 200 m wide, widening downslope, slightly to moderately mantled by gravels and pebbles. Soils are crusted duplexes, red clayey sands over yellowish red light medium clays > 1 m; pH 7.0-9.0 with an alkaline trend. Principal profile form: Dr1.33.	Scattered (PFC 10-20%) low shrublands dominated by <i>Cratystylis subspinescens</i> and <i>Atriplex vesicaria</i> . Mid shrubs (1-2 m): <i>Acacia tetragonophylla</i> , <i>A. victoriae</i> , <i>Eremophila pterocarpa</i> , <i>Cassia desolata</i> , <i>C. subspinescens</i> . Low shrubs (< 1 m): <i>C. subspinescens</i> , <i>Atriplex vesicaria</i> , <i>Ptilotus beardii</i> , <i>Eremophila maculata</i> , <i>Maireana tomentosa</i> , <i>M. integra</i> , <i>Frankenia pauciflora</i> , <i>Halosarcia</i> spp.	2 inventory sites, 2 condition sites and traversed Vegetation type: Saltbush/Bluebush Shrubland. Palatable perennials include: <i>Atriplex vesicaria</i> , <i>Eremophila maculata</i> , <i>Cratystylis subspinescens</i> , <i>Ptilotus beardii</i> , <i>Frankenia pauciflora</i> , <i>Maireana platycarpa</i> , <i>M. integra</i> . Pastoral use limitations: Moderately susceptible to accelerated erosion when perennials are degraded and susceptible to increases in unpalatable shrubs such as <i>Eremophila pterocarpa</i> .
Unit 4: Wide drainage floors (5%) Gently sloping (< 0.4%) saline drainage tracts receiving sheet flow from unit 3, often with shallow, braided channels and runnels; extending to 1 km wide, although more commonly < 0.5 km. Soils are deep crusted duplexes pH 6.0 with an alkaline reaction trend. Principal profile form: Dr1.16.	Very scattered (PFC < 10%) mixed shrublands dominated by <i>Eremophila pterocarpa</i> . Tall shrubs (> 2 m): <i>Acacia cuspidifolia</i> . Mid shrubs (1-2 m): <i>E. pterocarpa</i> , <i>A. tetragonophylla</i> , <i>Cassia desolata</i> . Low shrubs (< 1 m): <i>E. crenulata</i> , <i>E. maculata</i> , <i>Scaevola spinescens</i> , <i>Ptilotus polakii</i> , <i>Maireana platycarpa</i> , <i>M. pyramidata</i> .	1 inventory site Vegetation type: Bluebush Shrubland. Palatable perennials include: <i>Eremophila maculata</i> , <i>Scaevola spinescens</i> , <i>Ptilotus polakii</i> , <i>Maireana platycarpa</i> , <i>M. pyramidata</i> . Pastoral use limitations: Susceptible to erosion if vegetation is depleted; prone to increases in unpalatable shrubs such as <i>Eremophila pterocarpa</i> , <i>E. crenulata</i> , <i>Acacia cuspidifolia</i> .
Unit 5: Claypans (3%) Variably shaped flat claypans to 500 m wide but more commonly < 250 m. Soils are deep clays.	No perennial vegetation.	Traversed
Unit 6: Drainage foci and small swamps (< 2%) Isolated seasonally inundated small swamps to 500 m in diameter. Soils are deep clays or clay loams.	Tall close shrublands, sometimes fringing perennial grasslands in lower parts of unit.	Traversed

Boulder land system 832 km² (0.97% of survey area)

Land type: 6; Pastoral potential: moderate.

Gently undulating stony plains and low rises supporting patchy, slightly saline, shrublands.

Geology: Tertiary silcrete and colluvium overlying Permian sedimentary rocks of the Lyons formation (Sakmarian series): sandstone, siltstone and shale with glacial pebbles.

Geomorphology: Erosional surfaces; minor low breakaways with short slopes above gently undulating stony plains with dense silcrete or variable, mixed mantling and shallow pans, draining onto lower, saline plains with occasional sandy banks; restricted drainage floors dissecting upper parts and broadening downslope to 0.5 km wide; relief usually < 20 m.

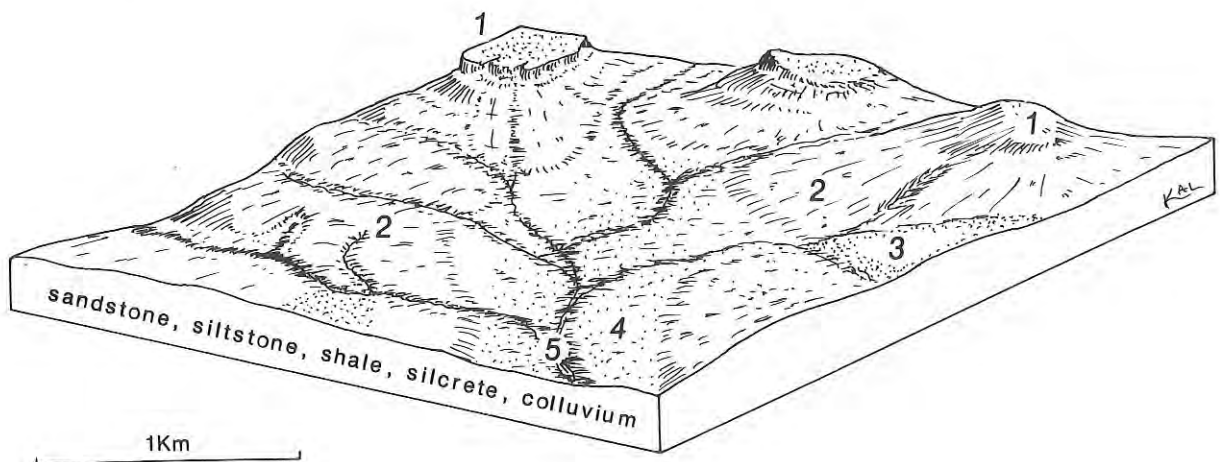
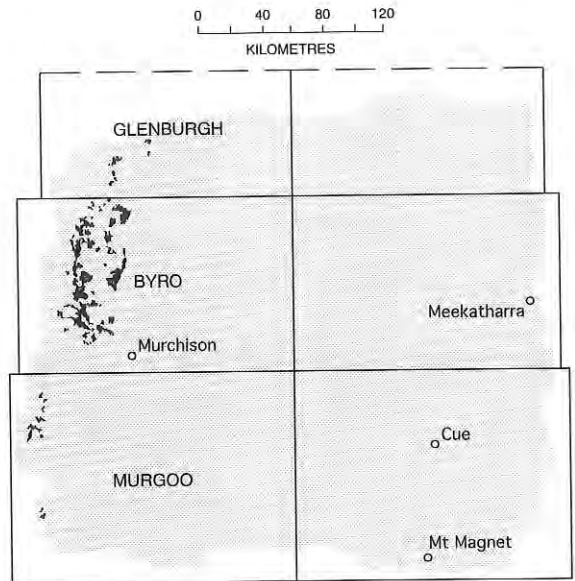
Vegetation and pastoral use: Granitic Mulga Shrubland, Stony Mulga Mixed Shrubland and Stony Snakewood Shrubland variably distributed on plateaux, stony slopes and higher plains; saline plains and drainage floors (units 4 and 5) support sparse halophytic shrubs and are moderately productive; units 4 and 5 are susceptible to water erosion and invasion by undesirable species.

Estimated carrying capacity, good condition: 12 ha / dse.

Range condition summary (146 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
87	12	1	0	25	54	21

- Unit: 1. Low hills and breakaways.
2. Stony plains.
3. Sand sheets.
4. Saline lower plains.
5. Drainage floors.



Boulder I.s.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Low hills and breakaways (10%) Rough boulder strewn low hills and occasional dissected plateaux to 15 m. Soils are stony lithosols over silcrete with a pH range of 5.5-6.5 with an acidic trend. Principal profile form: Uc1.43.	Very scattered (PFC < 10%) mixed shrublands dominated by <i>Solanum lasiophyllum</i> , <i>Eremophila fraseri</i> or <i>E. latrobei</i> . Trees (2-4 m): <i>Acacia aneura</i> . Mid shrubs (1-2 m): <i>Eremophila fraseri</i> , <i>E. latrobei</i> , <i>Thryptomene baeckeacea</i> , <i>Calytrix</i> sp. Low shrubs (< 1 m): <i>Solanum lasiophyllum</i> , <i>Ptilotus obovatus</i> , <i>P. schwartzii</i> , <i>Hemigenia</i> sp. Perennial grass: <i>Eragrostis lanipes</i> .	1 inventory site, 1 condition site and traversed Vegetation type: Rocky Hill Mixed Shrubland. Palatable perennials include: <i>Ptilotus obovatus</i> , <i>P. schwartzii</i> , <i>Eremophila latrobei</i> , <i>Eragrostis lanipes</i> . Pastoral use limitations: None under controlled grazing.
Unit 2: Stony plains (60%) Extensive, (up to 5 km in extent) undulating and gently sloping (< 1.5%) densely mantled plains with occasional silcrete outcrops to 3 m high; partly saline in lower parts. Soils are red earths, stony lithosols or occasionally hardpan types with a silcrete pan at < 50 cm deep; pH 5.5-8.0. Principal profile forms: Gn2.12, Gn2.13, Uc5.21, Uc1.43, Um5.51, Um5.31.	Scattered (PFC 10-20%) shrublands dominated by <i>Acacia aneura</i> , <i>A. grasbyi</i> or <i>Maireana triptera</i> . Trees (2-4 m): <i>A. aneura</i> . Tall shrubs (> 2 m): <i>A. cuthbertsonii</i> , <i>A. grasbyi</i> , <i>A. xiphophylla</i> , <i>A. aneura</i> , <i>A. acuminata</i> . Mid shrubs (1-2 m): <i>Eremophila platycalyx</i> , <i>Cassia desolata</i> , <i>A. tetragonophylla</i> , <i>A. grasbyi</i> , <i>E. latrobei</i> . Low shrubs (< 1 m): <i>Maireana triptera</i> , <i>M. convexa</i> , <i>M. georgei</i> , <i>Ptilotus obovatus</i> , <i>P. schwartzii</i> , <i>Rhagodia eremaea</i> , <i>Eremophila punicea</i> , <i>Solanum lasiophyllum</i> , <i>Hemigenia</i> spp.	7 inventory sites, 13 condition sites and traversed Vegetation type: Stony Mulga Mixed Shrubland. Palatable perennials include: <i>Maireana georgei</i> , <i>M. convexa</i> , <i>Ptilotus obovatus</i> , <i>P. schwartzii</i> , <i>Rhagodia eremaea</i> , <i>Prostanthera tysoniana</i> . Pastoral use limitations: None under controlled grazing. Vegetation condition %: VG/G 32, F 52, P/VP 16. 88 obs.
Unit 3: Sand sheets (5%) Occasional flat or gently sloping tracts of sandplain to 1 km long and 0.5 km wide. Soils are probably deep sands over silcrete. Principal profile form: Uc5.21.	Moderately dense (PFC 20-30%) mixed shrublands with <i>Acacia ramulosa</i> , <i>Thryptomene</i> sp., <i>Eremophila</i> aff. <i>latrobei</i> , <i>Prostanthera</i> sp. and <i>Monachather paradoxa</i> .	Traversed Vegetation type: Sandplain Wanderrrie Grassy Shrubland. Palatable perennials include: <i>Monachather paradoxa</i> , <i>Eremophila latrobei</i> . Pastoral use limitations: None under controlled grazing.
Unit 4: Saline lower plains (20%) Gently sloping saline plains, lightly mantled with quartz and Permian pebbles. Soils are duplex types, yellowish-red loamy sand over yellowish-brown fine sandy clays on silcrete at variable depth; pH 7.0-9.0 with an alkaline trend. Principal profile form: Db3.33, Dr2.53.	Very scattered (PFC < 10%) low shrublands dominated by <i>Eremophila pterocarpa</i> and <i>Maireana platycarpa</i> . Tall shrubs (> 2 m): <i>E. pterocarpa</i> , <i>E. platycalyx</i> , <i>Acacia tetragonophylla</i> , <i>Hakea preissii</i> . Low shrubs (< 1 m): <i>Ptilotus beardii</i> , <i>P. polakii</i> , <i>M. platycarpa</i> , <i>M. pyramidata</i> , <i>Solanum lasiophyllum</i> , <i>Cassia phyllodinea</i> .	2 inventory sites, 6 condition sites and traversed Vegetation type: Bluebush/Stony Snakewood Shrubland. Palatable perennials include: <i>Maireana platycarpa</i> , <i>M. pyramidata</i> , <i>Ptilotus beardii</i> , <i>P. polakii</i> . Pastoral use limitations: Moderate susceptibility to erosion when vegetation is degraded, may be subject to increases in unpalatable shrubs such as <i>Eremophila pterocarpa</i> and <i>Hakea preissii</i> .
Unit 5: Drainage floors (5%) Narrow and commonly braided drainage tracts up to 0.5 km wide, occasionally with incised channels to 2 m deep. Soils are clay types, yellowish-brown clay loams over red light clays; pH 6.5-7.5 with a neutral trend. Principal profile form: Uf6.71.	Moderately close to close (PFC 20-50%) tall shrublands dominated by <i>Acacia tetragonophylla</i> . Tall shrubs (> 2 m): <i>A. tetragonophylla</i> , <i>A. sclerosperma</i> . Mid shrubs (1-2 m): <i>Eremophila platycalyx</i> , <i>Exocarpus aphyllus</i> . Low shrubs (< 1 m): <i>Maireana triptera</i> , <i>M. pyramidata</i> , <i>Rhagodia eremaea</i> , <i>Ptilotus divaricatus</i> , <i>P. obovatus</i> , <i>Solanum lasiophyllum</i> . Perennial grass: <i>Stipa elegantissima</i> .	1 inventory site and traversed Vegetation type: Creekline Shrubland. Desirable perennials include: <i>Maireana pyramidata</i> , <i>Rhagodia eremaea</i> , <i>Ptilotus divaricatus</i> , <i>P. obovatus</i> . Pastoral use limitations: Local susceptibility to water erosion when degraded.

Breberle land system 115 km² (0.13% of survey area)

Land type: 12; Pastoral potential: moderate.

Level saline drainage plains adjacent to ephemeral lakes, claypans and swampy drainage foci with sandy margins and occasional sand dunes; supports tall acacia shrublands and other fringing shrublands with zonations of perennial grasses and halophytes.

Geology: Quaternary lake and playa deposits of sand, clay and gypsum; aeolian sands in dune formations.

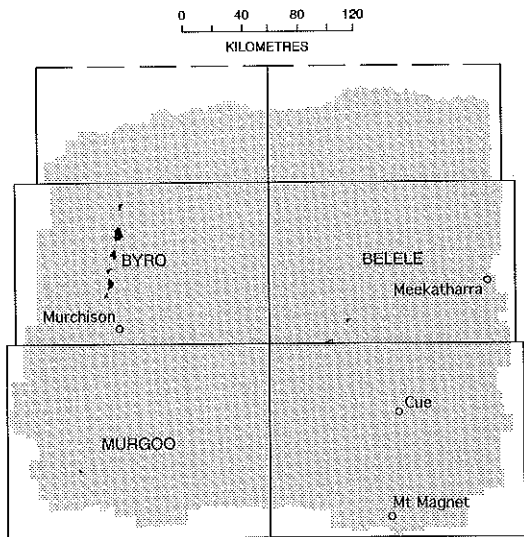
Geomorphology: Alluvial and aeolian depositional surfaces; slightly elevated sandplain tracts with low dunes fringing saline alluvial plains, interspersed with numerous drainage foci with deep duplex soils and occasional gilgai micro relief; drainage partly internal, widely disorganised but locally well defined and channelled; overall relief mainly < 3 m.

Vegetation and pastoral use: A minor system with moderately productive mixed vegetation: Wanderrie Bank Grassy Shrubland on sandplains and low banks; intervening saline plains support Samphire or Mixed Halophyte Shrubland, varying in productivity according to degree of salinity; stands of palatable halophytes commonly degraded through overuse; drainage tracts with dense Mulga Grove Woodland support some perennial grasses and abundant annuals in good season but generally few edible shrubs; drainage foci and pans locally bare but often carry highly productive Alluvial Tussock Grassland. System not normally susceptible to erosion.

Estimated carrying capacity, good condition: 12 ha/dse.

Range condition summary (27 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
100	0	0	0	4	41	55



- Unit: 1. Sand sheets and low banks.
2. Saline alluvial plains.
3. Groved drainage tracts.
4. Lakes, swamps and claypans.



Breberle I.s.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Sand sheets and low banks (50%) Confused and reticulate low sandy banks to 2 m high grading into more extensive gently sloping (< 2%) sheets down slope. Soils are red earthy sands to > 1 m deep; pH is 6.5-7.5 with a neutral trend. Principal profile form: Uc5.21.	Close (PFC 30-50%) tall shrublands or mixed woodlands dominated by <i>Melaleuca uncinata</i> . Tall shrubs (> 2 m): <i>M. uncinata</i> , <i>Acacia distans</i> . Mid shrubs (1-2 m): <i>M. uncinata</i> , <i>A. ramulosa</i> . Low shrubs (< 1 m): <i>Solanum lasiophyllum</i> , <i>Cassia nemophila</i> . Perennial grasses: <i>Monachather paradoxa</i> , <i>Thyridolepis multiculmis</i> .	1 inventory site and traversed Vegetation type: Wanderrie Bank Grassy Shrubland. Palatable perennials include: <i>Monachather paradoxa</i> , <i>Thyridolepis multiculmis</i> . Pastoral use limitations: None under controlled grazing.
Unit 2: Saline alluvial plains (20%) Flat to very gently sloping interconnected strongly saline alluvial plains. Soils are either brown duplex types, loamy sands over fine sandy clays overlying calcrete hard pan at 35 cm; pH 9.0 with a strongly alkaline trend, or clay types in lower areas. Principal profile form: Db0.53.	Scattered (PFC 10-20%) low shrublands dominated by <i>Halosarcia indica</i> . Tall shrubs (> 2 m): <i>Acacia victoriae</i> . Low shrubs (< 1 m): <i>H. indica</i> , <i>Frankenia pauciflora</i> . Perennial grass: <i>Eragrostis dielsii</i> .	1 inventory site and traversed Vegetation type: Samphire Shrubland. Palatable perennials include: <i>Frankenia pauciflora</i> , <i>Eragrostis dielsii</i> . Pastoral use limitations: High salt content of pasture plants.
Unit 3: Groved drainage tracts (10%) Very gently sloping, densely vegetated (often in groves) tracts receiving overland sheet flow and draining into unit 4. Soils are clayey types often overlying calcrete as in unit 2.	Closed (PFC > 20%) woodland dominated by <i>Acacia distans</i> . Trees: <i>Eucalyptus coolabah</i> (6-8 m), <i>Acacia distans</i> (4-6 m). Tall shrubs (2-4 m): <i>Melaleuca uncinata</i> .	1 inventory site and traversed Vegetation type: Mulga Grove Woodland. Pastoral use limitations: None with controlled grazing.
Unit 4: Lakes, swamps and claypans (20%) Irregularly shaped drainage depressions to 3 km long and 2 km wide (Lake Breberle), but more commonly < 0.5 km in diameter; locally with gilgaied surfaces. Soils are probably deep clays.	Vegetation of variable density; swamp margins mostly fringed with dense <i>Melaleuca uncinata</i> and <i>Halosarcia</i> spp. Seasonally inundated areas may have moderately dense perennial grass. (<i>Eragrostis dielsii</i> or <i>Eriachne flaccida</i>) with scattered <i>Eucalyptus coolabah</i> to 8 m and <i>Muehlenbeckia cunninghamii</i> .	Traversed Vegetation type: Bare or scattered Samphire (or lignum) Shrubland, also open <i>Eucalyptus coolabah</i> woodland with grass understorey. Pastoral use limitations: Seasonally inundated, but generally no limitations under controlled grazing.

Bullimore land system (W) 67 km² (0.08% of survey area)

Land type: 9; Pastoral potential: very low.

Gently undulating sandplain with occasional linear dunes and stripped surfaces supporting tall shrublands and hard spinifex.

Geology: Quaternary aeolian sand derived primarily from gneiss and granite.

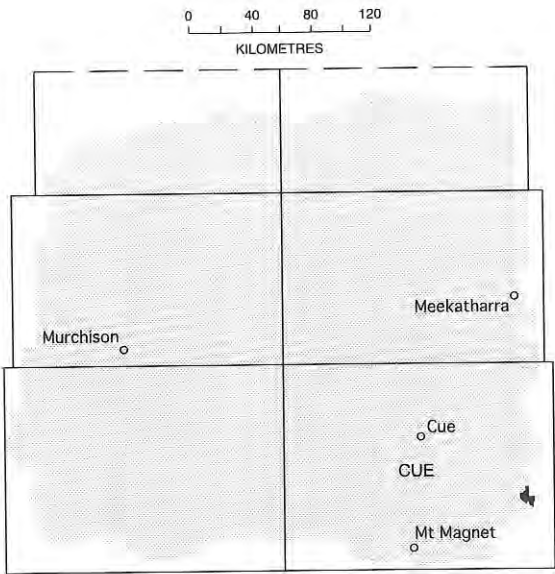
Geomorphology: Depositional surfaces of the 'old plateau' type, extensive elevated sandplain with infrequent low linear dunes; mainly without drainage features but locally with broad, poorly developed drainage zones with more soil development; relief to 10 m.

Vegetation and pastoral use: Sandplain Mallee-Acacia-Spinifex Shrubland of very low productivity, mainly through annual forbs and grasses in good seasons after fire; unit 3 is slightly more productive with a larger component of desirable shrubs and grasses. Not normally susceptible to erosion. A very minor system in this area.

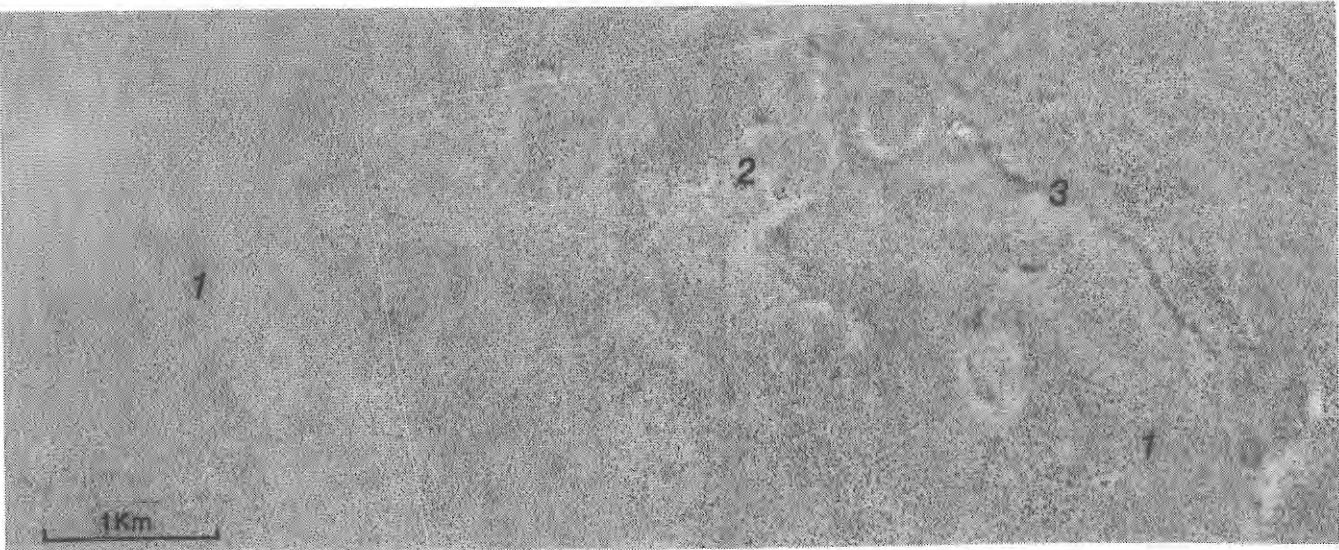
Estimated carrying capacity, good condition: 30 ha / dse.

Range condition summary (21 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
100	0	0	0	90	10	0



- Unit: 1. Sand sheet.
2. Gravelly plains.
3. Drainage zones.



Bullimore I.s.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Sand sheet (85%) Almost flat (slopes < 0.3%) plains with isolated low dunes. Soils are deep, dark red earthy sands and clayey sands with an acid reaction trend. Principal profile form: Uc5.21.	Spinifex (<i>Triodia basedowii</i>) hummock grasslands with scattered (PFC 10-20%) low trees and shrubs, mostly <i>Eucalyptus</i> spp. and <i>Acacia ramulosa</i> . Trees: <i>Eucalyptus kingsmillii</i> , <i>E. spp.</i> <i>Acacia aneura</i> . Tall shrubs (> 2 m): <i>Duboisia hopwoodii</i> , <i>Acacia ramulosa</i> , <i>A. aneura</i> , <i>Grevillea</i> spp. Mid shrubs (1-2 m): <i>A. aneura</i> , <i>A. ramulosa</i> . Low shrubs (< 1 m): <i>Pityrodia</i> sp, <i>Eremophila granitica</i> , <i>E. glabra</i> . Perennial grasses: <i>Triodia basedowii</i> , <i>Monachather paradoxa</i> , <i>Eriachne helmsii</i> , <i>Paraneurachne muelleri</i> , <i>Amphipogon strictus</i> .	3 inventory sites, 3 condition sites and traversed Vegetation type: Mallee-Acacia-Spinifex Sandplain Shrubland. Generally few desirable shrubs; some forage is provided by annuals. Pastoral use limitations: Very low grazing value; prescribed burning may improve value by promoting more palatable forbs and grasses. Vegetation condition %: VG/G 90, F 10, P/VP 0. 21 obs.
Unit 2: Gravelly plains (5%) Gently sloping or undulating stripped surfaces mantled by lateritic gravel or ironstone pebbles. Soils are probably earthy or gravelly sands.	Vegetation similar to unit 1 but less cover. Generally dominated by <i>Acacia ramulosa</i> , <i>Eucalyptus kingsmillii</i> and <i>Triodia basedowii</i> .	Traversed Vegetation type: Sandplain Mallee-Acacia-Spinifex Shrubland. Pastoral use limitations: As for unit 1.
Unit 3: Drainage zones (10%) Gently sloping, flat surfaced drainage tracts receiving some local sheet flow. Soils are probably earthy sands, red earths or occasionally hardpan types.	More cover than units 1 and 2. Dominated by <i>Acacia aneura</i> and <i>A. ramulosa</i> ; occasional <i>Rhagodia eremaea</i> , <i>Maireana villosa</i> , <i>Monachather paradoxa</i> and <i>Eriachne helmsii</i> .	Traversed Vegetation type: Mulga Grove Woodland. Palatable shrubs include: <i>Rhagodia eremaea</i> , <i>Maireana villosa</i> . Pastoral use limitations: None.

Bunny land system 485 km² (0.56% of survey area)

Land type: 13; Pastoral potential: moderate.

Hardpan wash plains with very broad sandy (wanderrie) banks and thin veneers of sandplain up to 5 km wide and minor channelled drainage lines; supports tall acacia shrublands with wanderrie grasses and is similar to Belele land system, but occurs only in the south-west.

Geology: Quaternary alluvium with cemented colluvium and aeolian sand.

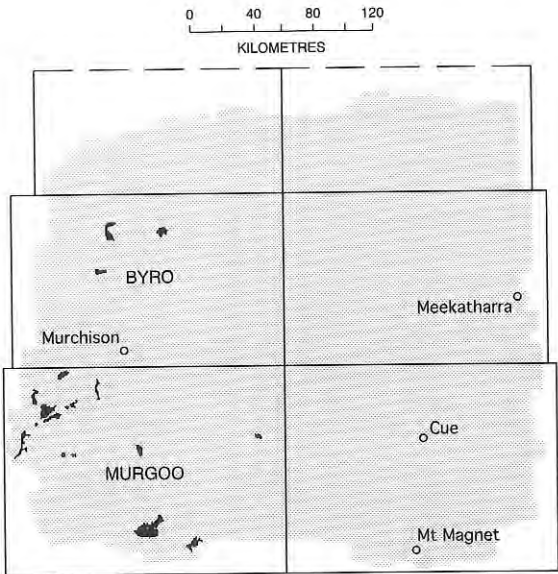
Geomorphology: Depositional surfaces; flat alluvial plains on red-brown hardpan, carrying sheet flow between slightly elevated plains masked by thin aeolian sand; minor lateritic plains with stripped surfaces and light ironstone mantles; alluvial drainage tracts with narrow channels not incised; isolated, small claypans; relief mostly < 5 m.

Vegetation and pastoral use: Wanderrie Bank Shrublands or Sandplain Wanderrie Grassy Shrublands; moderately productive with a balance of desirable perennial shrubs and grasses when in good condition. Hardpan Mulga Shrubland; scattered to moderately close on units 2 and 3, providing reasonable shrub reserves. System is not usually susceptible to erosion.

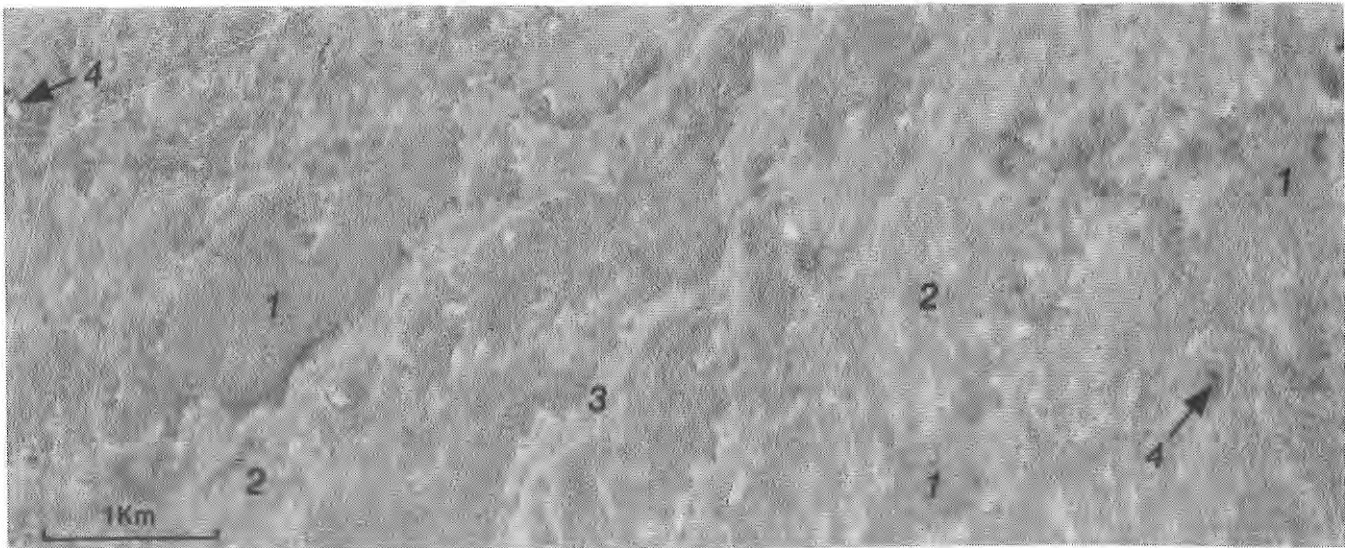
Estimated carrying capacity, good condition: 12 ha/dse.

Range condition summary (108 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
97	3	0	0	32	46	22



- Unit: 1. Sandy banks and thin sand sheets.
2. Hardpan plains.
3. Drainage tracts.
4. Drainage foci and claypans.



Bunny I.s.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Sandy banks and thin sand sheets (60%) Gently sloping (< 0.5%) sandy banks and minor, thin sand sheets up to 1 km in extent. Soils are brown or red earthy sands over hardpan at 0.5 to 1 m; pH 5.5-6.5 with a neutral or acidic reaction trend. Principal profile forms: Uc5.21 and Uc5.22	Scattered to moderately close (PFC 10-30%) mixed grassy shrublands. Tall shrubs (> 2 m): <i>Acacia ramulosa</i> , <i>A. aneura</i> , <i>Hakea arida</i> , <i>Grevillea juncifolia</i> . Mid shrubs (1-2 m): <i>Eremophila forrestii</i> , <i>A. tetragonophylla</i> . Low shrubs (< 1 m): <i>E. forrestii</i> , <i>Solanum lasiophyllum</i> , <i>Calytrix</i> spp., <i>Ptilotus schwartzii</i> . Perennial grasses: <i>Monachather paradoxa</i> , <i>Thyridolepis multiculmis</i> , <i>Eragrostis eriopoda</i> , <i>Eriachne helmsii</i> .	3 inventory sites, 4 condition sites and traversed Vegetation type: Wanderrie Bank Grassy Shrubland. Palatable perennials include: <i>Ptilotus schwartzii</i> , <i>P. obovatus</i> , <i>Eremophila forrestii</i> , <i>Monachather paradoxa</i> , <i>Thyridolepis multiculmis</i> . Pastoral use limitations: None with controlled grazing; not normally susceptible to accelerated erosion. Vegetation condition %: VG/G 80, F 18, P/V 2. 41 obs.
Unit 2: Hardpan plains (30%) Mostly flat plains underlain by hardpan; locally with ironstone or weathered sandstone gravelly mantle. Soils are hardpan types, red, or dark red clay loams or sandy clay loams to 40 cm over hardpan; pH 6.0-7.0 with a neutral or acidic reaction trend. Principal profile form; Um5.31.	Scattered (PFC 10-20%) mid shrublands dominated by <i>Hakea arida</i> and <i>Acacia grasbyi</i> . Trees (4-6 m): <i>A. aneura</i> . Tall shrubs (> 2 m): <i>A. grasbyi</i> , <i>A. tetragonophylla</i> . Mid shrubs (1-2 m): <i>H. arida</i> , <i>A. tetragonophylla</i> , <i>A. ramulosa</i> , <i>Eremophila platycalyx</i> , <i>Grevillea deflexa</i> , <i>E. aff. mackinlayi</i> , <i>Cassia nemophila</i> . Low shrubs (< 1 m): <i>Ptilotus obovatus</i> , <i>Sida calyxhymentia</i> , <i>C. phyllodinea</i> , <i>Hemigenia</i> sp., <i>Solanum lasiophyllum</i> , <i>Maireana villosa</i> , <i>Dianella revoluta</i> . Perennial grass: <i>Stipa elegantissima</i> .	3 inventory sites, 2 condition sites and traversed Vegetation type: Hardpan Mulga Shrubland. Palatable perennials include: <i>Ptilotus obovatus</i> , <i>Sida calyxhymentia</i> , <i>Maireana villosa</i> , <i>Grevillea deflexa</i> . Pastoral use limitations: None under controlled grazing.
Unit 3: Drainage tracts (5%) Very gently sloping drainage tracts to 0.5 km wide, but more commonly < 200 m with braided narrow channels incised in hardpan. Soils are dark red or brown earthy sands or hardpan types to 0.5 m over hardpan or weathered granite; pH 6.0-6.5 with a neutral or acidic trend. Principal profile forms: Uc5.21, Um5.31.	Scattered to close (PFC 10-50%) tall shrublands dominated by <i>Acacia burkittii</i> or <i>A. grasbyi</i> . Tall shrubs (> 2 m): <i>A. burkittii</i> , <i>A. grasbyi</i> , <i>A. aneura</i> , <i>A. tetragonophylla</i> , <i>Hakea recurva</i> . Mid shrubs (1-2 m): <i>A. tetragonophylla</i> , <i>A. xiphophylla</i> , <i>Cassia nemophila</i> , <i>Eremophila georgei</i> . Low shrubs (< 1 m): <i>Ptilotus obovatus</i> , <i>Maireana triptera</i> , <i>M. thesioides</i> , <i>Rhagodia</i> sp., <i>Enchylaena tomentosa</i> , <i>Scaevola spinescens</i> . Perennial grass: <i>Stipa elegantissima</i> .	2 inventory sites and traversed Vegetation type: Creekline Shrubland or Hardpan Mulga Shrubland. Palatable perennials include: <i>Maireana thesioides</i> , <i>M. triptera</i> , <i>Ptilotus obovatus</i> , <i>Rhagodia</i> sp., <i>Enchylaena tomentosa</i> , <i>Scaevola spinescens</i> . Pastoral use limitations: None under controlled grazing.
Unit 4: Drainage foci and claypans (5%) Occasional foci < 200 m in diameter. Soils probably shallow clays.	Mostly bare, but where vegetated probably moderately close tall shrublands with <i>Acacia tetragonophylla</i> being dominant.	Traversed

Byro land system 497 km² (0.58% of survey area)

Land type: 5; Pastoral potential: moderate.

Gently undulating or slightly terraced, extensive saline stony plains based on sedimentary rocks, with very variable mulga, snakewood and halophytic shrublands.

Geology: Permian sedimentary rocks of the Artinskian series: sandstones and siltstones of the Byro group; also thin veneers of Quaternary alluvium and colluvium plus minor aeolian deposits.

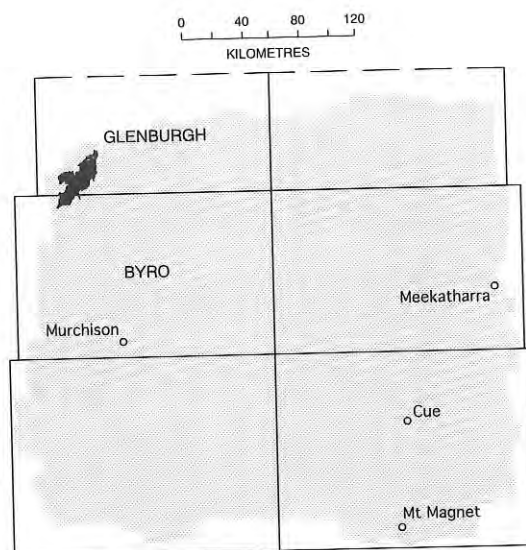
Geomorphology: Erosional and depositional surfaces; complex and irregular plains with isolated low sandstone rises and breakaways; highly variable alluvial lower plains (occasionally fringed with low dunes) with similarly variable sedimentary or ferruginous mantles, lower plains strongly saline and gypsiferous in parts; drainage mostly poorly developed, with throughflow from plains draining to eroding channelled zones and incised major channels; scattered discrete drainage foci; overall relief is < 10 m.

Vegetation and pastoral use: Mixed Halophytic, Stony Snakewood, Bluebush and Samphire Shrublands, highly productive when in good condition but some extensive areas are degraded to primarily annual species. Erosion is common and particularly serious on lower plains and across drainage zones, with large tracts of scalding, rilling, minor gullies and pedestalling; increases by unpalatable shrub species are widespread.

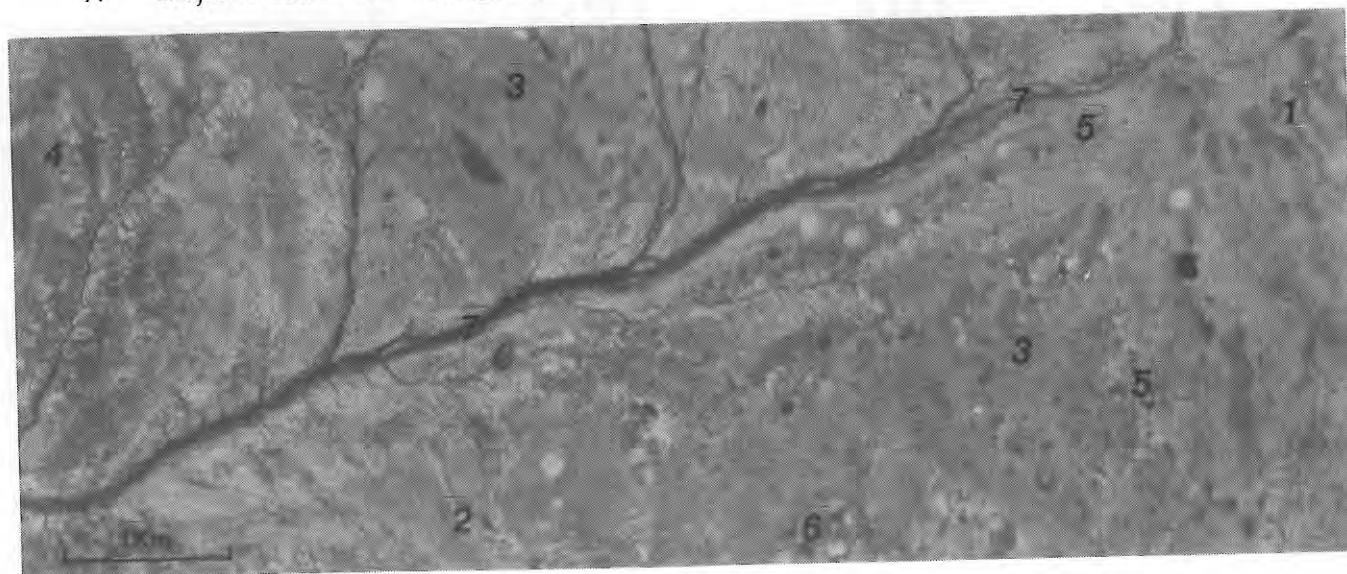
Estimated carrying capacity, good condition: 12 ha/dse.

Range condition summary (96 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
42	38	19	1	6	34	60



- Unit:
1. Sand dunes and banks.
 2. Outcrops and breakaway remnants.
 3. Pebbly plains.
 4. Gypsiferous plains.
 5. Saline plains.
 6. Drainage foci.
 7. Major channels and drainage tracts.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Sand dunes and banks (4%) Reticulate and elongate dunes to 200 m wide and 5 m high, slopes mostly < 10%; extending to 2 km in length parallel to the direction of flow. Soils are deep red earthy sands with a neutral trend. Principal profile form: Uc5.21.	Scattered (PFC 10-20%) tall shrublands dominated by <i>Calytrix</i> sp and <i>Grevillea stenobotrya</i> . Tall shrubs (> 2 m): <i>G. stenobotrya</i> . Mid shrub <i>Eremophila maitlandii</i> . Low shrubs (< 1 m): <i>Calytrix</i> sp, <i>Scaevola tomentosa</i> , <i>Rhagodia eremaea</i> , <i>Enchylaena tomentosa</i> .	1 inventory site and traversed Vegetation type: Sand Dune Shrubland. Palatable perennials include: <i>Enchylaena tomentosa</i> , <i>Rhagodia eremaea</i> , <i>Scaevola tomentosa</i> . Pastoral use limitations: None under controlled grazing.
Unit 2: Outcrops and breakaway remnants (2%) Residuals of sandstone and siltstone with indurated crests and short, steep footslopes, up to 7 m above surrounding plains. Soils are skeletal lithosols.	Patchy shrublands, non-saline in higher parts of the unit, saline in lower parts.	
Unit 3: Pebbly plains (75%) Gently sloping (< 1%) colluvial and alluvial plains with relief to 2 m above adjacent unit 4; with sparse to moderate mantle of weathered sandstone or ferruginous pebbles and gravels. Soils are deep duplex types: yellowish red or brown loamy to clayey sands over fine sandy clays to light clays over bedrock; pH 7.0-8.0 with alkaline reaction trend. Principal profile form: Db3.33, Dr1.13, Dr1.33.	Very scattered to scattered (PFC < 20%) shrublands, variably dominated. Tall shrubs (> 2 m): <i>Acacia cuspidifolia</i> , <i>A. xiphophylla</i> , <i>A. aneura</i> . Mid shrubs (1-2 m): <i>Hakea preissii</i> , <i>Eremophila platycalyx</i> , <i>A. victoriae</i> . Low shrubs (< 1 m): <i>Rhagodia eremaea</i> , <i>Maireana platycarpa</i> , <i>M. pyramidata</i> , <i>M. aphylla</i> , <i>Frankenia pauciflora</i> , <i>Ptilotus polakii</i> , <i>P. beardii</i> , <i>P. obovatus</i> , <i>Solanum lasiophyllum</i> , <i>Atriplex vesicaria</i> , <i>A. bunburyana</i> , <i>Enchylaena tomentosa</i> , <i>Eremophila maculata</i> .	4 inventory sites, 9 condition sites and traversed Vegetation type: Stony Snakewood Shrubland, Saltbush and Bluebush Shrubland. Palatable perennials include: <i>Maireana platycarpa</i> , <i>Ptilotus</i> spp., <i>Frankenia pauciflora</i> , <i>Atriplex</i> spp. Increaser species include: <i>Eremophila platycalyx</i> , <i>E. crenulata</i> , <i>Hakea preissii</i> . Pastoral use limitations: Moderately susceptible to accelerated erosion where vegetation is degraded. Vegetation condition %: VG/G 3, F 35, P/V 62. Erosion incidence %: min 39, mod 20, sev 2. 59 obs.
Unit 4: Gypsiferous plains (5%) Mostly flat (slope < 0.3%) plains of gypsiferous materials with puffy, thinly crusted saline surfaces; relief to 2 m. Soils are very shallow loams with gypsiferous sediments overlying a shale pan at 25-50 cm; pH 7.5 with a neutral reaction trend. Principal profile form: Um1.23.	Scattered (PFC 10-20%) low shrublands dominated by <i>Halosarcia pruinosa</i> . Low shrubs (< 1 m): <i>H. pruinosa</i> , <i>Atriplex vesicaria</i> , <i>Maireana aphylla</i> , <i>Solanum lasiophyllum</i> , <i>Rhagodia eremaea</i> , <i>Eremophila lachnocalyx</i> .	1 inventory site and traversed Vegetation type: Samphire Shrubland. Palatable perennials include: <i>Atriplex vesicaria</i> , <i>Maireana aphylla</i> , <i>M. amoena</i> , <i>Rhagodia eremaea</i> . Pastoral use limitations: High levels of salinity in pasture plants combined with poor availability of good stock water.
Unit 5: Saline plains (10%) Flat to gently sloping (< 0.5%) strongly saline alluvial plains with low stony ridges or rises to 2 m above surrounding plains. Mostly covered with very sparse to very dense sandstone mantle. Soils are red, soft surfaced mottled duplexes overlying sedimentary rock; pH 6.5 with a neutral reaction trend. Principal profile form: Dr4.12.	Very scattered (PFC < 10%) low shrublands dominated by <i>Halosarcia</i> species. Tall shrubs (> 2 m): <i>Acacia cuspidifolia</i> . Mid shrubs (1-2 m): <i>A. cuthbertsonii</i> , <i>Eremophila lachnocalyx</i> . Low shrubs (< 1 m): <i>Ptilotus polakii</i> , <i>P. obovatus</i> , <i>Halosarcia</i> spp., <i>H. pruinosa</i> , <i>Frankenia</i> spp., <i>Solanum lasiophyllum</i> , <i>Rhagodia eremaea</i> , <i>Atriplex vesicaria</i> , <i>Maireana amoena</i> , <i>M. integra</i> .	3 inventory sites, 1 condition site and traversed Vegetation type: Samphire Shrubland Palatable perennials include: <i>Ptilotus polakii</i> , <i>P. obovatus</i> , <i>Rhagodia eremaea</i> , <i>Atriplex vesicaria</i> , <i>Maireana</i> spp. Pastoral use limitations: High salt content of pasture plants.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 6: Drainage foci (< 2%) Scattered drainage foci and small swamps to 0.5 km long and 0.2 km wide. Soils are probably deep red earths.	Close (PFC 30-50%) tall shrubland or low woodland dominated by <i>Acacia tetragonophylla</i> . Trees (4-6 cm): <i>A. aneura</i> . Tall shrubs (> 2 m): <i>A. tetragonophylla</i> , <i>Santalum spicatum</i> . Mid shrubs (1-2 m): <i>A. cuthbertsonii</i> . Low shrubs (< 1 m): <i>Eremophila maculata</i> , <i>Enchylaena tomentosa</i> , <i>Maireana aphylla</i> , <i>M. platycarpa</i> , <i>M. pyramidata</i> , <i>Ptilotus obovatus</i> .	1 inventory site and traversed Palatable perennials include: <i>Eremophila maculata</i> , <i>Enchylaena tomentosa</i> , <i>Maireana aphylla</i> , <i>M. pyramidata</i> , <i>M. platycarpa</i> , <i>Ptilotus obovatus</i> . Pastoral use limitations: None under controlled grazing.
Unit 7: Major channels and drainage tracts (2%) Major drainage lines partly with narrow flood plains flanking incised channels to 3 m deep. Soils are deep red earths or light clays or juvenile profiles fringing main channels which carry deep sandy bedloads.	Close to closed (PFC 30 - > 50%) tall shrublands dominated by <i>Acacia tetragonophylla</i> and <i>A. sclerosperma</i> . Trees (8-10 m): <i>Eucalyptus camaldulensis</i> . Tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. tetragonophylla</i> , <i>Heterodendrum oleaefolium</i> , <i>A. sclerosperma</i> . Mid shrubs (1-2 m): <i>A. sclerosperma</i> , <i>Rhagodia eremaea</i> , <i>Maireana pyramidata</i> , <i>Atriplex amnicola</i> , <i>Scaevola spinescens</i> . Perennial grasses: <i>Eragrostis setifolia</i> , <i>Cenchrus setigerus</i> , <i>C. ciliaris</i> , <i>Dichanthium</i> sp., <i>Eulalia fulva</i> .	2 inventory sites and traversed Vegetation type: Creekline Grassy Shrubland. Palatable perennials include: <i>Atriplex amnicola</i> , <i>Scaevola spinescens</i> , <i>Ptilotus obovatus</i> , <i>Rhagodia eremaea</i> , <i>Maireana pyramidata</i> , <i>Eragrostis setifolia</i> , <i>Cenchrus</i> spp. Pastoral use limitations: Susceptible to accelerated erosion by major flows when vegetation is degraded.

Carnegie land system (W) 1281 km² (1.49% of survey area)

Land type: 17; Pastoral potential: high.

Salt lakes with extensive fringing saline plains, dunes and sandy banks, supporting low halophytic shrublands and scattered tall acacia shrublands; lake beds are highly saline, gypsiferous and mainly unvegetated.

Geology: Quaternary lacustrine sand and clay deposits; also aeolian deposits on margins.

Geomorphology: Depositional surfaces; salt lakes and dunes: large lake beds up to 70 km long containing saline muds, receiving episodic major catchment flows via calcreted tributary flood plains. Smaller pans with associated lunettes in areas of impeded drainage; bare lake beds with scattered low gypsiferous or higher greenstone islands. Alluvial marginal plains with tributary fans and channels interrupted by minor sandplain with fringing dunes and low banks away from lake margins; restricted interdunal alluvial swales or claypans; occasional kopi dunes mainly on sides of lake edges. Overall relief is mostly < 7 m.

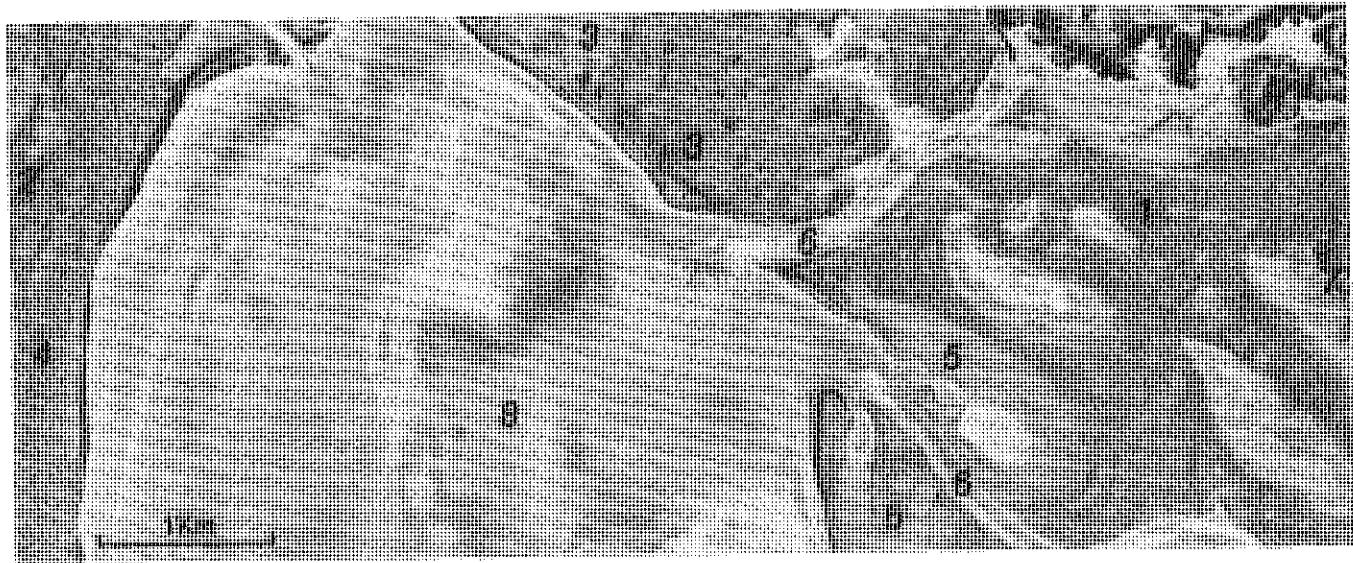
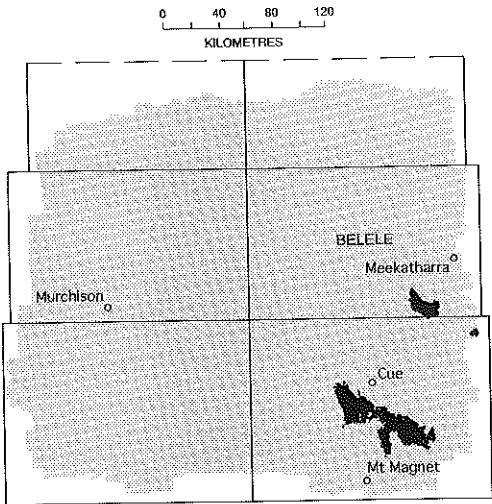
Vegetation and pastoral use: Sand Dune Shrubland and Wanderrie Bank Grassy Shrubland on sandplain units; moderately productive and generally in a stable condition. Mixed Halophytic Shrubland with varying levels of salinity; low to moderate on units 2, 3 and 7; moderate to extreme on units 4, 5 and 8; pastoral value is mostly dependent on salinity levels; pasture condition is fair to good for much of the system; erosion susceptibility is generally low. Lower lake beds represent mostly no pastoral value and should be considered accordingly.

Estimated carrying capacity, good condition: 7 ha/dse.

Range condition summary (107 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
93	7	0	0	77	19	4

- Unit: 1. Sand sheets, dunes and low banks.
2. Hardpan plains.
3. Alluvial plains.
4. Kopi dunes and platforms.
5. Saline plains and lake margins.
6. Drainage tracts.
7. Swamps and drainage foci.
8. Lake beds.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Sand sheets, dunes and low banks (10%)		10 inventory sites and traversed
<p>Gently undulating sand sheets on outer margins of system with associated cut off relict dunes to > 5 m high fringing unit 5 or on lakebed; also low elliptical banks (distinct from dunes) to 2 m high surrounding small (< 300 m diameter) saline interbank plains with duplex soils. Soils are dark red deep earthy sands on the sand sheets and deep siliceous sands on the dunes; pH 6.0-7.0 with a mainly neutral reaction trend. Principal profile forms: Uc1.23, Uc5.21.</p>	<p>Scattered to moderately close (PFC 10-30%) tall or mixed shrublands with a prominent mid storey dominated by <i>Acacia aneura</i>, <i>A. sclerosperma</i> and <i>A. xiphophylla</i>; Trees (2-6 m): <i>A. aneura</i>. Tall shrubs (> 2 m): <i>A. aneura</i>, <i>A. grasbyi</i>, <i>A. murrayana</i>, <i>A. ramulosa</i>, <i>A. sclerosperma</i>, <i>A. tetragonophylla</i>, <i>A. xiphophylla</i>, <i>Eremophila miniata</i>, <i>Hakea preissii</i>. Mid shrubs (1-2 m): <i>Jacksonia</i> spp., <i>Eremophila forrestii</i>, <i>E. margarethae</i>, <i>E. miniata</i>, <i>E. glabra</i>, <i>Cassia nemophila</i>. Low shrubs (< 1 m): <i>Atriplex bunburyana</i>, <i>A. vesicaria</i>, <i>Ptilotus obovatus</i>, <i>E. granitica</i>, <i>Maireana convexa</i>, <i>M. triptera</i>, <i>M. pyramidata</i>, <i>M. thesioides</i>, <i>M. tomentosa</i>, <i>Cratystylis subspinescens</i>, <i>Rhagodia eremaea</i>, <i>R. drummondii</i>, <i>Gunniopsis quadrifidum</i>, <i>Frankenia</i> spp., <i>Solanum lasiophyllum</i>. Perennial grasses: <i>Eriachne helmsii</i>, <i>Eragrostis eriopoda</i>, <i>E. lanipes</i>, <i>Monachather paradoxa</i>.</p>	<p>Vegetation type: Sand Dune Shrubland, Wanderrie Bank Grassy Shrubland or Saltbush Shrubland. Palatable perennials include: <i>Maireana</i> spp., <i>Atriplex</i> spp., <i>Rhagodia</i> spp., <i>Cratystylis subspinescens</i>, <i>Eragrostis</i> spp., <i>Monachather paradoxa</i>. Pastoral use limitations: None with controlled grazing. Vegetation condition %: VG/G 62, F 33, P/V 5. 21 obs.</p>
Unit 2: Hardpan plains (2%)		1 inventory site, 1 condition site and traversed
<p>Minor areas of hardpan plain near system boundary; slopes < 0.5% with infrequent undulations to 1 m relief. Soils are dark red shallow hardpan types or hard-setting duplexes over hardpan at < 50 cm deep; pH 7.0 with a neutral trend. Principal profile form: Dr2.52, Um5.31.</p>	<p>Scattered (PFC 10-20%) mixed acacia shrublands dominated by <i>Acacia aneura</i>. Trees (to 6 m): <i>A. aneura</i>. Tall shrubs (> 2 m): <i>A. aneura</i>, <i>A. tetragonophylla</i>, <i>A. grasbyi</i>. Mid-shrubs (1-2 m): <i>A. ramulosa</i>, <i>Eremophila forrestii</i>, <i>Cassia nemophila</i>, <i>Rhagodia eremaea</i>. Low shrubs (< 1 m): <i>Atriplex bunburyana</i>, <i>Maireana pyramidata</i>, <i>M. triptera</i>, <i>M. georgei</i>, <i>M. thesioides</i>, <i>Ptilotus obovatus</i>, <i>Solanum orbiculatum</i>, <i>S. lasiophyllum</i>.</p>	<p>Vegetation type: Mulga Chenopod Shrubland. Palatable perennials include: <i>Atriplex</i> spp., <i>Maireana</i> spp., <i>Ptilotus obovatus</i>, <i>Rhagodia eremaea</i>. Pastoral use limitations: None with controlled grazing and not normally susceptible to accelerated erosion. Vegetation condition %: VG/G 65, F 21, P/V 14. 14 obs.</p>
Unit 3: Alluvial plains (10%)		3 inventory sites, 3 condition sites and traversed
<p>Mostly flat (slopes < 0.5%) broad interdunal plains, mostly saline, occasionally strewn with gravelly ironstone mantles. Soils are red duplex types, clayey sands or loamy sands over light clays < 50 cm deep over hardpan; pH 7.0-8.5 with neutral or alkaline reaction trend. Principal profile forms: Dr2.12, Dr2.53.</p>	<p>Very scattered to moderately close (PFC < 30%) low shrublands mainly dominated by <i>Atriplex vesicaria</i> or <i>Maireana pyramidata</i>. Tall shrubs (> 2 m): <i>Melaleuca uncinata</i>, <i>Acacia aneura</i>, <i>A. xiphophylla</i>, <i>Hakea preissii</i>. Mid shrubs (1-2 m): <i>Eremophila pterocarpa</i>, <i>A. xiphophylla</i>. Low shrubs (< 1 m): <i>Maireana amoena</i>, <i>M. atkinsiana</i>, <i>M. glomerifolia</i>, <i>M. integra</i>, <i>M. platycarpa</i>, <i>M. pyramidata</i>, <i>M. triptera</i>, <i>M. tomentosa</i>, <i>Atriplex amnicola</i>, <i>A. vesicaria</i>, <i>Cratystylis subspinescens</i>, <i>Solanum lasiophyllum</i>, <i>Sida filiformis</i>.</p>	<p>Vegetation type: Saltbush or Bluebush Shrubland. Palatable perennials include: <i>Atriplex</i> spp., <i>Maireana</i> spp., <i>Cratystylis subspinescens</i>. Increaser species include: <i>Hakea preissii</i>, <i>Eremophila pterocarpa</i>. Pastoral use limitations: Areas overgrazed and degraded are susceptible to invasion by <i>Hakea preissii</i>, <i>Solanum lasiophyllum</i> and <i>Eremophila pterocarpa</i>. Mild to moderate susceptibility to accelerated erosion where perennial vegetation is degraded. Vegetation condition %: VG/G 77, F 20, P/V 3. Erosion incidence %: min 35. 35 obs.</p>

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 4: Kopi dunes and platforms (2%) Expanses of aeolian gypsiferous material occurring either as linear curved dunes to 10 m high and 500 m wide fringing mainly western shorelines of major lakes; or as raised flats adjacent to major lakebeds. Soils are mostly absent except for wind blown pockets of fine sands in pits or depressions.	Very scattered to moderately close (PFC < 30%) woodlands or mixed shrublands dominated by <i>Eucalyptus striatocalyx</i> , <i>Lawrencia helmsii</i> or <i>Melaleuca</i> spp., or low shrublands dominated by <i>Halosarcia indica</i> . Trees (to 6 m): <i>E. striatocalyx</i> . Tall shrubs (> 2 m): <i>Melaleuca</i> spp. Mid shrubs (1-2 m): <i>Melaleuca uncinata</i> , <i>M. spp.</i> , <i>Acacia sclerosperma</i> . Low shrubs (< 1 m): <i>Lawrencia</i> spp., <i>Halosarcia indica</i> , <i>Frankenia</i> spp., <i>Atriplex bunburyana</i> . Perennial grass: <i>Eragrostis falcata</i> (infrequent).	3 inventory sites and traversed Pastoral use limitations: High levels of salinity of dominant species and few desirable species limit grazing potential.
Unit 5: Saline plains and lake margins (10%) Flat, saline and gypsiferous alluvial lower plains adjacent to lakebeds. Soils are mostly reddish-brown clays with crystalline gypsum with thin saline crusts and fine quartz or calcrete mantles. Occasional areas with shallow alluvia to 15 cm deep, often mounded around shrub bases.	Very scattered to moderately close (PFC < 30%) low shrublands (mostly < 0.5 m) dominated by <i>Atriplex</i> , <i>Frankenia</i> or <i>Halosarcia</i> spp. Low shrubs (< 1 m): <i>A. quinii</i> , <i>A. sp.</i> , <i>Carpobrotus</i> sp., <i>F. spp.</i> , <i>H. auriculata</i> , <i>H. doleiformis</i> , <i>H. halocnemoides</i> , <i>H. indica</i> , <i>Lawrencia helmsii</i> , <i>Maireana</i> aff. <i>tormentosa</i> , <i>Senecio</i> sp.	4 inventory sites, 1 condition site and traversed Vegetation type: <i>Frankenia</i> or <i>Samphire</i> Shrubland. Palatable perennials include: <i>Atriplex</i> spp., <i>Maireana</i> spp. Pastoral use limitations: Extreme salinity levels of plants and lack of accessible good quality ground water locally. Vegetation condition %: VG/G 100. 26 obs.
Unit 6: Drainage tracts (3%) Tracts carrying concentrated flow, with channels incised to 1 m deep, draining into major lakes. Soils are probably similar to units 3 or 5.	Scattered low or mixed shrubs, probably similar to unit 5; channels and more frequently flooded saline areas mostly bare except for infrequent <i>Halosarcia</i> spp.	Traversed Vegetation type: <i>Samphire</i> Shrubland or Unvegetated.
Unit 7 Swamps and drainage foci (3%) Scattered, irregular drainage foci located on units 2 and 3; ranging in size from < 100 m to > 500 m in diameter, mostly < 1 m deep. Soils are probably deep duplexes or red clays.	Close (PFC 30-50%) low or mid shrublands dominated by <i>Atriplex amnicola</i> or <i>Melaleuca uncinata</i> ; or scattered low shrublands with <i>Halosarcia</i> spp. Tall and mid shrubs (> 1 m): <i>M. uncinata</i> , <i>Hakea preissii</i> . Low shrubs (< 1 m): <i>A. amnicola</i> , <i>Senecio</i> sp. Perennial grass: <i>Eriachne</i> sp.	1 inventory site and traversed Vegetation type: <i>Saltbush</i> Shrubland. Palatable perennials include: <i>Atriplex amnicola</i> , <i>Eriachne</i> sp. Pastoral use limitations: Seasonal inundation limits grazing access.
Unit 8 Lake beds (60%) Extensive flat saline lakebeds to > 6 km wide with many cut offs and spurs forming minor lakes; beds consist of saline sediments and crystalline gypsum, often with water-tables close to surface.	Mostly bare of vegetation, with patches of <i>Halosarcia</i> communities.	Traversed

Challenge land system 5159km² (6.01% of survey area)

Land type: 4; Pastoral potential: moderate.

Gently sloping gritty and sandy-surfaced plains with granite outcrops and minor breakaways, supporting mulga and some halophytic shrublands.

Geology: Massive Archaean granite with veneers of Quaternary colluvium and minor alluvial deposits and Tertiary laterite.

Geomorphology: Mainly erosional surfaces; breakaways and hills to 20 m high with quartz strewn slopes; tor fields or occasional large batholiths above sandy or stony footslopes; extensive sandy-surfaced plains below hills and tor fields; stony interfluvies (non-saline and saline); alluvial footslopes and restricted saline plains below weathered granite outcrops; hardpan plains carrying sheet flow on lower margins of system; alluvial sandy fans and sinuous drainage tracts with incised channels and sandy bedloads. Overall relief to 30 m.

Vegetation and pastoral use: Granitic Mulga Shrubland and Mulga Chenopod Shrubland of moderate productivity, with minor Bluebush or Mixed Halophytic Shrublands on unit 2 with good drought reserves where not overgrazed; system not normally susceptible to accelerated erosion except on alluvial footslopes and drainage floors. Kite-leaf poison occurs locally, mainly around domes and tors but occasionally on sandy fans and in creeklines, rendering some areas unsuited to stocking.

Estimated carrying capacity, good condition: 12 ha / dse.

Range condition summary (834 traverse observations):

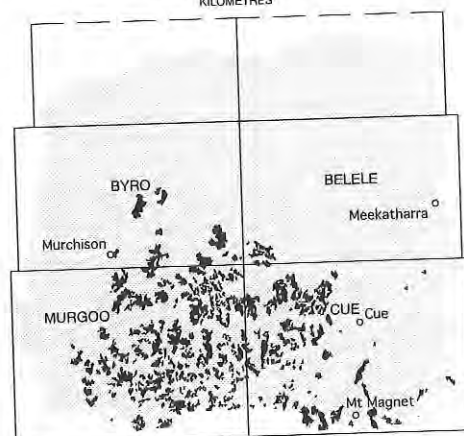
(a) Erosion status (%)

Nil	Min.	Mod.	Sev.
91	7	2	0

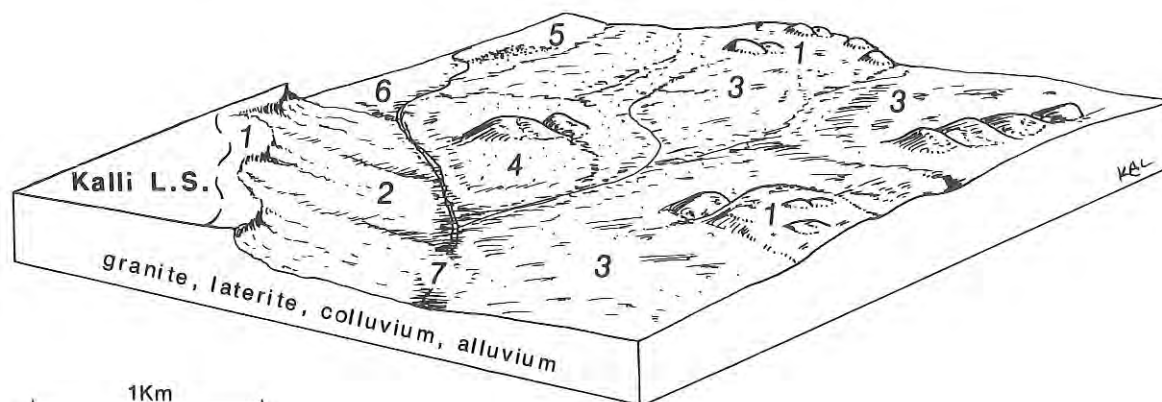
(b) Vegetation condition (%)

Good	Fair	Poor
25	50	25

0 40 80 120
KILOMETRES



- Unit: 1. Domes, tor fields and low breakaways.
 2. Footslopes and saline plains.
 3. Grit-surfaced plains.
 4. Stony plains.
 5. Sandy banks.
 6. Hardpan plains.
 7. Drainage lines



Challenge I.s.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 1: Domes, tor fields and low breakaways (10%)</p> <p>Irregular aggregations of exfoliating granite protrusions and outcrops, of mainly unweathered rocks but also occasional low breakaways with weathered profiles and laterite; occasionally to 25 m high but generally < 10 m. Surfaces are usually strewn with moderately dense mantles of quartz or granite fragments. Soils are red or dark red granitic siliceous sands mainly less than 30 cm deep; pH 6.0-6.5 with a mainly neutral trend. Principal profile form: Uc1.43.</p>	<p>(a) Scattered or very scattered (PFC < 20%) mixed or tall shrublands dominated by <i>Acacia aneura</i> or <i>A. grasbyi</i>; with <i>Cassia nemophila</i>, <i>Eremophila macmillaniana</i> or <i>E. platycalyx</i> often co-dominant.</p> <p>(b) Close to closed (PFC < 30%) tall shrublands or low woodlands very locally at run-on sites below domes, dominated by <i>Acacia rhodophloia</i>, <i>A. quadrimarginea</i> and <i>Gastrolobium laytonii</i>. Trees and tall shrubs (to 6 m): <i>Acacia rhodophloia</i>, <i>A. quadrimarginea</i>, <i>A. aneura</i>, <i>A. grasbyi</i>, <i>A. burkittii</i>, <i>A. cuthbertsonii</i>, <i>Canthium lineare</i>, <i>C. latifolium</i>, <i>Santalum spicatum</i>, <i>Pittosporum phylliraeoides</i>. Mid shrubs (1-2 m): <i>A. tetragonophylla</i>, <i>A. victoriae</i>, <i>Cassia sturtii</i>, <i>C. nemophila</i>, <i>Eremophila platycalyx</i>, <i>E. macmillaniana</i>, <i>E. forrestii</i>, <i>Gastrolobium laytonii</i>. Low shrubs (< 1 m): <i>C. nemophila</i>, <i>Solanum lasiophyllum</i>, <i>Ptilotus obovatus</i>, <i>S. ashbyi</i>, <i>Corchorus walcottii</i>, <i>Sida</i> spp., <i>Rhagodia eremaea</i>, <i>Enchylaena tomentosa</i>, <i>Maireana melanocoma</i>, <i>M. thesioides</i>, <i>M. triptera</i>. Perennial grasses: <i>Cymbopogon ambiguus</i>, <i>Digitaria brownii</i>.</p>	<p>1 inventory site, 5 condition sites and traversed</p> <p>Vegetation type: (a) Rocky Hill Mixed Shrubland. (b) Mulga Grove Woodland. Palatable perennials include: <i>Maireana</i> spp., <i>Rhagodia eremaea</i>, <i>Enchylaena tomentosa</i>, <i>Sida</i> spp., <i>Ptilotus</i> spp. Pastoral use limitations: Kite leaf poison, <i>Gastrolobium laytonii</i>, occurs fairly widely, mainly in discrete thickets.</p>
<p>Unit 2: Footslopes and saline plains (5%)</p> <p>Gently sloping saline plains mainly adjacent to and receiving run-off from unit 1, sparse quartz mantles of pebbles and gravels. Soils are dark red duplexes or earthy sands, mainly loamy sands over sandy clay loams < 30 cm deep, pH 6.0-7.0 with a neutral reaction trend. Principal profile forms: Dr1.52, Dr 2.52, Uc5.21.</p>	<p>Very scattered to scattered (PFC < 20%) low shrublands usually dominated by <i>Maireana</i> spp. Tall shrubs (> 2 m): <i>Acacia xiphophylla</i>, <i>A. burkittii</i>, <i>A. aneura</i>, <i>A. tetragonophylla</i>, <i>A. grasbyi</i>, <i>Hakea preissii</i>. Mid shrubs (1-2 m): <i>M. pyramidata</i>, <i>Cassia sturtii</i>. Low shrubs (< 1 m): <i>M. triptera</i>, <i>M. georgei</i>, <i>M. tomentosa</i>, <i>Atriplex vesicaria</i>, <i>Enchylaena tomentosa</i>, <i>Rhagodia eremaea</i>, <i>Solanum lasiophyllum</i>.</p>	<p>2 inventory sites, 6 condition sites and traversed</p> <p>Vegetation type: Bluebush Shrubland or Stony Snakewood Shrubland. Palatable perennials include: <i>Maireana</i> spp., <i>Atriplex vesicaria</i>, <i>Enchylaena tomentosa</i>, <i>Rhagodia eremaea</i>, <i>Ptilotus obovatus</i>, <i>P. beardii</i>, <i>Eremophila forrestii</i>, <i>Chenopodium gaudichaudianum</i>, <i>Frankenia pauciflora</i>. Pastoral use limitations: Mild to moderate susceptibility to erosion where perennial vegetation is degraded. Vegetation condition %: VG/G 29, F 39, P/VP 32. Erosion incidence %: min 31, mod 8. 49 obs.</p>
<p>Unit 3: Grit-surfaced plains (50%)</p> <p>Extensive, undulating gritty surfaced plains with sandy soils and slopes < 2%; frequent low granite outcrops. Often characterised by pale pinkish appearance of the ground, due to extensive mantling of quartz grit and outcrops of granite bed rock. Soils are usually granitic siliceous sands to 70 cm over decomposing granite; occasionally with thin hardpan and frequently with inclusions of quartz fragments throughout profile; pH 6.5-7.0 with a neutral trend. Principal profile form: Uc5.21.</p>	<p>Scattered to very scattered (PFC < 20%) mixed or tall shrublands dominated by <i>Acacia aneura</i>, <i>A. ramulosa</i>, <i>A. quadrimarginea</i>, <i>Cassia desolata</i> or <i>C. helmsii</i>. Trees (to 6 m): <i>A. aneura</i>, <i>A. pruinocarpa</i>. Tall shrubs (> 2 m): <i>A. aneura</i>, <i>A. ramulosa</i>, <i>A. quadrimarginea</i>, <i>A. tetragonophylla</i>, <i>A. craspedocarpa</i>, <i>A. victoriae</i>. Mid shrubs (1-2 m): <i>A. grasbyi</i>, <i>A. ramulosa</i>, <i>Cassia helmsii</i>, <i>C. sturtii</i>, <i>C. nemophila</i>, <i>Eremophila forrestii</i>, <i>E. platycalyx</i>. Low shrubs (< 1 m): <i>Cassia desolata</i>, <i>C. helmsii</i>, <i>Ptilotus obovatus</i>, <i>Eremophila compacta</i>, <i>Solanum lasiophyllum</i>, <i>S. orbiculatum</i>, <i>Maireana convexa</i>, <i>M. planifolia</i>, <i>Rhagodia eremaea</i>. Perennial grasses: (occasional) <i>Monachather paradoxa</i>, <i>Eragrostis lanipes</i>.</p>	<p>5 inventory sites, 36 condition sites and traversed</p> <p>Vegetation type: Granitic Mulga Shrubland. Palatable perennials include: <i>Eremophila forrestii</i>, <i>E. compacta</i>, <i>Ptilotus obovatus</i>, <i>Maireana</i> spp., <i>Rhagodia eremaea</i>. Pastoral use limitations: None with controlled grazing. Vegetation condition %: VG/G 26, F 52, P/VP 22. Erosion incidence %: min 3. 380 obs.</p>

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 4: Stony plains (20%) Mostly flat or very gently undulating interfluvial plains with occasional outcrops and low rises; often quite saline and variably mantled by quartz pebbles and granite fragments. Soils are shallow red earths or duplex types over granite at < 30 cm deep; pH 6.0-7.0 with a neutral trend. Principal profile forms: Um5.51, Um5.41, Dr1.12.	Scattered or very scattered (PFC < 20%) mixed shrublands dominated by either <i>Acacia aneura</i> with <i>Eremophila</i> spp. or <i>A. victoriae</i> and <i>A. xiphophylla</i> with halophytic low shrubs. Trees (2-4 m): <i>Acacia aneura</i> . Tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. tetragonophylla</i> , <i>A. cuthbertsonii</i> , <i>A. victoriae</i> , <i>A. grasbyi</i> , <i>A. xiphophylla</i> , <i>Hakea preissii</i> , <i>H. arida</i> . Mid shrubs (1-2 m): <i>Cassia phyllodinea</i> , <i>C. helmsii</i> , <i>C. nemophila</i> , <i>Eremophila fraseri</i> , <i>E. macmillaniana</i> , <i>E. pterocarpa</i> , <i>H. preissii</i> . Low shrubs (< 1 m): <i>E. compacta</i> , <i>E. macmillaniana</i> , <i>Maireana convexa</i> , <i>M. georgei</i> , <i>M. triptera</i> , <i>M. thesioides</i> , <i>Ptilotus beardii</i> , <i>P. obovatus</i> , <i>Solanum lasiophyllum</i> , <i>Rhagodia eremaea</i> , <i>Sida calyxhymenia</i> .	9 inventory sites, 25 condition sites and traversed Vegetation type: Mulga Chenopod Shrubland or Stony Mulga Mixed Shrubland (mainly in NW of area). Palatable perennials include: <i>Eremophila compacta</i> , <i>E. spp.</i> , <i>Maireana georgei</i> , <i>Ptilotus beardii</i> , <i>P. obovatus</i> , <i>P. schwartzii</i> , <i>Rhagodia eremaea</i> , <i>Sida calyxhymenia</i> . Pastoral use limitations: None with controlled grazing. Vegetation condition %: VG/G 22, F 44, P/VP 24. Erosion incidence %: min 3. 151 obs.
Unit 5: Sandy banks (2%) Occasional low sandy banks or restricted tracts of sandplain less than 0.5 km long and 0.2 km wide occurring mainly on units 2 and 4. Soils are red earthy sands to 65 cm deep over granite; pH is with a neutral trend. Principal profile form: Uc5.21.	Scattered (PFC 10-20%) mixed shrublands dominated by <i>Eremophila</i> aff. <i>foliosissima</i> , <i>Acacia grasbyi</i> or <i>A. ramulosa</i> . Trees (2-4 m): <i>A. aneura</i> . Tall shrubs (> 2 m): <i>A. grasbyi</i> , <i>A. aneura</i> , <i>A. ramulosa</i> . Mid shrubs (1-2 m): <i>E. forrestii</i> , <i>Cassia helmsii</i> , <i>C. desolata</i> . Low shrubs (< 1 m): <i>E. aff. foliosissima</i> , <i>Rhagodia eremaea</i> , <i>Enchylaena tomentosa</i> , <i>Ptilotus obovatus</i> , <i>Solanum lasiophyllum</i> , <i>Sida sp.</i> , <i>Scaevola spinescens</i> , <i>Maireana planifolia</i> . Perennial grasses: <i>Eriachne helmsii</i> , <i>Monachather paradoxa</i> , <i>Eragrostis lanipes</i> .	1 inventory site traversed Vegetation type: Wanderrie Bank Grassy Shrubland. Palatable perennials include: <i>Rhagodia</i> spp., <i>Enchylaena tomentosa</i> , <i>Ptilotus obovatus</i> , <i>Sida sp.</i> , <i>Scaevola spinescens</i> , <i>Maireana</i> spp., <i>Monachather paradoxa</i> , <i>Eragrostis lanipes</i> . Pastoral use limitations: None with controlled grazing.
Unit 6: Hardpan plains (6%) Very gently sloping hardpan plains receiving run-on from higher units. Soils are red earthy sands or red earths with some hardpan over granite usually at < 50 cm deep; pH 6.5-7.0 with a neutral trend; occasionally alkaline in lower parts. Principal profile forms: Uc5.21, Um5.51.	Scattered to moderately close (PFC 15-25%) tall shrublands dominated by <i>Acacia aneura</i> , <i>A. ramulosa</i> . Tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. ramulosa</i> , <i>A. grasbyi</i> . Mid shrubs (1-2 m): <i>A. ramulosa</i> , <i>A. grasbyi</i> , <i>A. tetragonophylla</i> . Low shrubs (< 1 m): <i>Eremophila fraseri</i> , <i>E. forrestii</i> , <i>Cassia helmsii</i> , <i>Maireana convexa</i> , <i>M. planifolia</i> , <i>Ptilotus obovatus</i> , <i>Rhagodia eremaea</i> , <i>Spartothamnella teucriiflora</i> , <i>Solanum lasiophyllum</i> .	2 inventory sites, 8 condition sites and traversed Vegetation type: Hardpan Mulga Shrubland. Palatable perennials include: <i>Maireana</i> spp., <i>Ptilotus obovatus</i> . Pastoral use limitations: Slightly susceptible to erosion where vegetation is degraded. Vegetation condition %: VG/G 22, F 48, P/VP 30. Erosion incidence %: min 6. 113 obs.
Unit 7: Drainage lines (7%) Sandy valley drainage floors to 750 m wide, with narrow incised channels or well developed creeklines. Soils are earthy sands or alluvial sediments with little profile development, often overlying granite or thin hardpan at < 1 m; pH 6.0-6.5 with a neutral or acidic trend. Principal profile form: Uc5.21.	Moderately close to closed (PFC 20- > 50%) tall shrublands dominated by <i>Acacia burkittii</i> , <i>A. aneura</i> , <i>A. tetragonophylla</i> . Trees (4-6 m): <i>A. aneura</i> , <i>A. burkittii</i> , <i>Hakea suberea</i> . Tall shrubs (> 2 m): <i>A. tetragonophylla</i> , <i>A. rhodophloia</i> , <i>A. victoriae</i> , <i>A. sclerosperma</i> . Mid shrubs (1-2 m): <i>Cassia sturtii/desolata</i> , <i>C. helmsii</i> , <i>Callistemon phoeniceus</i> (in creeklines), <i>Gastrolobium laytonii</i> . Low shrubs (< 1 m): <i>Ptilotus obovatus</i> , <i>Eremophila forrestii</i> , <i>Solanum lasiophyllum</i> , <i>Chenopodium gaudichaudianum</i> .	1 inventory site and traversed Vegetation type: Creekline Shrubland. Palatable perennials include: <i>Ptilotus obovatus</i> , <i>Eremophila forrestii</i> . Pastoral use limitations: Moderately susceptible to accelerated erosion where vegetation is degraded. Kite leaf poison, <i>Gastrolobium laytonii</i> , occurs locally, mainly in S of area. Vegetation condition %: VG/G 14, F 52, P/VP 34. Erosion incidence %: min 34, mod 14. 56 obs.

Channel land system (CB) 94 km² (0.11% of survey area)

Land type: 14; Pastoral potential: low.

Deeply incised creeklines and major channels carrying concentrated drainage from the Wooramel River catchment; flanked by narrow, sharply dissected stony hardpan plains supporting acacia shrublands.

Geology: Permian sandstones overlain by cemented Quaternary alluvium and colluvium (red-brown hardpan); patches of Tertiary calcrete and early Proterozoic metamorphic rock.

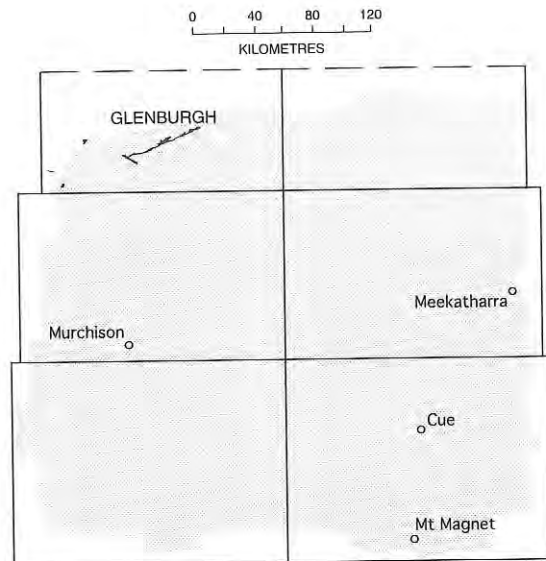
Geomorphology: Erosional surfaces; narrow plains and truncated slopes with frequent dendritic, tributary drainage lines, sharply incised into hardpan and sandstone and joining major channels; bedloads of coarse sand, gravels and rocks; overall relief to 20 m.

Vegetation and pastoral use: Scattered non-saline shrublands similar to Hardpan Mulga Shrublands, with sparse desirable shrubs and grasses; lower units often inaccessible to stock. No accelerated erosion evident.

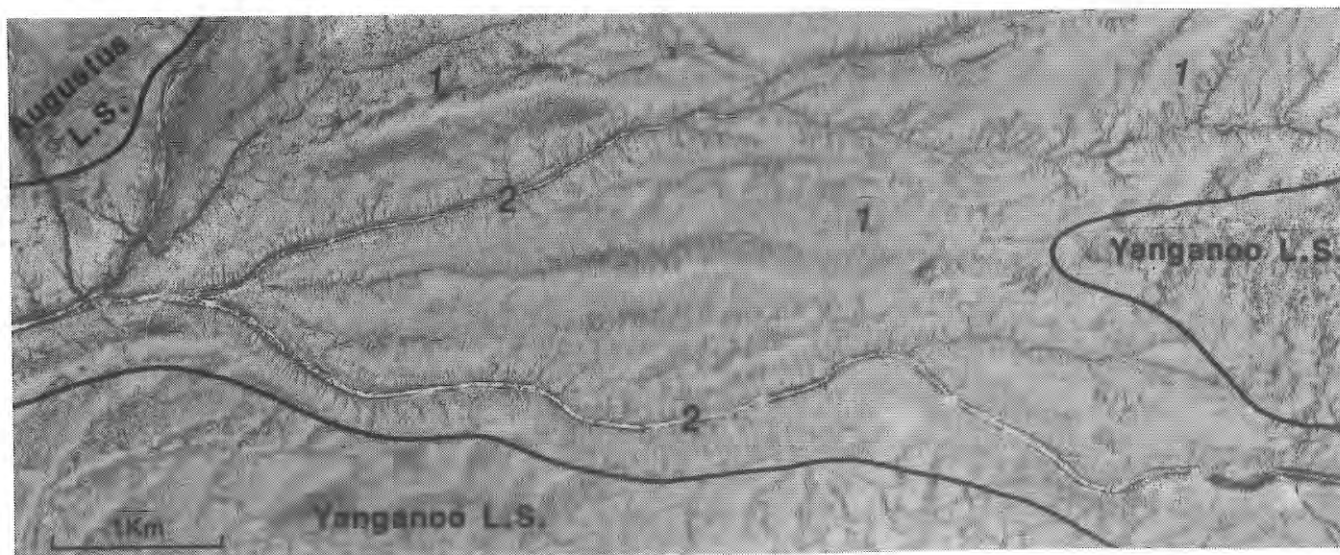
Estimated carrying capacity, good condition: 12 ha/dse.

Range condition summary (12 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
100	0	0	0	50	50	0



- Unit: 1. Dissected slopes and hardpan plains.
2. Channels.



Channel I.s.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 1: Dissected slopes and hardpan plains (85%)</p> <p>Gently sloping and undulating erosional slopes dissected by dendritic tributary drainage channels to 20 m deep; occasionally with low breakaways to 20 m high. Often densely mantled by quartz pebbles and with frequent outcrops of weathered sedimentary rock and hardpan. Soils are probably red hardpan loams, shallow on unit margins and deeper elsewhere.</p>	<p>Very scattered (PFC < 10%) mixed shrublands dominated by <i>Acacia grasbyi</i>, <i>Cassia</i> spp. or <i>Eremophila</i> spp. Trees (2-4 m): <i>A. aneura</i>. Tall shrubs (> 2 m): <i>A. grasbyi</i>, <i>A. aneura</i>, <i>A. kempeana</i>. Mid shrubs (1-2 m): <i>A. kempeana</i>, <i>A. sclerosperma</i>, <i>A. cuspidifolia</i>, <i>A. tetragonophylla</i>, <i>Dodonaea</i> sp., <i>Cassia nemophila</i>. Low shrubs (< 1 m): <i>Cassia helmsii</i>, <i>Tribulus platypterus</i>, <i>Ptilotus obovatus</i>, <i>Solanum lasiophyllum</i>.</p>	<p>1 inventory site and traversed</p> <p>Vegetation type: Hardpan Mulga Shrubland. Palatable perennials include: <i>Ptilotus obovatus</i>, <i>Cassia helmsii</i>, <i>Tribulus platypterus</i>. Pastoral use limitations: None with controlled grazing.</p>
<p>Unit 2: Channels (15%)</p> <p>Major channels incised up to 30 m deep and 200 m wide, but usually < 20 m deep and < 100 m wide. Channels carry bedloads of coarse alluvial sand and cobbles.</p>	<p>Scattered or closed woodland on channel margins dominated by <i>Eucalyptus coolabah</i>, <i>E. camaldulensis</i> and <i>Melaleuca</i> spp. over mixed shrubs with some sedges and grasses.</p>	<p>Vegetation type: Creekline Shrubland. Palatable perennials include: <i>Chrysopogon fallax</i>.</p>

Cole land system (W) 1196 km² (1.39% of survey area)

Land type: 13; Pastoral potential: moderate.

Hardpan wash plains with reticulate patterns of wanderrie banks and mulga groves and more concentrated drainage tracts, supporting mixed mulga and wanderrie shrublands.

Geology: Quaternary cemented alluvium and aeolian sand.

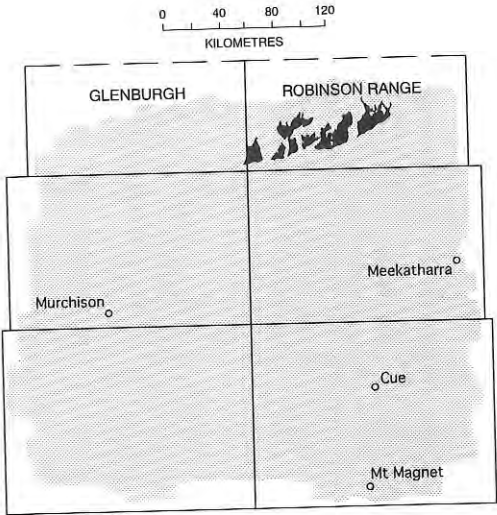
Geomorphology: Depositional surfaces; alluvial hardpan plains carrying sheet flows off granitic hills adjacent to Gascoyne-Murchison catchment divide; flows intercepted by elliptical and often interconnected mulga groves on higher parts; other parts of plains feature reticulate, water-modified patterns of aeolian sand, as wanderrie banks; minor tracts of slightly elevated wanderrie sandplain; central drainage tracts, with minor channelling and groves; total system relief is generally < 5 m.

Vegetation and pastoral use: Wanderrie Bank Grassy Shrubland and Hardpan Mulga Shrubland with patches of Mulga Grove Woodland; moderately productive with sparse perennial forage shrubs and abundant annuals in good seasons; groves are highly productive because of flow interception and deep soils. Preferential overgrazing of intergroves and drainage floors has resulted in extensive degradation; shrub composition frequently dominated by unpalatable *Acacia*, *Eremophila* and *Cassia* species; minor susceptibility to erosion when degraded.

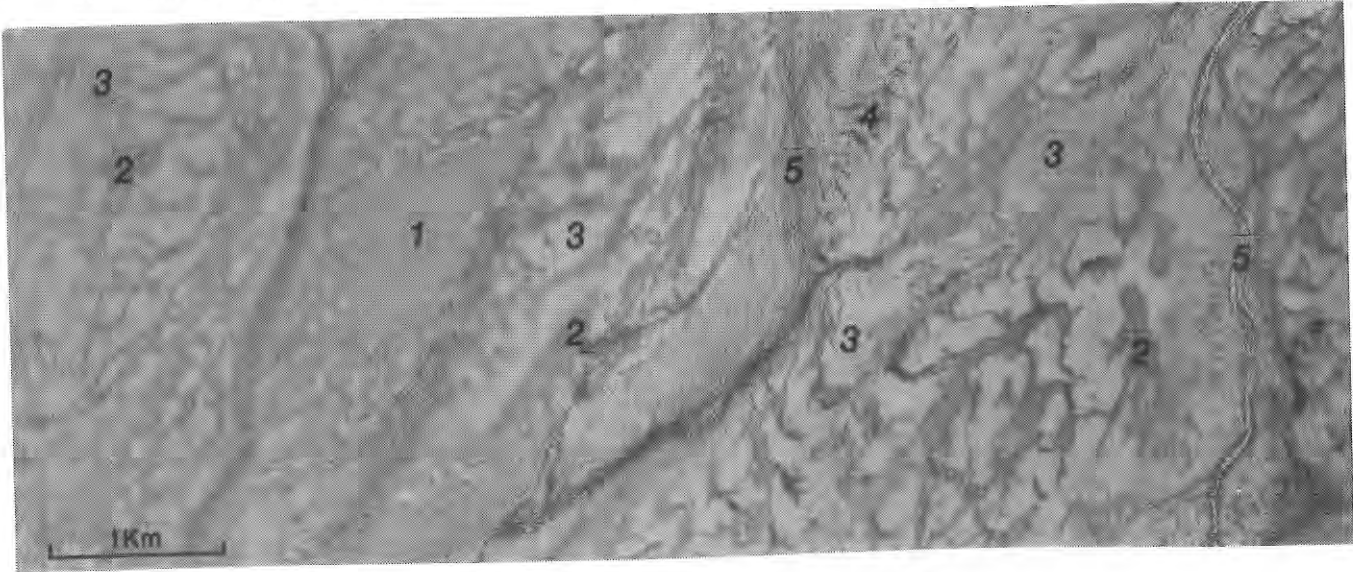
Estimated carrying capacity, good condition: 12 ha/dse.

Range condition summary (151 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
94	6	0	0	2	23	75



- Unit: 1. Sand sheets.
2. Wanderrie banks.
3. Hardpan plains.
4. Mulga groves.
5. Broad drainage zones.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 1: Sand sheets (5%)</p> <p>Isolated tracts of slightly elevated sand plain up to 1 km wide, occurring centrally generally at the confluence of smaller, often radial sandy banks; extending downslope for up to 3 km, mostly < 1.5 m above surrounding plains. Soils are probably earthy sands to 1 m deep. Principal profile form probably Uc5.21.</p>	<p>Scattered (PFC 10-20%) tall shrublands dominated by <i>Acacia aneura</i>, <i>A. ramulosa</i> or <i>Eremophila forrestii</i>; grassy layer prominent in places. Trees and tall shrubs (> 2 m): <i>A. aneura</i>, <i>A. kempeana</i>, <i>A. ramulosa</i>, <i>Grevillea</i> sp. Mid shrubs (1-2 m): <i>E. forrestii</i>, <i>E. margarethae</i>, <i>E. aff. foliosissima</i>, <i>Cassia desolata</i>, <i>C. sturtii</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>Solanum lasiophyllum</i>. Perennial grasses: <i>Eragrostis eriopoda</i>, <i>Eriachne helmsii</i>, <i>Monachather paradoxa</i>.</p>	<p>1 condition site and traversed</p> <p>Vegetation type: Wanderrie Bank Grassy Shrubland. Palatable perennials include: <i>Eremophila forrestii</i>, <i>Ptilotus obovatus</i>, <i>Eragrostis eriopoda</i>, <i>Monachather paradoxa</i>. Pastoral use limitations: None with controlled grazing.</p>
<p>Unit 2: Wanderrie banks (25%)</p> <p>Complex networks of interconnecting wanderrie banks to 1 m relief, occurring in a mostly reticulate or 'cobweb' pattern upslope, 50-300 m wide and becoming slightly more elongate downslope. Soils are probably similar to unit 1, though probably shallower on margins.</p>	<p>Scattered shrublands of a composition similar to unit 1, but with more perennial grasses.</p>	<p>11 condition sites and traversed</p> <p>Vegetation type: Wanderrie Bank Grassy Shrubland. Palatable perennials: As for unit 1. Pastoral use limitations: None with controlled grazing.</p>
<p>Unit 3: Hardpan plains (45%)</p> <p>Level plains up to 2 km in extent and carrying sheet flow between sandy banks (unit 2) and groves (unit 4); often sandy-surfaced with sparse quartz and ironstone gravel mantles. Soils are probably dark red sandy clay loams or light clays < 50 cm over red brown hardpan.</p>	<p>Very scattered to scattered (PFC < 20%) tall shrublands dominated by <i>Acacia aneura</i>. Trees (to 4 m): <i>A. aneura</i>, <i>A. pruinocarpa</i>, <i>A. quadrimarginea</i>, <i>Grevillea striata</i>, <i>Hakea suberea</i>. Tall shrubs (> 2 m): <i>A. tetragonophylla</i>, <i>A. kempeana</i>, <i>A. aff. citrinoviridis</i>, <i>Eremophila fraseri</i>. Mid shrubs (1-2 m): <i>E. forrestii</i>, <i>E. latrobei</i>, <i>E. margarethae</i>, <i>Cassia desolata</i>, <i>C. sturtii</i>, <i>C. helmsii</i>. Low shrubs (< 1 m): <i>C. helmsii</i>, <i>Ptilotus obovatus</i>, <i>P. schwartzii</i>, <i>E. macmillianiana</i>, <i>E. spathulata</i>, <i>Rhagodia eremaea</i>, <i>Sida calyxhymenia</i>.</p>	<p>11 condition sites and traversed</p> <p>Vegetation type: Hardpan Mulga Shrubland. Palatable perennials include: <i>Eremophila forrestii</i>, <i>E. latrobei</i>, <i>Ptilotus</i> spp., <i>Rhagodia eremaea</i>, <i>Maireana</i> spp., <i>Sida calyxhymenia</i>. Pastoral use limitations: Vegetation widely degraded, loss of many desirable species has reduced grazing potential. Slightly susceptible to accelerated erosion where vegetation is degraded. Vegetation condition %: VG/G 3, F 15, P/VP 82. Erosion incidence %: nil 5. 110 obs.</p>
<p>Unit 4: Mulga groves (< 5%)</p> <p>Numerous arcuate groves up to 100 m wide and 1 km long on unit 3; some with sandy accumulations and grading into wanderrie banks. Soils are mostly dark red hardpan sandy clay loams or sandy clays, about 50 cm deep over hardpan; occasionally deeper. Principal profile forms: Um5.31, Uf6.71.</p>	<p>Moderately close to closed (PFC 20 - > 50%) low mulga woodland dominated by <i>Acacia aneura</i>, <i>A. tetragonophylla</i> or <i>Eremophila fraseri</i>. Trees (2-10 m): <i>A. aneura</i>, <i>A. pruinocarpa</i>, <i>A. tetragonophylla</i>, <i>A. distans</i>, <i>Canthium lineare</i>, <i>Grevillea striata</i>. Tall shrubs (> 2 m): <i>A. tetragonophylla</i>, <i>A. cuthbertsonii</i>, <i>A. kempeana</i>, <i>E. fraseri</i>. Mid shrubs (1-2 m): <i>E. forrestii</i>, <i>E. fraseri</i>, <i>E. latrobei</i>, <i>E. macmillianiana</i>, <i>E. spathulata</i>, <i>Cassia desolata</i>, <i>C. helmsii</i>, <i>C. sturtii</i>. Low shrubs (< 1 m): <i>C. helmsii</i>, <i>C. chatelainiana</i>, <i>Ptilotus obovatus</i>, <i>P. schwartzii</i>, <i>Scaevola spinescens</i>, <i>Sida calyxhymenia</i>, <i>S. sp.</i>, <i>Rhagodia eremaea</i>, <i>Maireana planifolia</i>, <i>M. convexa</i>. Perennial grasses: <i>Eragrostis eriopoda</i>, <i>Eriachne helmsii</i>, <i>E. flaccida</i>, <i>Chrysopogon fallax</i>, <i>Monachather paradoxa</i>.</p>	<p>1 inventory site and traversed</p> <p>Vegetation type: Mulga Grove Woodland. Palatable perennials include: <i>Eremophila forrestii</i>, <i>E. latrobei</i>, <i>Cassia chatelainiana</i>, <i>Ptilotus</i> spp., <i>Scaevola spinescens</i>, <i>Sida</i> spp., <i>Rhagodia eremaea</i>, <i>Maireana</i> aff. <i>villosa</i>, <i>Eragrostis eriopoda</i>, <i>Eriachne flaccida</i>, <i>Chrysopogon fallax</i>, <i>Monachather paradoxa</i>. Pastoral use limitations: None with controlled grazing.</p>

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 5: Broad drainage zones (20%)</p> <p>Very gently inclined plains carrying more concentrated drainage flows than unit 3; mostly occurring as broad, unchanneled tracts to 1 km wide, locally with numerous small braided channels; elsewhere large channels to 30 m wide and to 2 m deep occur. Soils are mostly yellowish-red or red earths or loams up to 1 m deep over hardpan; pH 6.0 with a neutral trend. Principal profile form: Um5.31</p>	<p>Scattered to moderately close (PFC 10-30%) tall shrublands dominated by <i>Acacia aneura</i> or <i>A. tetragonophylla</i>. Trees and tall shrubs (2-8 m): <i>A. aneura</i>, <i>A. cyperophylla</i>, <i>A. grasbyi</i>, <i>A. cuthbertsonii</i>, <i>A. kempeana</i>, <i>A. tetragonophylla</i>, <i>Eremophila fraseri</i>, <i>Hakea suberea</i>. Mid shrubs (1-2 m): <i>E. fraseri</i>, <i>E. forrestii</i>, <i>A. craspedocarpa</i>, <i>Cassia sturtii</i>, <i>C. helmsii</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>Rhagodia eremaea</i>, <i>Solanum lasiophyllum</i>, <i>Enchylaena tomentosa</i>, <i>Sida calyxhymenia</i>. Perennial grasses: <i>Eriachne benthamii</i>, <i>E. helmsii</i>, <i>E. flaccida</i>, <i>Chrysopogon fallax</i>.</p>	<p>1 inventory site and traversed</p> <p>Vegetation type: Hardpan Mulga Shrubland and Creekline Grassy Shrubland. Palatable perennials include: <i>Eremophila forrestii</i>, <i>Ptilotus obovatus</i>, <i>Rhagodia eremaea</i>, <i>Enchylaena tomentosa</i>, <i>Sida calyxhymenia</i>, <i>Eriachne benthamii</i>, <i>E. flaccida</i>, <i>Chrysopogon fallax</i>. Pastoral use limitations: Mildly susceptible to accelerated erosion.</p>

Coolabulla land system 50 km² (0.06% of survey area)

Land type: 16; Pastoral potential: high.

River floodplains with calcrete or hardpan at shallow depth and lower clayey plains adjacent to meandering channels; supports halophytic shrublands and fringing eucalypt woodland.

Geology: Quaternary alluvium with patches of late Tertiary calcrete.

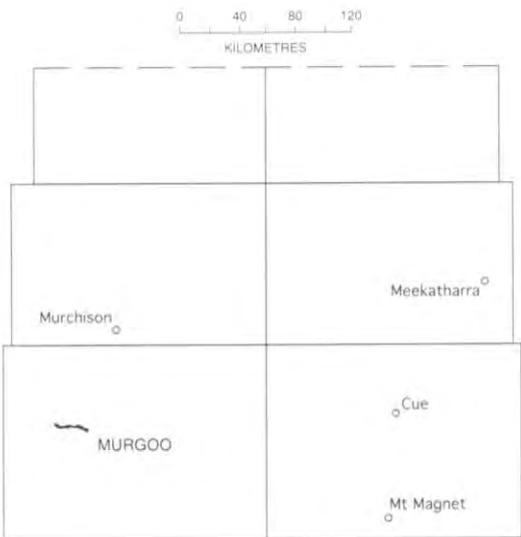
Geomorphology: Depositional surfaces; alluvial plains 2 to 4 km wide, higher areas of cemented hardpan with light surface mantles of calcrete and ironstone; lower floodplains receiving regular flooding subject to surface redistribution and accelerated streambank erosion; watercourses are variable - major river channels about 50 m wide, or smaller braided channels with pronounced meanders.

Vegetation and pastoral use: Highly productive Saltbush Shrubland, Riverine Mixed Shrubland and Calcrete Eucalypt Woodland, mostly degraded through overgrazing; desirable shrubs and perennial grasses widely replaced by invading *Acacia*, *Cassia* and *Eremophila* species. Channels not important in terms of forage value, but highly susceptible to accelerated erosion. A very minor system in the survey area.

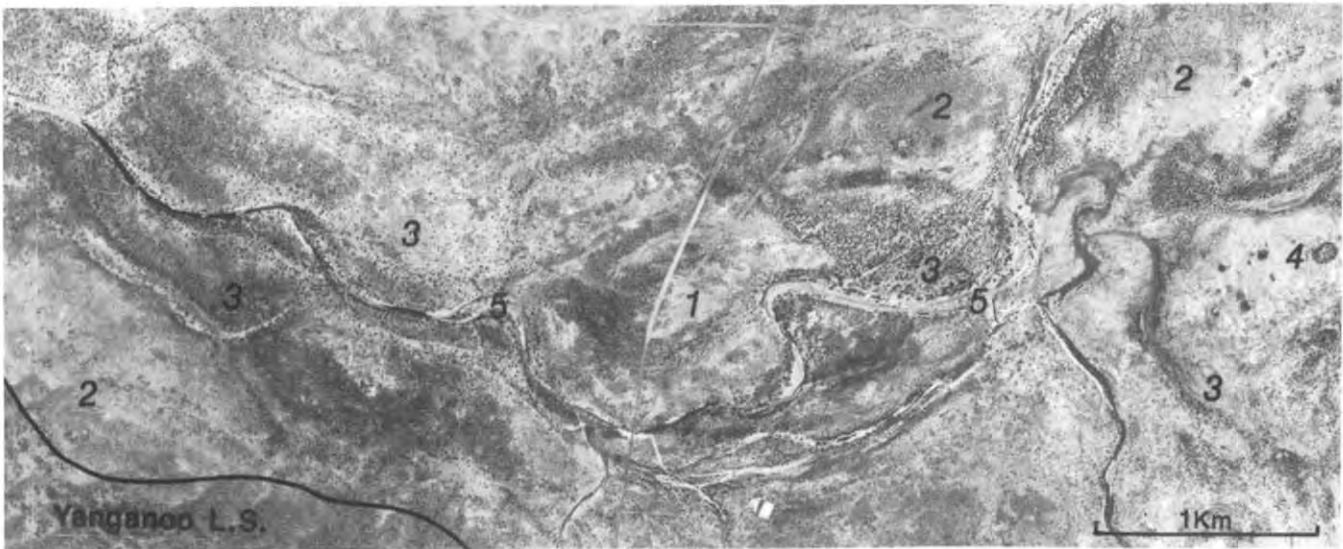
Estimated carrying capacity, good condition: 7 ha/dse.

Range condition summary (12 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
92	8	0	0	0	8	92



- Unit: 1. Calcrete plains.
2. Alluvial plains on hardpan.
3. Flood plains.
4. Drainage foci.
5. Major channels.



Coolabulla I.s.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Calcrete plains (5%) Gently sloping calcrete plains usually < 1 km wide and < 2 km long, mainly on outer parts of the land system. Often strewn with calcrete pebbles and gravels. Soils are yellowish-red fine sandy clay loams with abundant calcrete inclusions throughout the profile overlying calcrete at variable depth; pH 9.0 with an alkaline reaction trend. Principal profile form: Gc1.12.	Scattered (PFC 10-20%) low woodland with prominent lower storey dominated by <i>Cassia sturtii</i> or <i>Ptilotus obovatus</i> . Trees (to 8 m): <i>Eucalyptus coolabah</i> , <i>Hakea suberea</i> , <i>Casuarina obesa</i> . Tall shrubs (> 2 m): <i>Acacia victoriae</i> , <i>Santalum spicatum</i> , <i>A. tetragonophylla</i> . Mid shrubs (1-2 m): <i>Cassia sturtii</i> , <i>C. helmsii</i> . Low shrubs (< 1 m): <i>P. obovatus</i> , <i>P. divaricatus</i> . Perennial grass: <i>Eragrostis setifolia</i> .	1 inventory site Vegetation type: Riverine Mixed Shrubland or * Calcrete Eucalypt Woodland. Desirable perennials include: <i>Ptilotus obovatus</i> , <i>P. divaricatus</i> , <i>Eragrostis setifolia</i> . Increaser species include: <i>Cassia</i> spp., <i>Acacia victoriae</i> . Pastoral use limitations: Susceptible to increases by unpalatable shrubs if degraded.
Unit 2: Alluvial plains on hardpan (30%) Very gently sloping alluvial plains marginal to adjoining wash systems (Bunny, Tindalarra and Yanganoo); frequently overlying hardpan at shallow depth. Soils are probably red earths or hardpan types < 1 m deep with some ironstone mantle and inclusions. Duplex types to 1 m also probably occur.	Very scattered or scattered (PFC < 20%) eucalypt woodland similar to unit 1 or scattered low shrublands with understorey <i>Maireana pyramidata</i> , <i>Acacia victoriae</i> and <i>Cassia</i> spp.; composition otherwise similar to unit 3.	Traversed Vegetation type: Riverine Mixed Shrubland or * Calcrete Eucalypt Woodland. Palatable perennials include: <i>Maireana</i> spp., <i>Eremophila laanii</i> , <i>Ptilotus divaricatus</i> and <i>Eragrostis setifolia</i> . Increaser species include: <i>Cassia</i> spp., <i>Acacia victoriae</i> . Pastoral use limitations: Susceptible to increases by unpalatable shrubs if degraded.
Unit 3 Flood plains (60%) Almost flat plains receiving regular flooding from overflow of major channels. Soils are deep (> 1 m) yellowish-red clays with calcareous nodules throughout profile; pH 8.5 with an alkaline reaction trend. Principal profile form: Uf6.12.	Scattered or moderately close (PFC 10-30%) eucalypt woodland dominated by <i>Eucalyptus coolabah</i> with <i>Atriplex amnicola</i> and <i>Acacia victoriae</i> . Trees (to 6 m): <i>E. coolabah</i> . Tall shrubs (> 2 m): <i>A. victoriae</i> , <i>A. sclerosperma</i> . Mid shrubs (1-2 m): <i>Eremophila laanii</i> , <i>A. victoriae</i> , <i>Cassia helmsii</i> . Low shrubs (< 1 m): <i>Atriplex amnicola</i> , <i>Ptilotus obovatus</i> , <i>P. divaricatus</i> , <i>Rhagodia eremaea</i> , <i>Solanum lasiophyllum</i> . Perennial grass: <i>Eragrostis</i> sp.	2 inventory sites, 1 condition site and traversed Vegetation type: Saltbush Shrubland or * Calcrete Eucalypt Woodland. Palatable perennials include: <i>Atriplex amnicola</i> , <i>Ptilotus obovatus</i> , <i>P. divaricatus</i> , <i>Rhagodia eremaea</i> . Increaser species include: <i>Acacia victoriae</i> , <i>Cassia</i> and <i>Eremophila</i> spp. Pastoral use limitations: Subject to invasion by unpalatable shrubs if degraded; not normally susceptible to accelerated erosion.
Unit 4: Drainage foci (1%) Scattered small depressions in units 1 or 3 with clayey soils.	Associations dominated by <i>E. coolabah</i> , <i>Acacia tetragonophylla</i> and <i>Eriachne flaccida</i> .	Vegetation type: Non-Calcareous Shrubby Grassland. Palatable perennials include: <i>Eriachne flaccida</i> . Pastoral use limitations: None under controlled grazing.
Unit 5: Major channels (5%) Meandering major channels and river beds up to 100 m wide and incised to 6 m deep with sandy, terraced banks; often with frequent oxbow and distinctive billabong formations adjacent to major channels. Soils on bank margins are probably red earths or alluvial deposits (often with exposed calcrete bedrock) while channel beds carry bedloads of coarse sand and calcrete rubble.	Scattered (PFC 10-20%) Eucalypt woodlands dominated by large <i>Eucalyptus coolabah</i> (to 12 m) with distinctive mid and lower storeys characterised by tall shrubs <i>Melaleuca</i> spp., <i>Acacia sclerosperma</i> and low shrubs <i>Muehlenbeckia cunninghamii</i> , <i>Atriplex amnicola</i> , <i>Juncus</i> spp., <i>Frankenia</i> spp., <i>Halosarcia</i> spp. on banks and terraces. Riverbeds are generally bare of vegetation except for occasional <i>Melaleuca</i> spp.	Traversed Vegetation type: Riverine Mixed Shrubland. Pastoral use limitations: Weakly consolidated soils on banks or terraces may be erodible if exposed through vegetation removal.

* Calcrete Eucalypt Woodland, very limited occurrence in survey area, not described in report.

Cunyu land system (W) 1083 km² (1.26% of survey area)

Land type: 15; Pastoral potential: high.

Calcreted drainage zones on hardpan; alluvial plains with raised calcrete platforms dissected by major flow zones and channels, supporting variable mostly non-halophytic shrublands and calcareous shrubby grasslands.

Geology: Tertiary 'valley' calcrete with opaline silica and gravels, overlain in parts by cemented Quaternary alluvium.

Geomorphology: Depositional surfaces; level hardpan plains 2 to 10 km wide carrying concentrated flow, interrupted by dissected residual calcreted valley fills with broad, flat-surfaced calcrete platforms to 4 m high, dissected by channelled drainage zones or alluvial plains with isolated drainage foci; overall relief to 6 m.

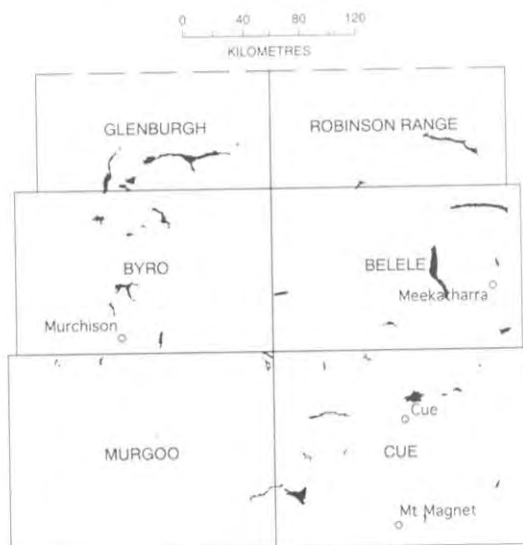
Vegetation and pastoral use: Non-saline river plains: wash plains with Hardpan Mulga Shrubland; widespread Calcrete Shrubby Grassland on calcrete platforms has been degraded almost everywhere by over-use by livestock and feral and native animals; also Riverine Mixed Shrubland and Non-Calcareous Shrubby Grassland of moderate productivity, with patches of Saltbush and Bluebush Shrubland. Desirable perennials widely degraded through overgrazing around favoured wells and bores mostly yielding fresh water. Mild susceptibility to accelerated erosion on units 4 and 5.

Estimated carrying capacity, good condition: 7 ha/dse.

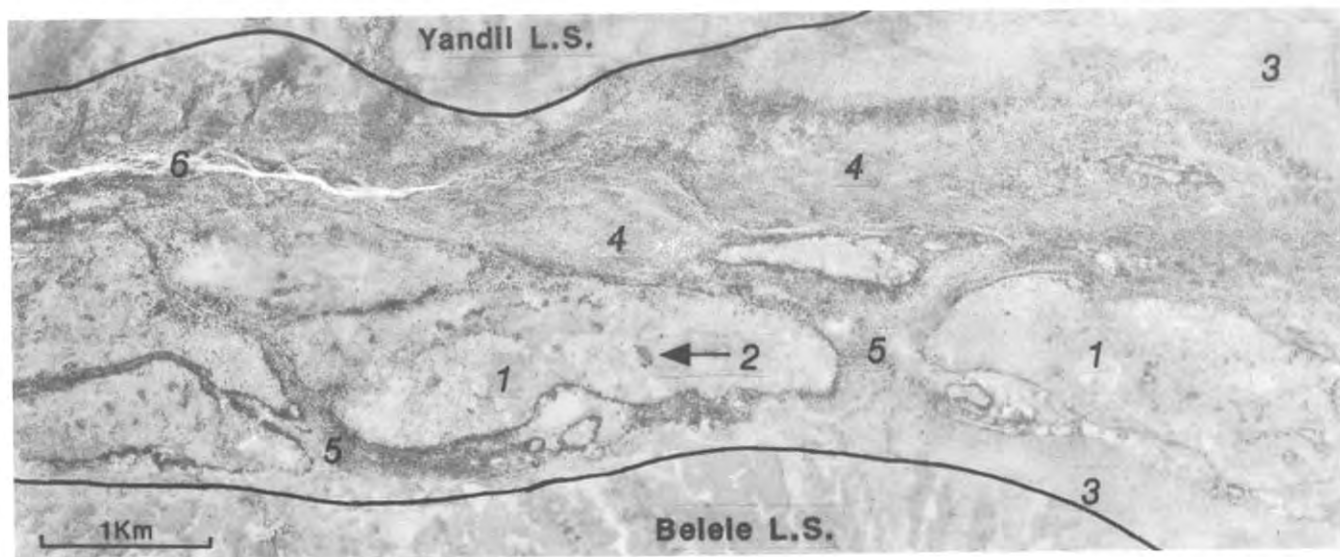
Range condition summary (234 traverse observations):

(a) Erosion status (%)			
Nil	Min.	Mod.	Sev.
79	16	4	1

(b) Vegetation condition (%)		
Good	Fair	Poor
12	29	59



- Unit: 1. Calcrete platforms.
2. Drainage foci and claypans.
3. Hardpan plains
4. Alluvial plains.
5. Drainage floors.
6. Major channelled flow zones.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Calcrete platforms (40%)	<p>Very scattered to moderately close (PFC < 30%) mixed shrublands or grassy shrublands dominated mostly by <i>Acacia aneura</i>, <i>A. sclerosperma</i> and <i>Grevillea</i> spp. Trees: <i>A. aneura</i>, <i>Grevillea striata</i>, <i>Pittosporum phylliraeoides</i>, <i>Codonocarpus cotinifolius</i>. Tall shrubs (> 2 m): <i>A. sclerosperma</i>, <i>A. aneura</i>, <i>A. grasbyi</i>, <i>A. xiphophylla</i>, <i>A. ligulata</i>, <i>A. tysonii</i>. Mid shrubs (1-2 m): <i>A. victoriae</i>, <i>A. aneura</i>, <i>A. sclerosperma</i>, <i>A. tetragonophylla</i>, <i>Cassia desolata</i>, <i>C. nemophila</i>, <i>Eremophila youngii</i>. Low shrubs (< 1 m): <i>Maireana pyramidata</i>, <i>M. trichoptera</i>, <i>Chorizema ericifolium</i>, <i>Cassia desolata</i>, <i>C. nemophila</i>, <i>Ptilotus obovatus</i>, <i>Rhagodia eremaea</i>, <i>Scaevola tomentosa</i>, <i>Solanum lasiophyllum</i>. Perennial grasses: <i>Eragrostis pergracilis</i>, <i>E. falcata</i>, <i>Enneapogon caeruleus</i>, <i>E. nigricans</i>, <i>Stipa scabra</i>.</p>	<p>10 inventory sites, 7 condition sites and traversed</p> <p>Vegetation type: Calcrete Shrubby Grassland (variably degraded) or Bluebush Shrubland. Palatable perennials include: <i>Enneapogon nigricans</i>, <i>E. caeruleus</i>, <i>Eragrostis pergracilis</i>, <i>E. falcata</i>, <i>Maireana</i> spp., <i>Rhagodia eremaea</i>, <i>Ptilotus obovatus</i>, <i>Scaevola tomentosa</i>. Pastoral use limitations: Perennial grasses invariably overutilised and more or less degraded through preferential grazing by stock, goats, kangaroos and rabbits; susceptible to shrub invasion by <i>Cassia nemophila</i>, <i>Acacia</i> spp. (including <i>A. aneura</i>) and <i>Dissocarpus paradoxus</i> where degraded; not normally susceptible to accelerated erosion. Vegetation condition %: VG/G 11, F 29, P/VP 60. 65 obs.</p>
Unit 2: Drainage foci and claypans (1%)	<p>Claypans mostly bare, drainage foci with closed (PFC > 50%) mixed woodland dominated by <i>Acacia aneura</i>. Trees (to 8 m): <i>A. aneura</i>, <i>A. distans</i>, <i>Eucalyptus coolabah</i>. Tall shrubs (> 2 m): <i>A. tetragonophylla</i>. Medium shrubs (1-2 m): <i>A. victoriae</i>. Low shrubs (< 1 m): <i>Scaevola spinescens</i>, <i>Rhagodia eremaea</i>, <i>Cassia desolata</i>. Perennial grass: <i>Eriachne flaccida</i>.</p>	<p>1 inventory site and traversed</p> <p>Vegetation type: Mulga Grove Woodland or Non-Calcareous Grassy Shrubland. Palatable perennials include: <i>Rhagodia eremaea</i>, <i>Scaevola spinescens</i>, <i>Eriachne</i> spp. Pastoral use limitations: None under controlled grazing.</p>
Unit 3: Hardpan plains (25%)	<p>Scattered (PFC 10-20%) mixed shrublands. Trees (4-6 m): <i>Grevillea striata</i>, <i>Acacia aneura</i>. Tall shrubs (> 2 m): <i>A. aneura</i>, <i>A. burkittii</i>, <i>A. craspedocarpa</i>, <i>A. victoriae</i>. Mid shrubs (1-2 m): <i>Eremophila fraseri</i>, <i>A. tetragonophylla</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>Rhagodia eremaea</i>, <i>Maireana planifolia</i>, <i>Sida calyxhymenia</i>, <i>Eremophila forrestii</i>, <i>E. maculata</i>, <i>Cassia helmsii</i>, <i>Solanum lasiophyllum</i>.</p>	<p>3 inventory sites, 1 condition site and traversed</p> <p>Vegetation type: Hardpan Mulga Shrubland. Palatable perennials include: <i>Ptilotus obovatus</i>, <i>Maireana planifolia</i>, <i>Rhagodia eremaea</i>, <i>Sida calyxhymenia</i>. Pastoral use limitations: Mild susceptibility to accelerated erosion where degraded. Vegetation condition %: VG/G 7, F 26, P/VP 67. Erosion incidence %: min 14, mod 3, sev 3. 76 obs.</p>
Unit 4: Alluvial plains (20%)	<p>Very scattered to moderately close (PFC < 30%) mixed shrublands. Trees: <i>Eucalyptus coolabah</i>. Tall shrubs (> 2 m): <i>A. aneura</i>, <i>A. sclerosperma</i>, <i>A. victoriae</i>. Mid shrubs (1-2 m): <i>Stylobasium spathulatum</i>, <i>A. victoriae</i>, <i>Scaevola spinescens</i>. Low shrubs (< 1 m): <i>Cratystylis subspinescens</i>, <i>Eremophila margarethae</i>, <i>E. maculata</i>, <i>E. malacoides</i>, <i>Solanum lasiophyllum</i>, <i>Scaevola spinescens</i>, <i>Rhagodia eremaea</i>, <i>Ptilotus divaricatus</i>, <i>Frankenia</i> spp., <i>Atriplex amnicola</i>, <i>Halosarcia</i> spp.</p>	<p>2 inventory sites, 5 condition sites and traversed</p> <p>Vegetation type: Riverine Mixed Shrubland. Palatable perennials include: <i>Ptilotus</i> spp., <i>Cratystylis subspinescens</i>, <i>Atriplex amnicola</i>, <i>Scaevola spinescens</i>, <i>Rhagodia eremaea</i>. Pastoral use limitations: Highly susceptible to accelerated erosion where degraded. Vegetation condition %: VG/G 5, F 28, P/VP 67. Erosion incidence %: min 50, mod 15. 40 obs.</p>

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 5: Drainage floors (12%)</p> <p>Mostly flat non-saline drainage tracts between calcrete platforms, up to 1 km wide but usually < 0.5 km wide with occasional channels. Soils are yellowish red, red, dark red or brown, red earths or light clays often overlying calcrete at an average depth of 60 cm, pH 6.0-9.0 with a mainly alkaline reaction trend. Principal profile forms: Gc1.12, Gn2.13, Uf6.71, Uf6.12, Um5.11.</p>	<p>Scattered to closed (PFC 10-> 50%) woodlands or mixed shrublands dominated by <i>Eucalyptus coolabah</i>, <i>E. striatocalyx</i>, <i>Melaleuca</i> aff. <i>leiocarpa</i>, <i>Acacia aneura</i>, <i>A. burkittii</i>, <i>A. cyperophylla</i>, <i>A. tetragonophylla</i> or <i>A. tysonii</i>. Trees (to 10 m): <i>E. coolabah</i>, <i>E. striatocalyx</i>, <i>A. aneura</i>, <i>M. aff. leiocarpa</i>, <i>A. cyperophylla</i>. Tall shrubs (> 2 m): <i>A. aneura</i>, <i>A. burkittii</i>, <i>A. tetragonophylla</i>, <i>A. tysonii</i>, <i>M. uncinata</i>. Mid shrubs (1-2 m): <i>A. tysonii</i>, <i>Eremophila longifolia</i>, <i>Scaevola spinescens</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>S. spinescens</i>, <i>Rhagodia eremaea</i>, <i>Solanum lasiophyllum</i>, <i>Cassia chatelainiana</i>. Perennial grasses: <i>Eriachne benthamii</i>, <i>E. flaccida</i>, <i>Stipa elegantissima</i>.</p>	<p>9 inventory sites, 1 condition sites and traversed</p> <p>Vegetation type: Non-Calcareous Shrubby Grassland or * Calcrete Eucalypt Woodland. Palatable perennials include: <i>Scaevola spinescens</i>, <i>Rhagodia eremaea</i>, <i>Ptilotus obovatus</i>, <i>Cassia chatelainiana</i>, <i>Eriachne benthamii</i>, <i>E. flaccida</i>. Pastoral use limitations: Mildly susceptible to erosion where degraded. Vegetation condition %: VG/G 24, F 41, P/VP 35. Erosion incidence %: min 15, mod 8. 34 obs.</p>
<p>Unit 6: Major channelled flow zones (2%)</p> <p>Flow zones up to 200 m wide with major channels incised to 2 m into calcrete or hardpan. Soils on banks and levees are dark red sandy, silty and clayey alluvial types; pH 7.5-9.0 with neutral or alkaline reaction trends; channels carry unsorted bedloads.</p>	<p>Moderately close (PFC 20-30%) tall shrublands and fringing woodland. Trees: <i>Acacia aneura</i>, <i>Eucalyptus camaldulensis</i>. Tall and mid shrubs (1-> 2 m): <i>Grevillea</i> aff. <i>stenobotrya</i>, <i>Hakea suberea</i>, <i>A. aneura</i>, <i>A. tysonii</i>, <i>Atriplex amnicola</i>. Low shrubs (< 1 m): <i>Pimelia microcephala</i>, <i>Ptilotus obovatus</i>, <i>Rhagodia eremaea</i>, <i>Cassia nemophila</i>, <i>Frankenia</i> spp. Perennial grass: <i>Enteropogon acicularis</i>.</p>	<p>1 inventory site and traversed</p> <p>Vegetation type: Riverine Mixed Shrubland. Palatable perennials include: <i>Atriplex amnicola</i>, <i>Rhagodia eremaea</i>, <i>Ptilotus obovatus</i>. Pastoral use limitations: None under controlled grazing.</p>

* Calcrete Eucalypt Woodland, very limited occurrence in survey area, not described in report.

Ero land system (W) 1589 km² (1.85% of survey area)

Land type: 16; Pastoral potential: high.

Tributary floodplains with shallow, erodible duplex soils on red-brown hardpan, more or less saline and supporting halophytic and non-halophytic shrublands; grazed preferentially and widely degraded and eroded.

Geology: Quaternary alluvium with minor deposits of aeolian sand.

Geomorphology: Depositional surfaces; tributary saline and non-saline alluvial plains 1-4 km wide, carrying concentrated drainage from broad wash plains to major drainages; non-saline hardpan plains flanking more saline central drainage tracts with minor anastomosing channels and widespread accelerated erosion and exposed red-brown hardpan; minor internal drainage foci; overall relief is < 3 m.

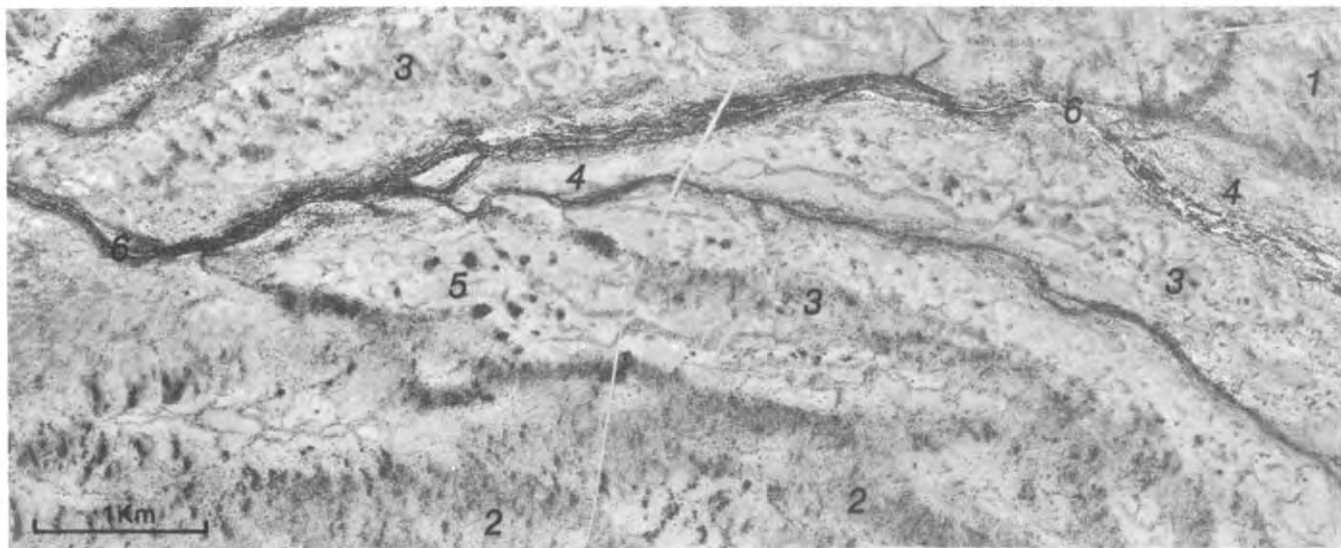
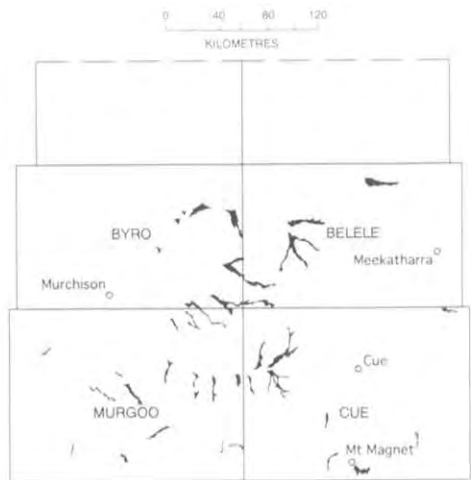
Vegetation and pastoral use: Originally, mainly moderately to highly productive Bluebush, Saltbush and Mixed Halophytic Shrublands but now often barely recognisable as such because of widespread degradation and erosion or extensive replacement of desirables by invading *Acacia* and *Eremophila* species. The systems provides nutritious drought reserves when in good condition and highly palatable annuals even when severely degraded and eroded. The system includes Hardpan Mulga Shrublands on non-saline marginal plains and pockets of highly productive and resilient Alluvial Tussock Grassland in drainage foci and frequently flooded lower plains. Whole system is preferentially overgrazed by stock and other animals when provided with permanent fresh water and paddocked with large areas of wash plain systems: 26% of traverse records on the system showed moderate or severe erosion.

Estimated carrying capacity, good condition: 7 ha/dse.

Range condition summary (518 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
39	35	24	2	10	25	65

- Unit: 1. Sandy banks.
2. Hardpan plains.
3. Alluvial plains.
4. Flood plains.
5. Drainage foci and claypans.
6. Minor channels.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Sandy banks (5%) Sandy banks up to 300 m in extent and up to 1 m above adjacent unit 2. Soils are dark red earthy sands 0.5- > 1 m deep over hardpan, pH 6.0-6.5 with a neutral soil reaction trend. Principal profile form: Uc5.21.	Very scattered to moderately close (PFC < 30%) tall shrublands dominated by <i>Acacia grasbyi</i> and <i>A. aneura</i> . Trees: <i>A. aneura</i> . Tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. grasbyi</i> . Mid shrubs (1-2 m): <i>A. tetragonophylla</i> . Low shrubs (< 1 m): <i>Eremophila forrestii</i> , <i>E. aff. compacta</i> , <i>Maireana triptera</i> , <i>Solanum lasiophyllum</i> , <i>Cassia helmsii</i> , <i>Ptilotus obovatus</i> , <i>Scaevola spinescens</i> , <i>Rhagodia eremaea</i> . Perennial grasses: <i>Monachather paradoxa</i> , <i>Eriachne helmsii</i> .	2 inventory sites and traversed Vegetation type: Wanderrie Bank Grassy Shrubland. Palatable perennials include: <i>Monachather paradoxa</i> , <i>Ptilotus obovatus</i> , <i>Scaevola spinescens</i> , <i>Rhagodia eremaea</i> . Pastoral use limitations: None under controlled grazing.
Unit 2: Hardpan plains (30%) Almost flat (slopes < 0.5%) plains, occasionally with a very sparse mantle of pebbles or cobbles. Soils are shallow red or dark red hardpan loams, or crusted duplexes or alkaline red earths over hardpan at < 0.75 m, pH 6.0-8.0 with a neutral to alkaline reaction trend. Principal profile forms: Um5.31, Dr1.53, Gn2.13.	Very scattered to moderately close (PFC < 30%) tall shrublands frequently dominated by <i>Eremophila fraseri</i> , <i>Acacia victoriae</i> or <i>A. grasbyi</i> . Tall shrubs (> 2 m): <i>E. fraseri</i> , <i>A. victoriae</i> , <i>A. grasbyi</i> , <i>A. tetragonophylla</i> , <i>A. burkittii</i> . Mid and low shrubs (< 2 m): <i>E. fraseri</i> , <i>E. forrestii</i> , <i>A. victoriae</i> , <i>A. tetragonophylla</i> , <i>Ptilotus obovatus</i> , <i>P. roei</i> , <i>Solanum lasiophyllum</i> , <i>Cassia helmsii</i> , <i>C. desolata</i> , <i>Rhagodia eremaea</i> , <i>Eremophila maculata</i> .	4 inventory sites, 10 condition sites and traversed Vegetation type: Hardpan Mulga Shrubland. Palatable perennials include: <i>Ptilotus obovatus</i> , <i>Rhagodia eremaea</i> , <i>Eremophila forrestii</i> , <i>E. maculata</i> , <i>Maireana</i> spp. Pastoral use limitations: Mildly to moderately susceptible to erosion where degraded. Vegetation condition %: VG/G 11, F 32, PVP 57. Erosion incidence %: min 26, mod 8, sev 3. 223 obs.
Unit 3: Alluvial plains (50%) Gently inclined (< 0.3%) saline alluvial plains, often widely degraded. Most areas more or less eroded, with little topsoil and hardpan exposures where soil loss is complete. Soils are dark red duplexes, hardpan loams or red clays 0.3- > 1 m deep, mainly over hardpan; pH 6.5-9.0 with an alkaline reaction trend. Principal profile forms: Dr1.52, Dr2.52, Dr2.53, Um5.31, Uf6.53.	Very scattered to scattered (PFC < 20%) low shrublands dominated by <i>Maireana</i> or <i>Atriplex</i> spp. when in good condition; unpalatable shrubs such as <i>Acacia victoriae</i> , <i>Eremophila pterocarpa</i> and <i>Cassia sturtii</i> dominate areas in poor condition. Trees (2-4m m): <i>A. aneura</i> . Tall shrubs (> 2 m): <i>Hakea preissii</i> , <i>A. victoriae</i> , <i>A. tetragonophylla</i> , <i>A. xiphophylla</i> . Mid shrubs (1-2 m): <i>Cassia</i> spp. <i>A. tetragonophylla</i> , <i>A. victoriae</i> , <i>Eremophila pterocarpa</i> . Low shrubs (< 1 m): <i>Maireana pyramidata</i> , <i>M. platycarpa</i> , <i>M. triptera</i> , <i>Rhagodia eremaea</i> , <i>Enchylaena tomentosa</i> , <i>Frankenia</i> spp., <i>Atriplex bunburyana</i> , <i>Eremophila pterocarpa</i> , <i>E. compacta</i> , <i>Ptilotus obovatus</i> , <i>Solanum lasiophyllum</i> , <i>Cassia desolata/sturtii</i> , <i>C. phyllodinea</i> , <i>C. helmsii</i> .	9 inventory sites, 27 condition sites and traversed Vegetation type: Bluebush Shrubland. Palatable perennials include: <i>Maireana pyramidata</i> , <i>M. platycarpa</i> , <i>Enchylaena tomentosa</i> , <i>Rhagodia eremaea</i> , <i>Ptilotus obovatus</i> , <i>Frankenia</i> spp. Increaser species include: <i>Hakea preissii</i> , <i>Eremophila pterocarpa</i> , <i>Cassia sturtii</i> , <i>C. phyllodinea</i> . Pastoral use limitations: Frequently degraded with marked loss of palatable perennial shrubs, highly susceptible to erosion where perennials are degraded, susceptible to shrub invasion. Vegetation condition %: VG/G 7, F16, PVP 77. Erosion incidence %: min 44, mod 39, sev 3. 246 obs.
Unit 4: Flood plains (10%) Gently inclined lower alluvial plains receiving more regular flooding than unit 3. Occasional ill-defined shallow meandering channels < 0.5 m deep. Soils are red brown or dark red, mostly full depth (> 1 m) light clays or duplexes or alkaline red earths, some over calcrete substrates. Soil reaction trend is alkaline. Principal profile form: Gn2.13, Uf6.71, Dr2.53.	Scattered to close (PFC 10-50%) tall shrublands dominated by <i>Acacia tetragonophylla</i> . Trees (2-4 m): <i>Hakea suberea</i> , <i>Eucalyptus coolabah</i> , <i>Acacia distans</i> . Tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. tetragonophylla</i> . Mid shrubs (1-2 m): <i>Eremophila fraseri</i> , <i>A. tetragonophylla</i> , <i>A. victoriae</i> , <i>A. sclerosperma</i> . Low shrubs (< 1 m): <i>Ptilotus obovatus</i> , <i>P. divaricatus</i> , <i>Maireana pyramidata</i> , <i>Scaevola spinescens</i> , <i>Enchylaena tomentosa</i> . Perennial grasses: <i>Eriachne flaccida</i> , <i>Stipa elegantissima</i> .	4 inventory sites, 2 condition sites and traversed Vegetation type: Riverine Mixed Shrubland. Palatable perennials include: <i>Atriplex bunburyana</i> , <i>Maireana pyramidata</i> , <i>Scaevola spinescens</i> , <i>Ptilotus obovatus</i> , <i>P. divaricatus</i> , <i>Eriachne flaccida</i> . Pastoral use limitations: None with controlled grazing.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 5: Drainage foci and claypans (3%)</p> <p>Seasonally flooded claypans and rounded drainage foci up to 400 m in diameter (usually smaller) occurring on units 3 and 4. Soils are yellowish-red or brown clays and hard-setting duplex types mostly > 1 m deep, pH 6.0-7.0 with a neutral trend. Principal profile forms: Dr2., Uf6.71.</p>	<p>Scattered to close PFC (10-50%) woodlands or tall shrublands dominated by <i>Acacia aneura</i>, <i>A. kempeana</i> and <i>A. tetragonophylla</i>; may occur over whole foci or as fringes around more open grassy centres. Trees (6-10 m): <i>A. aneura</i>, <i>Pittosporum phylliraeoides</i>. Tall shrubs (> 2 m): <i>A. kempeana</i>, <i>A. victoriae</i>, <i>A. tetragonophylla</i>, <i>Eremophila</i> spp. Mid shrubs (1-2 m): <i>Cassia helmsii</i>, <i>E. glabra</i>, <i>A. tetragonophylla</i>. Low shrubs (< 1 m): <i>Cratystylis subspinescens</i>, <i>Solanum lasiophyllum</i>, <i>Enchylaena tomentosa</i>, <i>Rhagodia eremaea</i>, <i>Ptilotus obovatus</i>. Perennial grasses: <i>Eriachne flaccida</i>, <i>Eragrostis xerophila</i>, <i>Enteropogon acicularis</i>.</p>	<p>4 inventory sites and traversed</p> <p>Vegetation type: Mulga Grove Woodland or Alluvial Tussock Grassland. Palatable perennials include: <i>Cratystylis subspinescens</i>, <i>Scaevola spinescens</i>, <i>Ptilotus obovatus</i>, <i>Enchylaena tomentosa</i>, <i>Eriachne flaccida</i>, <i>Enteropogon acicularis</i>, <i>Eragrostis xerophila</i>. Pastoral use limitations: None under controlled grazing.</p>
<p>Unit 6: Minor channels (< 2%)</p> <p>Anastomosing channels up to 25 m wide incised to 2 m deep with hardpan or calcrete exposures. Channel floors carry bedloads of coarse sand and grit. Soils on banks are alluvial types of variable depth and with alkaline soil reaction trends.</p>	<p>Close to closed (PFC 30- > 50%) fringing woodlands or tall shrublands dominated by <i>Casuarina obesa</i> or <i>Acacia burkittii</i>. Trees (8-10 m): <i>A. burkittii</i>, <i>C. obesa</i>. Tall shrubs (> 2 m): <i>A. burkittii</i>, <i>A. sclerosperma</i>, <i>A. aneura</i>. Medium shrubs (1-2 m): <i>Cassia sturtii</i>, <i>C. helmsii</i>, <i>Scaevola spinescens</i>, <i>A. tetragonophylla</i>, <i>Grevillea stenobotrya</i>. Low shrubs (< 1 m): <i>C. sturtii</i>, <i>Atriplex amnicola</i>, <i>Ptilotus obovatus</i>, <i>Rhagodia eremaea</i>, <i>Frankenia</i> sp., <i>Enchylaena tomentosa</i>, <i>Halosarcia</i> sp.</p>	<p>2 inventory sites and traversed</p> <p>Vegetation type: Saltbush Shrubland or Creekline Shrubland. Palatable perennials include: <i>Atriplex amnicola</i>, <i>Rhagodia eremaea</i>, <i>Enchylaena tomentosa</i>, <i>Scaevola spinescens</i>, <i>Frankenia</i> sp., <i>Ptilotus obovatus</i>. Pastoral use limitations: None under controlled grazing.</p>

Eurardy land system 195 km² (0.23% of survey area)

Land type: 11; Pastoral potential: very low.

Gently undulating sandplain with low dunes, supporting acacia shrublands, patchy mallee and tree form eucalypts and low heathlands, representing a transition to the South-Western Botanical Province; only in far south-west of area.

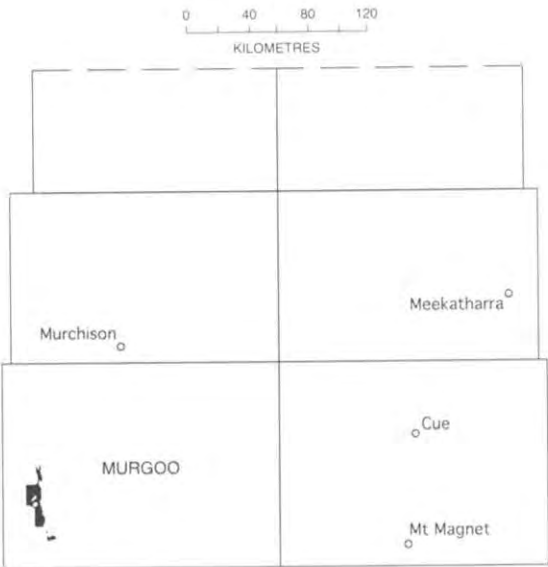
Geology: Quaternary aeolian sand.

Geomorphology: Depositional surfaces; extensive undulating sandplain with occasional rounded dunes to 5 m; no drainage features other than scattered drainage foci.

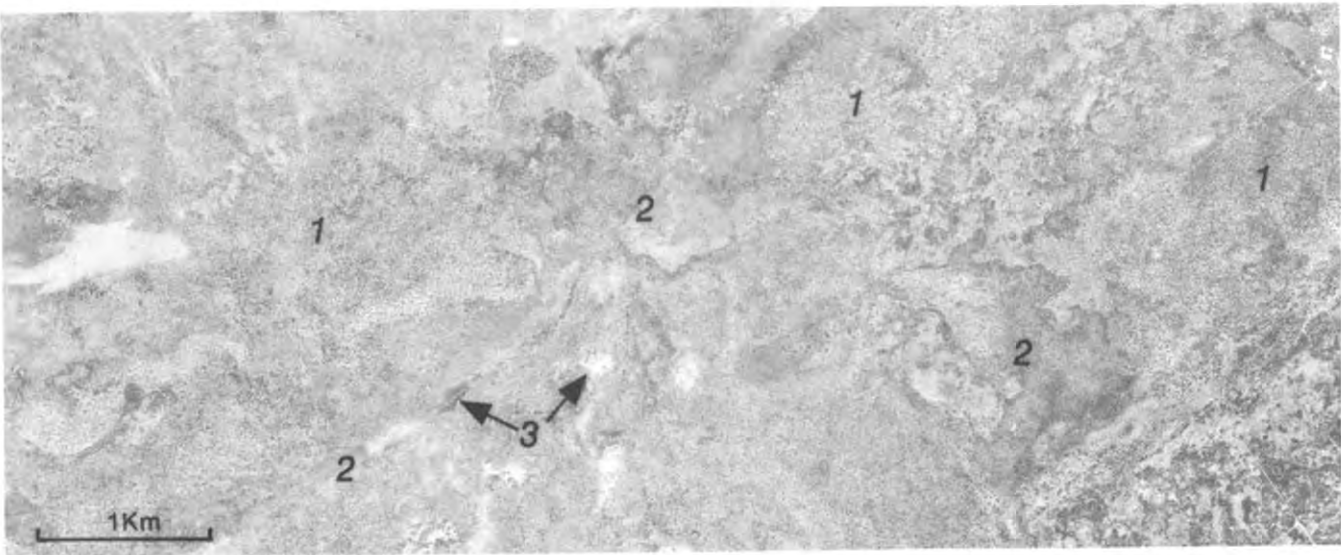
Vegetation and pastoral use: Mainly South-Western Sandplain Shrubland-heathy vegetation containing mostly South-Western Botanical Province species of very little use for grazing; also minor Sandplain Wanderrie Grassy Shrubland of low productivity. A system unsuited to pastoral development.

Estimated carrying capacity, good condition: 30 ha/dse.

Range condition summary: Insufficiently sampled but in good condition where encountered.



- Unit: 1. Sandplain with low dunes.
2. Lower plains.
3. Drainage foci and claypans.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Sandplain with low dunes (88%) Extensive tracts of gently undulating yellowish sandplain, with little relief except for occasional low dunes (< 5 m). Soils are deep, yellowish red earthy sands. Principal profile form: Uc5.21.	Moderately close (PFC 20-30%) mixed height shrublands (and heathlands) with many undetermined South-Western Botanical Province species; also patches of tree and mallee form eucalypts. Trees (to 12 m+): <i>Eucalyptus loxophleba</i> , <i>E. foecunda</i> . Tall shrubs (> 2 m): <i>Acacia ramulosa</i> , <i>A. sclerosperma</i> , <i>A. roycei</i> , <i>Melaleuca</i> sp., <i>Callitris columellaris</i> . Mid shrubs (1-2 m): <i>A. ramulosa</i> , <i>A. tetragonophylla</i> , <i>Dononaea attenuata</i> . Low shrubs (< 1 m): <i>Conospermum</i> sp., <i>Hakea</i> sp., <i>Rhagodia</i> sp., <i>Solanum lasiophyllum</i> , <i>S. orbiculatum</i> , <i>Ptilotus obovatus</i> , <i>Pimelia microcephala</i> and numerous unidentified species. Perennial grasses: <i>Monachather paradoxa</i> , <i>Thyridolepis multiculmis</i> , <i>Stipa</i> sp., <i>Triodia</i> sp.	4 inventory sites and traversed Vegetation type: Sandplain Mallee Acacia Spinifex Shrubland, Sandplain Wanderrie Grass Shrubland, * South Western Sandplain Shrubland. Palatable perennials include: <i>Ptilotus obovatus</i> , <i>Monachather paradoxa</i> , <i>Thyridolepis multiculmis</i> . Pastoral use limitations: Pastoral potential is very low owing to scarcity of palatable species.
Unit 2: Lower plains (10%) Flat plains with more soil development than unit 1 and receiving some local run-on. Soils are probably yellowish-red earthy sands over a calcrete pan at variable depth, pH 7.0 with a neutral reaction trend. Principal profile forms probably: Uc5.21, Uc5.22.	Vegetation similar to unit 1.	As for unit 1.
Unit 3: Drainage foci and claypans (2%) Isolated claypans up to 300 m in diameter, mostly located on lower parts of system. Soils are deep red earths or clays.	Generally bare of vegetation although occasionally fringed with dense <i>Acacia tetragonophylla</i> or <i>Melaleuca</i> spp.	

* South Western Sandplain Shrubland, very limited occurrence in survey area, not described in report.

Farmer land system 81 km² (0.09% of survey area)

Land type: 1; Pastoral potential: very low.

Rough hills and footslopes of gabbro and dolerite rising steeply from surrounding plains, supporting sparse tall acacia shrublands.

Geology: Archaean and early Proterozoic gabbro with frequent intrusive dykes and sills of dolerite; Quaternary colluvium on slopes.

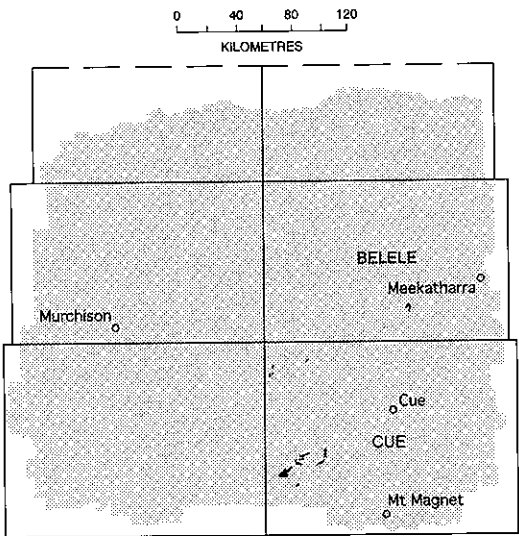
Geomorphology: Erosional surfaces; hill crests and peaks with much outcrop and mantle of gabbro and dolerite; slopes variable but mostly > 10% and concave with interfluvies dissected by narrow valleys; lower slopes and plains with stony mantles; relief up to 160 m.

Vegetation and pastoral use: Rocky Hill Mixed Shrubland of mostly very low pastoral value, with upper slopes and crests largely inaccessible to domestic stock; generally in good condition with little erosion owing to extensive protective mantle.

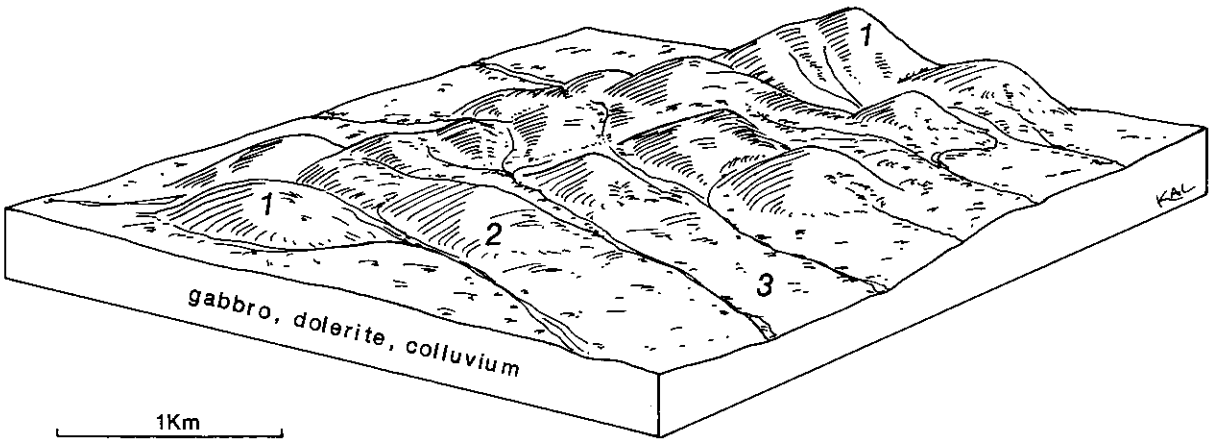
Estimated carrying capacity, good condition: 30 ha/dse.

Range condition summary (19 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
100	0	0	0	63	32	5



- Unit: 1. Hills and ridges.
2. Upper slopes.
3. Lower footslopes and marginal plains.



Farmer I.s.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 1: Hills and ridges (50%)</p> <p>Rough hill crests and peaks to 160 m with spurs and ridges densely mantled with dolerite and gabbro cobbles and boulders; rock outcrops frequent in higher parts. Occasional pockets of soil, very shallow reddish brown duplexes or lithosols with dolerite substrates at < 20 cm; pH 7.5-8.0 with a neutral reaction trend.</p>	<p>Scattered (PFC 10-20%) mixed shrublands dominated by <i>Acacia</i> spp. or <i>Eremophila platycalyx</i>. Tall shrubs (> 2 m): <i>A. sp.</i>, <i>A. aneura</i>, <i>A. tetragonophylla</i>. Mid shrubs (1-2 m): <i>E. platycalyx</i>, <i>E. forrestii</i>, <i>E. aff. mackinlayi</i>. Low shrubs (< 1 m): <i>Hibiscus</i> sp., <i>Ptilotus obovatus</i>, <i>Cassia helmsii</i>, <i>C. sturtii</i>, <i>Pimelia microcephala</i>, <i>Solanum lasiophyllum</i>. Perennial grass: <i>Stipa</i> spp.</p>	<p>1 inventory site and traversed</p> <p>Vegetation type: Rocky Hill Mixed Shrubland. Pastoral use limitations: Poorly accessible to stock and very few palatable shrubs.</p>
<p>Unit 2: Upper slopes (20%) and</p> <p>Unit 3: Lower footslopes and marginal plains (30%)</p> <p>Steep upper footslopes (slopes to > 10%) grading to flatter lower slopes and plains. Very dense gabbro mantles and frequent outcrops. Soils are very shallow stony lithosols, reddish brown fine sandy loams or clayey sands mostly < 20 cm, overlying greenstone or gabbro material; pH 7.0 with a neutral reaction trend. Principal profile forms: Uc1.43, Um5.51.</p>	<p>Scattered (PFC 10-20%) mixed shrublands dominated by <i>Eremophila platycalyx</i> and <i>Acacia</i> MRS 399. Trees (to 4 m): <i>A. aneura</i>. Tall shrubs (> 2 m): <i>A. P49</i>, MRS 399, <i>E. platycalyx</i>, <i>A. burkittii</i>, <i>Dodonaea</i> spp. Mid shrubs (1-2 m): <i>A. sp.</i>, <i>E. platycalyx</i>, <i>E. georgei</i>, <i>E. forrestii</i>, <i>Cassia nemophila</i>, <i>C. sturtii</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>P. schwartzii</i>, <i>Thryptomene decussata</i>, <i>Sida</i> sp., <i>Solanum lasiophyllum</i>, <i>Corchorus</i> spp., <i>Hemigenia macphersonii</i>. Perennial grass: <i>Cymbopogon ambiguus</i>.</p>	<p>2 inventory sites and traversed</p> <p>Vegetation type: Rocky Hill Mixed Shrubland. Palatable perennials include: <i>Ptilotus obovatus</i>, <i>P. schwartzii</i>, <i>Sida</i> sp. Pastoral use limitations: Low potential.</p>

Flood land system (G) 439 km² (0.51% of survey area)

Land type: 13; Pastoral potential: moderate.

Hardpan wash plains with long, interconnected wanderrie banks supporting mulga and wanderrie shrublands; mainly in catchment of Wooramel River and further north.

Geology: Quaternary cemented alluvium with aeolian deposits.

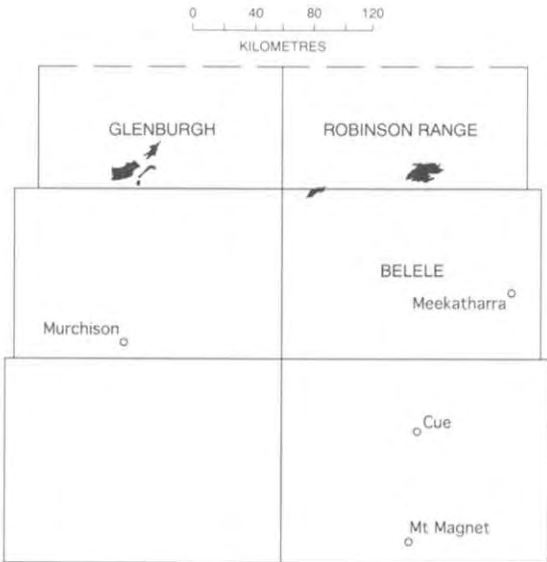
Geomorphology: Depositional surfaces; alluvial plains carrying sheet flow and extensive wind-deposited, flow-modified wanderrie banks arranged mostly parallel to flow direction but with some transverse interconnecting banks; hardpan interbank plains with intermittent grove formations; little channel development and overall relief is generally < 5 m.

Vegetation and pastoral use: Wanderrie Bank Grassy Shrubland and Hardpan Mulga Shrubland of moderate productivity and some drought reserves; more productive parts of unit 3 tend to be somewhat overgrazed; minor susceptibility to erosion on unit 4.

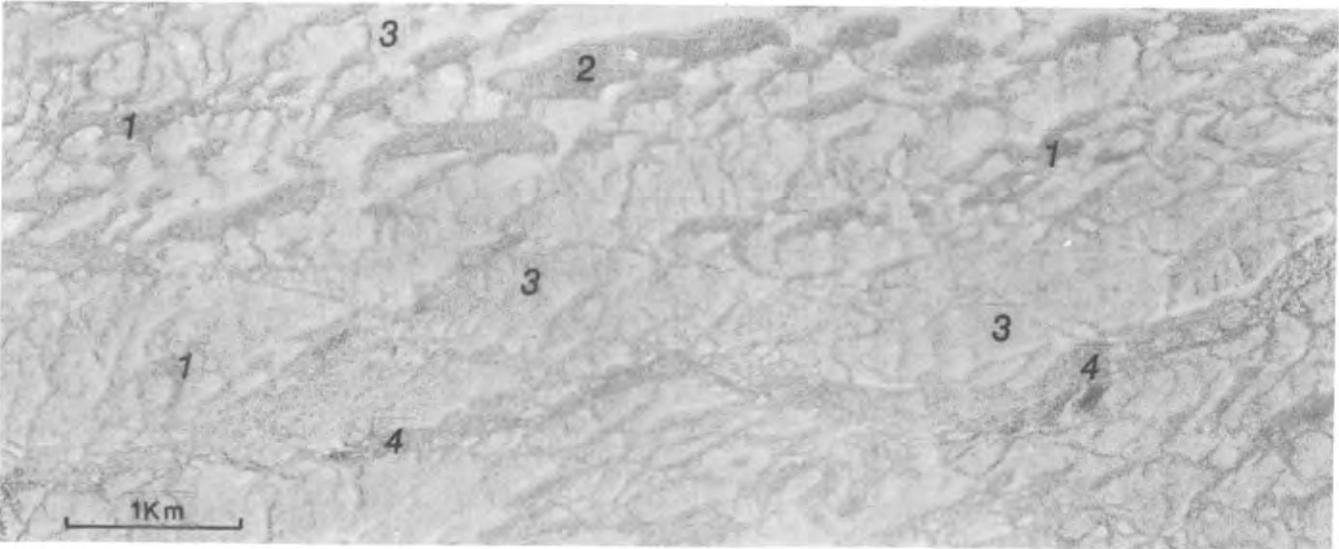
Estimated carrying capacity, good condition: 12 ha / dse.

Range condition summary (60 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
93	7	0	0	27	32	41



- Unit: 1. Sandy banks.
2. Sand sheets.
3. Hardpan plains.
4. Drainage tracts.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Sandy banks (30%) Reticulate or linear sandy banks to 3 m above surrounding unit 3; slopes < 1%. Variable in size; mostly < 200 m wide and < 1 km long but also grading into broader expanses similar to unit 2. Soils are red earthy sands > 1 m deep; pH 5.5 with an acidic reaction trend. Principal profile form: Uc5.21.	Moderately close (PFC 20-30%) grassy shrubland dominated by <i>Acacia</i> aff. <i>coolgardiensis</i> , <i>A. ramulosa</i> , <i>Eremophila forrestii</i> . Trees (to 6 m): <i>A. pruinocarpa</i> , <i>Grevillea</i> spp. Tall shrubs (> 2 m): <i>A. aff. coolgardiensis</i> . Mid shrubs (1-2 m): <i>A. aff. coolgardiensis</i> , <i>E. margarethae</i> , <i>A. murrayana</i> , <i>E. forrestii</i> , <i>A. ramulosa</i> . Low shrubs (< 1 m): <i>Solanum lasiophyllum</i> , <i>Cassia desolata</i> . Perennial grasses: <i>Monachather paradoxa</i> , <i>Eriachne helmsii</i> , <i>Eragrostis lanipes</i> .	2 inventory sites, 4 condition sites and traversed Vegetation type: Wanderrie Bank Grassy Shrubland. Palatable perennials include: <i>Monachather paradoxa</i> , <i>Eragrostis lanipes</i> , <i>Tribulus platypterus</i> . Pastoral use limitations: None under controlled grazing.
Unit 2: Sand sheets (10%) Gently sloping (< 0.5%) broad sand sheets extending to 5 km in length but more commonly < 2 km long and < 1 km wide arranged longitudinal to direction of water flow. Soils are deep red earthy sands > 1 m deep; pH 6.5-7.0 with a neutral trend. Principal profile form: Uc5.21.	Very scattered to scattered (PFC > 20%) grassy shrublands dominated by perennial grasses (<i>Eragrostis eriopoda</i> , <i>Monachather paradoxa</i> , <i>Eriachne helmsii</i>) and <i>Eremophila margarethae</i> . Trees (4-6 m): <i>Eucalyptus coolabah</i> , <i>E. dichromophloia</i> . Tall shrubs (> 2 m): <i>Acacia ramulosa</i> , <i>A. kempeana</i> , <i>A. aneura</i> . Mid shrubs (1-2 m): <i>A. kempeana</i> , <i>A. murrayana</i> . Low shrubs (< 1-2): <i>Eremophila margarethae</i> , <i>Cassia desolata</i> , <i>Solanum lasiophyllum</i> . Perennial grasses: <i>Eragrostis eriopoda</i> , <i>E. lanipes</i> , <i>Eriachne helmsii</i> , <i>Monachather paradoxa</i> , <i>Aristida browniana</i> .	1 inventory site and traversed Vegetation type: Sandplain Wanderrie Grassy Shrubland. Palatable perennials include: <i>Eragrostis eriopoda</i> , <i>E. lanipes</i> , <i>Monachather paradoxa</i> . Pastoral use limitations: None under controlled grazing.
Unit 3: Hardpan plains (50%) Gently inclined (< 0.5%) plains subject to broad sheet flow between sandy banks, grading to more extensive areas with locally groved vegetation formations downslope. Soils are probably shallow red earths, sandy clay loams over sandy clays on hardpan to < 50 cm deep; pH 6.0-7.0 with a neutral trend.	Scattered (PFC 10-20%) low woodland or mixed shrublands dominated by <i>Acacia aneura</i> and <i>Cassia</i> spp. Trees (2-4 m): <i>A. aneura</i> . Tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. tetragonophylla</i> . Mid shrubs (1-2 m): <i>Cassia desolata</i> , <i>A. kempeana</i> , <i>Canthium lineare</i> , <i>Eremophila fraseri</i> , <i>E. mackinlayi</i> , <i>Grevillea deflexa</i> . Low shrubs (< 1 m): <i>Ptilotus obovatus</i> , <i>Sida calyxhymenia</i> , <i>Cassia helmsii</i> , <i>Solanum lasiophyllum</i> , <i>Maireana planifolia</i> .	7 condition sites and traversed Vegetation type: Hardpan Mulga Shrubland. Palatable perennials include: <i>Ptilotus obovatus</i> , <i>Sida calyxhymenia</i> , <i>Maireana planifolia</i> , <i>Canthium lineare</i> . Pastoral use limitations: Mild susceptibility to accelerated erosion when degraded. Vegetation condition %: VG/G 26, F 23, P/V 51. Erosion incidence %: min 5. 39 obs.
Unit 4: Drainage tracts (10%) Drainage floors to 1 km wide with occasional small channels, but mostly unchannelled. Soils are probably shallow red earths or clays overlying hardpan at about 50 cm.	Scattered (PFC 10-20%) to moderately close (PFC 20-30%) low woodlands or mixed shrublands dominated by <i>Acacia aneura</i> , <i>A. tetragonophylla</i> , <i>Eremophila fraseri</i> or <i>Cassia</i> species.	Traversed Vegetation type: Hardpan Mulga Shrubland or Creekline Shrubland. Pastoral use limitations: Mild susceptibility to accelerated erosion.

Frederick land system (G) 36 km² (0.04% of survey area)

Land type: 13; Pastoral potential: moderate.

Hardpan wash plains characterised by broad, reticulate mulga groves and wanderrie banks supporting tall acacia shrublands with grassy understorey; in survey area it occurs only along the boundary of Gascoyne-Murchison River catchment divide.

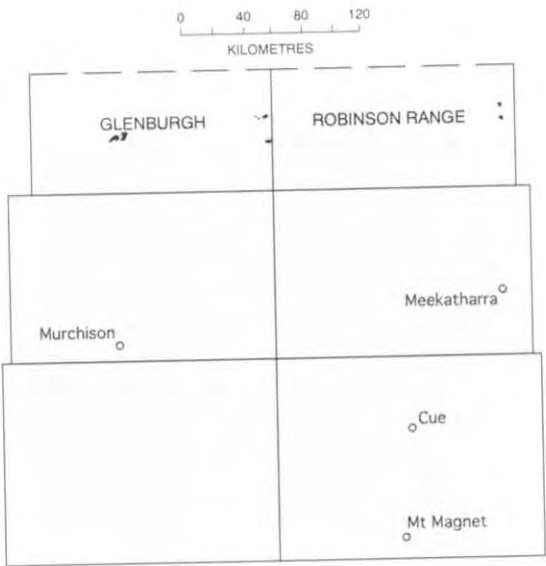
Geology: Quaternary alluvium with aeolian deposits.

Geomorphology: Depositional surfaces; alluvial plains carrying sheet flow; intercepted by arcuate mulga groves, slightly elevated above broad intergrove hardpan plains and up to 500 m long and 100 m wide, above central unchannelled drainage tracts receiving slightly more concentrated flow; minor linear wanderrie banks, relief usually < 5 m.

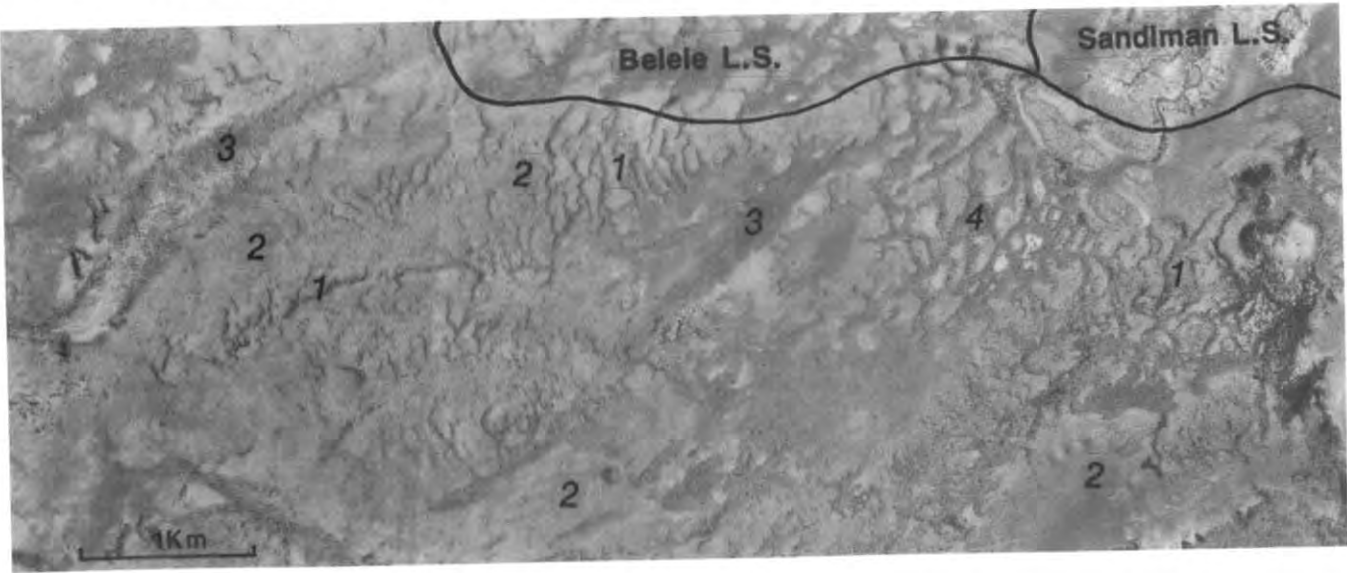
Vegetation and pastoral use: Hardpan Mulga Shrubland and Mulga Grove Woodland with minor Wanderrie Bank Grassy Shrubland; moderately productive perennial shrublands; drainage plains slightly susceptible to erosion where degraded and prone to increases by unpalatable shrubs.

Estimated carrying capacity, good condition: 12 ha/dse.

Range condition summary: Insufficiently sampled; vegetation probably mostly in fair condition; little or no erosion.



- Unit: 1. Groves.
2. Intergrove plains.
3. Floodplains with concentrated flow zones.
4. Low sandy banks.



Frederick I.s. (adapted from Wilcox and McKinnon, 1972)

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Groves (15%) Parts of almost flat alluvial plains characterised by pronounced arcuate groves of dense mulga and shrubs arranged transverse to the slope; often interconnected and up to 500 m long and 100 m wide. Soils are red-brown sandy loams or sandy clay loams < 1 m deep; frequently over hardpan; pH 6.0-7.0.	Moderately close to close (PFC 30-50%) mulga <i>Acacia aneura</i> woodlands. Trees and tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. grasbyi</i> , <i>A. pruinocarpa</i> . Mid and low shrubs (< 2 m): <i>Eremophila forrestii</i> , <i>E. fraseri</i> , <i>E. exilifolia</i> , <i>E. gilesii</i> , <i>Canthium</i> sp., <i>Ptilotus obovatus</i> , <i>Rhagodia</i> sp. Perennial grasses: <i>Monachather paradoxa</i> , <i>Eriachne helmsii</i> .	Traversed Vegetation type: Mulga Grove Woodland. Palatable perennials include: <i>Eremophila forrestii</i> , <i>Rhagodia eremaea</i> , <i>Ptilotus obovatus</i> , <i>Monachather paradoxa</i> . Pastoral use limitations: None with controlled grazing.
Unit 2: Intergrove plains (65%) Flat plains interspersed with groves (unit 1) and sandy banks (unit 4); extending up to several kilometres downslope and up to 500 m wide; surfaces are usually sealed and strewn with light quartz mantles. Soils are reddish-brown sandy clay loams over hardpan < 50 cm deep; pH 5.0-7.0.	Very scattered (PFC < 10%) mixed shrublands dominated by <i>Acacia aneura</i> . Trees and tall shrubs (> 2 m): <i>A. aneura</i> , <i>Grevillea striata</i> , <i>Eremophila fraseri</i> . Mid and low shrubs (< 2 m): <i>E. margarethae</i> , <i>E. spathulata</i> , <i>Ptilotus obovatus</i> , <i>P. schwartzii</i> .	Traversed Vegetation type: Hardpan Mulga Shrubland. Palatable perennials include: <i>Ptilotus</i> spp. Pastoral use limitations: None with controlled grazing.
Unit 3: Flood plains with concentrated flow zones (15%) Almost flat plains similar to unit 2 but receiving more concentrated sheet flow, up to 5 km long and up to 500 m wide often with small braided central channels; outer plains are usually lightly to moderately mantled with small quartz pebbles. Soils are reddish-brown gritty clays < 1 m deep, over hardpan.	Scattered (PFC 10-20%) mixed shrublands similar to unit 2 but with more frequent low shrubs (<i>Ptilotus obovatus</i> , <i>P. schwartzii</i> and <i>Solanum lasiophyllum</i>).	Traversed Vegetation type: Hardpan Mulga Shrubland. Pastoral use limitations: None with controlled grazing.
Unit 4: Low sandy banks (5%) Sandy banks, up to 500 m wide, and slightly elevated (< 1 m) above unit 3, extending up to 2 km downslope. Soils are reddish brown loamy sands > 1 m deep.	Scattered (PFC 10-20%) mixed shrublands with <i>Acacia aneura</i> , <i>A. ramulosa</i> , <i>Eremophila forrestii</i> , <i>Ptilotus obovatus</i> and <i>Cassia</i> spp. and infrequent perennial grasses <i>Monachather paradoxa</i> , <i>Eriachne helmsii</i> .	Traversed Vegetation type: Wanderrie Bank Grassy Shrubland. Palatable perennials include: <i>Eremophila forrestii</i> , <i>Ptilotus obovatus</i> , <i>Monachather paradoxa</i> . Pastoral use limitations: None with controlled grazing.

Gabanintha land system (W) 962 km² (1.12% of survey area)

Land type: 1; Pastoral potential: low.

Ridges, hills and footslopes of various metamorphosed volcanic rocks (greenstones), supporting sparse acacia and other mainly non-halophytic shrublands.

Geology: Metamorphosed Archaean volcanic and sedimentary rocks; mainly jaspilite/banded ironstone, basaltic intrusives and felsic volcanics; with thin Quaternary colluvium veneers; also minor residual material from former Tertiary laterite cappings.

Geomorphology: Erosional surfaces, long ranges of low hills and ridges with extensive outcrops of schist, jaspilite and other parent rocks; peaks to 120 m; rough rounded crests and concave footslopes with incised more or less rectangular drainage; level stony plains with minor shallow hardpan development on lowest units; minor sandy surfaced lateritic plains; overall relief is < 130 m.

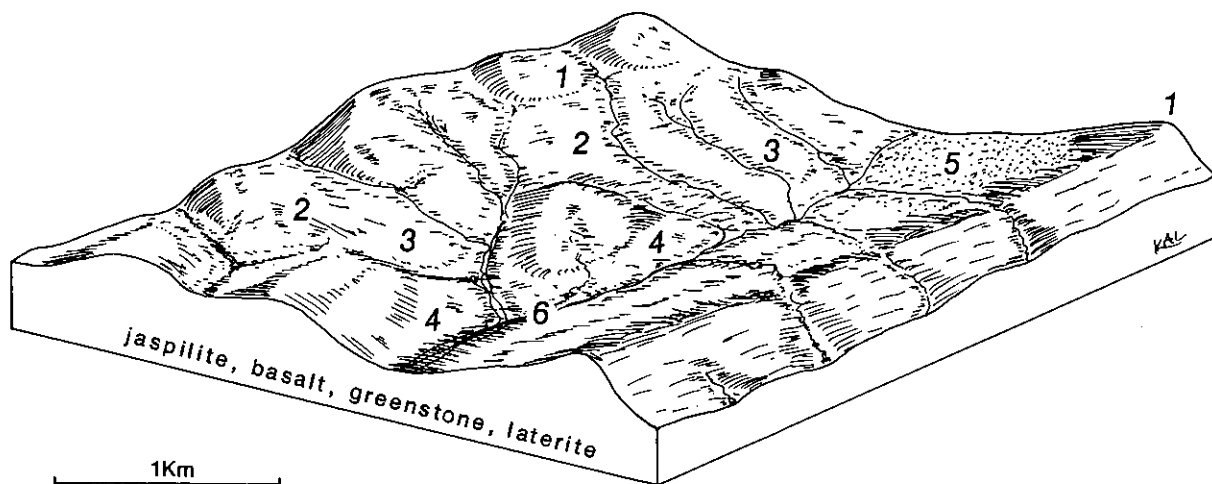
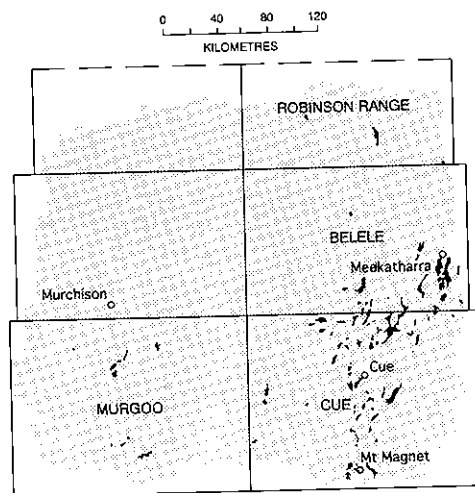
Vegetation and pastoral use: Rocky Hill Mixed Shrubland and Stony Mulga Mixed Shrubland; mostly low in productivity, but with halophytic understorey shrubs on accessible footslopes and stony plains below weathering outcrops; productivity of annuals moderate in good seasons; mostly in fair condition, except for areas of halophytes selectively overgrazed; hills mostly poorly accessible; not generally susceptible to grazing-induced erosion but widely scarred by past mining activities.

Estimated carrying capacity, good condition: 20 ha/dse.

Range condition summary (133 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
92	7	1	0	22	36	42

- Unit: 1. Hill crests, ridges and hill spurs.
2. Upper slopes.
3. Lower slopes.
4. Stony plains.
5. Gravelly plains.
6. Creeks and drainage tracts.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 1: Hill crests, ridges and hill spurs (30%)</p> <p>Rough greenstone hill crests, spurs and ridges with peaks to 120 m; slopes variable but usually 5 to 10%. Dense surface mantles of greenstone, quartz or schist, also frequent rock outcrop. Soils are stony lithosols overlying greenstone; pH 6.0 with a neutral trend. Principal profile forms: Uc1.43, Um5.51, Um5.41.</p>	<p>Scattered (PFC 10-20%) mixed shrublands. Tall shrubs (> 2 m): <i>Acacia aneura</i>, A. MRS 399. Mid shrubs (1-2 m): <i>Acacia aneura</i>, A. MRS 399, <i>Eremophila macmillaniana</i>, <i>Dodonaea pinifolia</i>, <i>Cassia sturtii</i>, <i>C. nemophila</i>. Low shrubs (< 1 m): <i>Kallstroemia platypterus</i>, <i>D. pinifolia</i>, <i>Solanum lasiophyllum</i>, <i>E. exilifolia</i>, <i>Calytrix muricata</i>, <i>Hybanthus floribundus</i>, <i>Ptilotus obovatus</i>, <i>Sida</i> sp., <i>Maireana georgei</i>, <i>M. melanocoma</i>, <i>M. triptera</i>.</p>	<p>1 inventory site</p> <p>Vegetation type: Stony Mulga Mixed Shrubland or Rocky Hill Mixed Shrubland. Palatable perennials include: <i>Ptilotus obovatus</i>, <i>Maireana georgei</i>, <i>M. triptera</i>, <i>M. melanocoma</i>, <i>Sida</i> sp., <i>Tribulus platypterus</i>. Pastoral use limitations: None with controlled grazing.</p>
<p>Unit 2: Upper slopes (20%)</p> <p>Densely mantled concave upper slopes to 10%; relief is occasionally to 50 m but usually less; outcrops of ironstone, schist, dolerite or other parent material. Soils are shallow stony lithosols dark red fine sandy loams or sandy clay loams with inclusions of decomposing parent material throughout the profile; pH 6.0-6.5 with an acidic or neutral trend. Principal profile forms: Uc1.43, Um5.41, Um5.51.</p>	<p>Scattered (PFC 10-20%) mixed shrublands dominated by <i>Acacia aneura</i> or <i>A. quadrimarginea</i>. Trees (to 6 m): <i>A. pruinocarpa</i>. Tall shrubs (> 2 m): <i>A. aneura</i>, <i>A. quadrimarginea</i>, <i>A. grasbyi</i>. Mid shrubs (1-2 m): <i>A. aneura</i>, <i>Eremophila macmillaniana</i>, <i>A. tetragonophylla</i>, <i>E. latrobei</i>. Low shrubs (< 1 m): <i>Cassia desolata</i>, <i>Ptilotus rotundifolius</i>, <i>P. obovatus</i>, <i>P. roei</i>, <i>P. schwartzii</i>, <i>E. exilifolia</i>, <i>E. glutinosa</i>, <i>Rhagodia eremaea</i>, <i>Maireana georgei</i>, <i>M. villosa</i>, <i>M. triptera</i>, <i>Tribulus platypterus</i>.</p>	<p>5 inventory sites, 1 condition site and traversed</p> <p>Vegetation type: Rocky Hill Mixed Shrubland or Stony Mulga Mixed Shrubland. Palatable perennials include: <i>Ptilotus rotundifolius</i>, <i>P. schwartzii</i>, <i>P. obovatus</i>, <i>P. roei</i>, <i>Maireana georgei</i>, <i>M. triptera</i>, <i>M. villosa</i>, <i>Atriplex bunburyana</i>, <i>Tribulus platypterus</i>, <i>Rhagodia eremaea</i>. Pastoral use limitations: None with controlled grazing.</p>
<p>Unit 3: Lower slopes (30%)</p> <p>Footslopes below unit 2, grading to gently undulating plains with slopes from 6% in upper parts falling to < 1% downslope; frequently dissected by drainage tracts forming rounded or undulating interfluvies up to 1 km wide with relief to 20 m. Soils are dark red soft surfaced duplexes or skeletal lithosols, generally < 50 cm deep; pH 6.5-8.5 with a neutral or acidic trend. Principal profile forms: Dr4.12, Uc5.21.</p>	<p>Very scattered or scattered (PFC < 20%) low woodlands or mixed shrublands dominated by <i>Acacia aneura</i>, <i>Eremophila macmillaniana</i>. Trees (4-6 m): <i>A. aneura</i>, <i>A. pruinocarpa</i>. Tall shrubs (> 2 m): <i>A. aneura</i>. Mid shrubs (1-2 m): <i>E. macmillaniana</i>, <i>E. spathulata</i>, <i>Cassia helmsii</i>. <i>A. tetragonophylla</i>, <i>E. fraseri</i>, <i>E. latrobei</i>. Low shrubs (< 1 m): <i>C. helmsii</i>, <i>E. spathulata</i>, <i>E. latrobei</i>, <i>Solanum lasiophyllum</i>, <i>Ptilotus roei</i>.</p>	<p>3 inventory sites, 5 condition sites and traversed</p> <p>Vegetation type: Stony Mulga Mixed Shrubland. Palatable perennials include: <i>Ptilotus roei</i>, <i>Eremophila latrobei</i>, <i>Cassia helmsii</i>, <i>Atriplex bunburyana</i>. Pastoral use limitations: None under controlled grazing and not normally susceptible to accelerated erosion. Vegetation condition %: VG/G 21, F 43, P/VP 36. Erosion incidence %: min 2. 58 obs.</p>
<p>Unit 4: Stony plains (15%)</p> <p>Gently undulating or almost flat stony plains with little or no relief. Soils are probably shallow loams overlying hardpan or weathered igneous rocks.</p>	<p>Very scattered or scattered (PFC < 20%) low or mixed shrublands dominated by <i>Acacia aneura</i>, <i>A. tetragonophylla</i> or <i>Solanum lasiophyllum</i>. Trees (2-4 m): <i>A. aneura</i>, <i>A. pruinocarpa</i>, <i>Brachychiton gregorii</i>. Tall shrubs (> 2 m): <i>A. aneura</i>, <i>A. tetragonophylla</i>. Mid shrubs (1-2 m): <i>A. ramulosa</i>, <i>Cassia sturtii</i>, <i>C. nemophila</i>, <i>Eremophila fraseri</i>, <i>E. linearis</i>, <i>E. platycarpa</i>. Low shrubs (< 1 m): <i>Ptilotus schwartzii</i>, <i>P. obovatus</i>, <i>P. roei</i>, <i>Solanum lasiophyllum</i>, <i>E. compacta</i>, <i>Maireana convexa</i>, <i>M. villosa</i>, <i>Sida calyxhyemia</i>.</p>	<p>3 condition sites and traversed</p> <p>Vegetation type: Stony Mulga Mixed Shrubland. Palatable perennials include: <i>Maireana convexa</i>, <i>M. villosa</i>, <i>Ptilotus obovatus</i>, <i>P. schwartzii</i>, <i>P. roei</i>, <i>Eremophila compacta</i>, <i>Sida calyxhyemia</i>. Pastoral use limitations: None under controlled grazing and not normally susceptible to erosion. Vegetation condition %: VG/G 19, F 30, P/VP 51. Erosion incidence %: min 0, mod 3. 37 obs.</p>

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 5: Gravelly plains (3%)	Scattered or moderately close (PFC 10-30%) mixed shrublands dominated by <i>Acacia aneura</i> or <i>Eremophila forrestii</i> . Trees (2-4 m): <i>A. aneura</i> . Tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. tetragonophylla</i> . Mid shrubs (1-2 m): <i>Eremophila forrestii</i> , <i>A. tetragonophylla</i> , <i>A. ramulosa</i> . Low shrubs (< 1 m): <i>E. forrestii</i> , <i>Solanum lasiophyllum</i> , <i>Canthium lineare</i> , <i>Cassia sturtii</i> . Perennial grasses: <i>Eriachne helmsii</i> , <i>Eragrostis eriopoda</i> , <i>Monachather paradoxa</i> .	1 inventory site and traversed Vegetation type: Sandplain Wanderrie Grassy Shrubland. Palatable perennials include: <i>Eremophila forrestii</i> , <i>Ptilotus schwartzii</i> , <i>Canthium lineare</i> , <i>Eragrostis eriopoda</i> , <i>Monachather paradoxa</i> . Pastoral use limitations: None with controlled grazing.
Unit 6: Creeks and drainage tracts (2%)	Moderately close or closed (PFC 20-50% or > 50%) woodlands dominated by <i>Acacia aneura</i> . Trees (4-6 m): <i>A. aneura</i> , <i>Brachychiton gregorii</i> . Tall shrubs (> 2 m): <i>A. aneura</i> , <i>Eremophila fraseri</i> . Mid shrubs (1-2 m): <i>E. fraseri</i> , <i>Cassia nemophila</i> , <i>C. sturtii</i> , <i>Dodonaea pinifolia</i> . Low shrubs (< 1 m): <i>Scaevola spinescens</i> , <i>Solanum lasiophyllum</i> , <i>Prostanthera sp.</i> , <i>Rulingia kempeana</i> , <i>Ptilotus obovatus</i> . Perennial grasses: <i>Chrysopogon fallax</i> , <i>Cymbopogon ambiguus</i> .	1 inventory site and traversed Vegetation type: Creekline Shrubland. Palatable perennials include: <i>Scaevola spinescens</i> , <i>Ptilotus obovatus</i> , <i>Chrysopogon fallax</i> . Pastoral use limitations: Mildly susceptible to water erosion where degraded.

Holmwood land system 355 km² (0.41% of survey area)

Land type: 5; **Pastoral potential:** high.

Gently undulating saline stony and alluvial plains below low breakaways on Permian sedimentary rocks on the eastern margins of the Victoria Sandplain; supports snakewood and various halophytic shrublands.

Geology: Permian sandstones and siltstones of the Sakmarian series with shale deposits of the Holmwood formation; early Tertiary sandstones of the Pindilya formation; slopes and plains mostly on Quaternary alluvium and colluvium with scattered aeolian deposits.

Geomorphology: Erosional surfaces; plateau edges and remnants with actively eroding breakaways and talus slopes. Also depositional surfaces with occasional sandstone or siltstone mantles; undulating or nearly level alluvial plains; isolated sandplain residuals; lower alluvial plains strongly saline with ill defined drainage patterns; relief mostly < 10 m.

Vegetation and pastoral use: Bluebush and Saltbush Shrubland with scattered tall shrubs; minor sandy areas carry moderately productive Wanderrie Bank Grassy Shrubland; lower saline plains often support Samphire Shrubland of high salinity; footslopes and alluvial plains (units 1 and 4) are liable to overgrazing and show minor susceptibility to erosion.

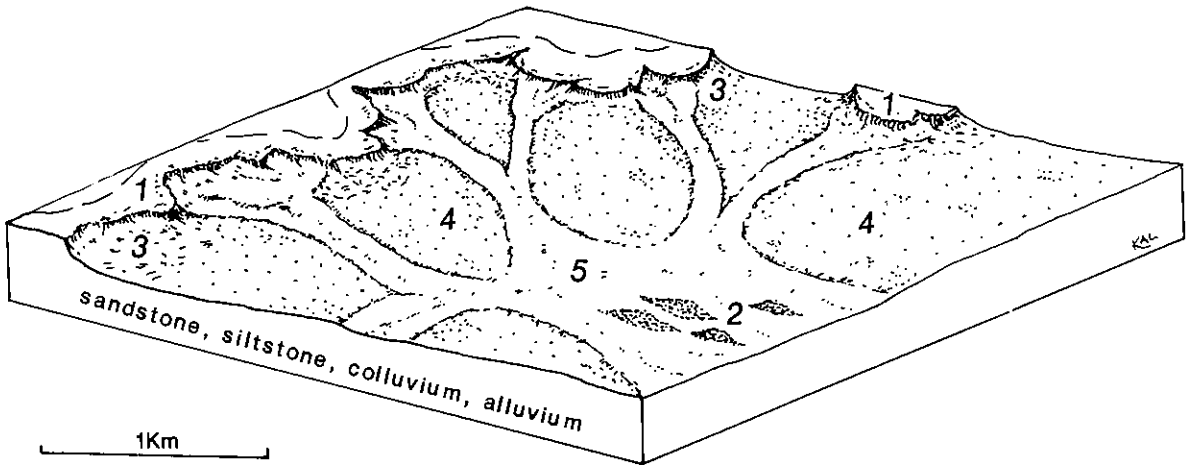
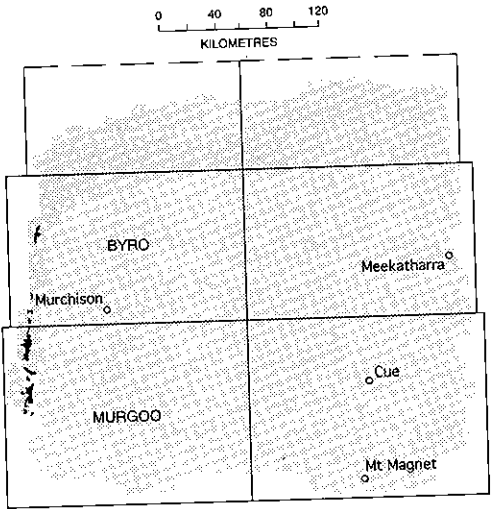
Estimated carrying capacity, good condition: 7 ha/dse.

Range condition summary (27 traverse observations):

(a) Erosion status (%)			
Nil	Min.	Mod.	Sev.
85	11	4	0

(b) Vegetation condition (%)		
Good	Fair	Poor
59	19	22

- Unit: 1. Low breakaways, plateaux and footslopes.
2. Sandy banks.
3. Saline stony plains.
4. Alluvial plains.
5. Lower saline plains.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 1: Low breakaways, plateaux and footslopes (10%)</p> <p>Low erosional scarps of weathered Permian siltstones and sandstones up to 10 m high, grading to gently sloping (< 2%) and undulating saline footslopes, usually strewn with a platy sandstone mantle. Soils are skeletal on stripped indurated upper surfaces, brown light clays on footslopes and probably duplexes with patchy depositions of coarser material from local erosional activity, overlying weathered parent rocks, about 40 cm deep; pH 6.0-7.0 with a neutral reaction trend. Principal profile forms: Uf6.71.</p>	<p>Scattered or very scattered (PFC < 20%) low shrublands dominated by <i>Atriplex vesicaria</i> on saline footslopes or mixed shrublands with <i>Acacia ramulosa</i> or <i>A. cuthbertsonii</i> prominent on low plateaux or breakaway tops. Tall shrubs (> 2 m): <i>A. cuthbertsonii</i>, <i>A. sclerosperma</i>, <i>A. ramulosa</i>. Low shrubs (< 1 m): <i>Atriplex vesicaria</i>, <i>Halosarcia</i> spp., <i>Maireana georgei</i>, <i>M. glomerifolia</i>, <i>M. tomentosa</i>, <i>M. pyramidata</i>, <i>M. atkinsiana</i>, <i>Ptilotus beardii</i>, <i>Frankenia</i> spp.</p>	<p>Vegetation type: Saltbush Shrubland. Palatable perennials include: <i>Atriplex vesicaria</i>, <i>Maireana</i> spp., <i>Ptilotus beardii</i>, <i>Frankenia</i> spp. Pastoral use limitations: Areas not protected by stony surface mantle are highly erodible owing to slope and soil type.</p>
<p>Unit 2: Sandy banks (5%)</p> <p>Wanderrie banks up to 0.5 km long and 200 m wide and sand sheets on narrow margins of system adjacent to higher Sandplain land system. Soils are probably red or brown earthy sands or sandy loams over hardpan or Permian shales with a neutral soil reaction trend.</p>	<p>Scattered or moderately close (PFC 10-30%) mixed grassy shrublands dominated by <i>Acacia ramulosa</i>. Tall shrubs (> 2 m): <i>A. ramulosa</i>, <i>A. sclerosperma</i>. Mid shrubs (1-2 m): <i>Eremophila forrestii</i>, <i>Cassia</i> spp. Low shrubs (< 1 m): <i>Solanum lasiophyllum</i>, <i>Ptilotus</i> spp. Perennial grasses: <i>Monachather paradoxa</i>, <i>Thyridolepis multiculmis</i>.</p>	<p>Vegetation type: Wanderrie Bank Grassy Shrubland. Palatable perennials include: <i>Eremophila forrestii</i>, <i>Ptilotus</i> spp., <i>Monachather paradoxa</i>, <i>Thyridolepis multiculmis</i>. Pastoral use limitations: None with controlled grazing.</p>
<p>Unit 3: Saline stony plains (10%)</p> <p>Gently sloping (< 1%) saline plains below unit 1; usually strewn with a moderately dense quartz mantle; occasional low rounded rises < 10 m also occur. Soils are duplexes, sandy loams over light clays with quartz inclusions throughout the profile; pH 7.0 with a neutral to alkaline trend. Principal profile forms: Dr1.56, Dr2.52, Dr2.53.</p>	<p>Very scattered or scattered (PFC < 20%) low shrublands dominated by <i>Atriplex vesicaria</i> or <i>A. sp.</i> Tall shrubs (> 2 m): <i>Hakea preissii</i>, <i>Acacia</i> sp. (aff. <i>xiphophylla</i>), <i>A. tetragonophylla</i>. Mid shrubs (1-2 m): <i>Eremophila pterocarpa</i>, <i>Cassia phyllodinea</i>. Low shrubs (< 1 m): <i>Atriplex</i> sp., <i>A. vesicaria</i>, <i>Maireana georgei</i>, <i>M. atkinsiana</i>, <i>M. pyramidata</i>, <i>Halosarcia</i> spp., <i>Frankenia</i> spp., <i>Scaevola spinescens</i>, <i>Ptilotus beardii</i>.</p>	<p>1 inventory site, 1 condition site and traversed</p> <p>Vegetation type: Saltbush Shrubland. Palatable perennials include: <i>Atriplex</i> spp., <i>Maireana</i> spp., <i>Frankenia</i> spp., <i>Scaevola spinescens</i>, <i>Ptilotus beardii</i>. Pastoral use limitations: None with controlled grazing.</p>
<p>Unit 4: Alluvial plains (35%)</p> <p>Mostly flat weakly saline alluvial plains with sluggish unchannelled drainage zones. Soils are crusted duplexes, red clayey sands over light clays to hardpan at 50 cm; pH 6.0-8.5 with an alkaline trend. Principal profile form: Dr1.56.</p>	<p>Moderately close (PFC 20-30%) shrublands dominated by <i>Atriplex bunburyana</i> and <i>Maireana pyramidata</i> in the lower storey and <i>Acacia xiphophylla</i> in the tall shrub layer. Trees (to 6 m): <i>A. xiphophylla</i>. Tall shrubs (> 2 m): <i>A. xiphophylla</i>. Mid shrubs (1-2 m): <i>Atriplex bunburyana</i>, <i>Cassia phyllodinea</i>, <i>Eremophila pterocarpa</i>. Low shrubs (< 1 m): <i>Maireana pyramidata</i>, <i>M. georgei</i>, <i>M. tomentosa</i>, <i>Rhagodia drummondii</i>, <i>Enchylaena tomentosa</i>, <i>Lycium australe</i>, <i>Scaevola spinescens</i>, <i>Frankenia</i> spp.</p>	<p>1 inventory site, 1 condition site and traversed</p> <p>Vegetation type: Bluebush or Saltbush Shrublands. Palatable perennials include: <i>Atriplex bunburyana</i>, <i>Maireana</i> spp., <i>Rhagodia drummondii</i>, <i>Enchylaena tomentosa</i>, <i>Lycium australe</i>, <i>Scaevola spinescens</i>, <i>Frankenia</i> spp. Pastoral use limitations: Moderately susceptible to accelerated erosion where degraded.</p>

Holmwood 1.s—continued

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 5: Lower saline plains (40%)</p> <p>Extensive flat saline plains slightly lower than unit 4 with little relief except for intermittent occurrences of low sandy banks. Some ill defined sluggish drainage tracts with little or no channel development. Soils are brown or dark red clayey or duplex types, sands over light or medium heavy clay > 1 m deep; quartz and weathered silcrete fragments common throughout profile: pH 7.0-8.5 with neutral to alkaline reaction trend. Principal profile forms: Dr1.52, Uf6.12.</p>	<p>Moderately close (PFC 20-30%) low shrublands with prominent zonations of dominant halophytes. Tall shrubs (> 2 m): <i>E. pterocarpa</i>, <i>Acacia tetragonophylla</i>, <i>A. sclerosperma</i>. Mid shrubs (1-2 m): <i>E. pterocarpa</i>. Low shrubs (< 1 m): <i>M. atkinsiana</i>, <i>M. amoena</i>, <i>M. platycarpa</i>, <i>M. pyramidata</i>, <i>M. georgei</i>, <i>Atriplex vesicaria</i>, <i>Carpobrotus</i> sp., <i>Frankenia magnifica</i>, <i>Gunnlopsis quadrifidum</i>, <i>Halosarcia</i> spp., <i>Lawrencia squamata</i>, <i>Cratystylis subspinescens</i>, <i>Scaevola spinescens</i>, <i>Ptilotus obovatus</i>, <i>Solanum lasiophyllum</i>, <i>Rhagodia drummondii</i>.</p>	<p>2 inventory sites, 1 condition site and traversed</p> <p>Vegetation type: Mixed Halophyte and Samphire Shrublands. Palatable perennials include: <i>Atriplex vesicaria</i>, <i>Maireana</i> spp., <i>Frankenia</i> spp., <i>Lawrencia squamata</i>, <i>Cratystylis subspinescens</i>, <i>Scaevola spinescens</i>, <i>Ptilotus obovatus</i>, <i>Rhagodia drummondii</i>. Pastoral use limitations: Grazing of highly saline pasture plants requires good quality stock water supplies.</p>

Horseshoe land system (G) 204 km² (0.24% of survey area)

Land type: 5; Pastoral potential: moderate.

Gently undulating stony plains and low rounded hills based on Proterozoic metamorphic rocks, with somewhat saline drainage foci and alluvial tracts; supports scattered mulga and wait-a-while shrublands with halophytes.

Geology: Lower Proterozoic rocks; hematite shale, phyllite and siltstones of the Labouchere and Horseshoe Range formations of the Padbury group; occasional Tertiary calcrete; Quaternary alluvium on lowlands.

Geomorphology: Erosional surfaces; rounded, weathered hills and low rises to 20 m with gently inclined stony footslopes and interfluvies above almost flat pebbly plains with partly internal drainage; flat marginal plains on hardpan, dissected by narrow drainage tracts; overall relief to 25 m but often less.

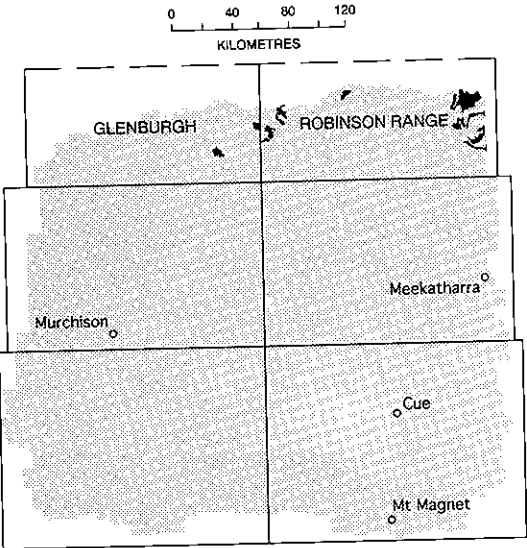
Vegetation and pastoral use: Hills, non-saline slopes and stony hardpan plains support Stony Mulga Mixed Shrubland and Hardpan Mulga Shrubland of low to moderate productivity; lower saline slopes, plains and drainage tracts carry moderately to highly productive Stony Snakewood, Bluebush and Samphire Shrublands, degraded to mainly annuals in overgrazed areas; system generally not susceptible to erosion.

Estimated carrying capacity, good condition: 12 ha/dse.

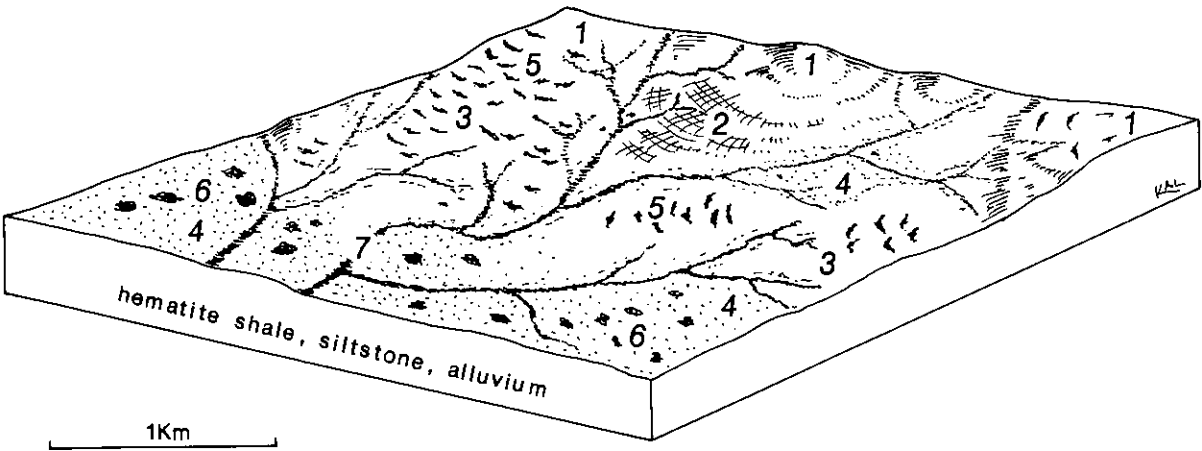
Range condition summary (30 traverse observations):

(a) Erosion status (%)			
Nil	Min.	Mod.	Sev.
100	0	0	0

(b) Vegetation condition (%)		
Good	Fair	Poor
16	47	37



- Unit: 1. Stony plains with low rises.
2. Gravelly plains.
3. Hardpan plains.
4. Saline plains.
5. Groves.
6. Drainage foci.
7. Drainage tracts.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Stony plains with low rises (30%) Gently undulating plains, low rounded rises and low hills to 25 m relief covered with a variable ironstone, quartz or shale mantle. Soils are probably shallow dark red or reddish brown earthy sands or hardpan sandy clay loams.	Very scattered or scattered (PFC < 20%) mixed shrublands dominated by <i>Acacia aneura</i> . Tall shrubs (> 2 m): <i>A. aneura</i> . Mid shrubs (1-2 m): <i>A. aneura</i> , <i>A. quadrimarginea</i> . Low shrubs (< 1 m): <i>Eremophila compacta</i> , <i>Ptilotus obovatus</i> , <i>P. rotundifolius</i> . Perennial grass: <i>Eragrostis eriopoda</i> .	Traversed Vegetation type: Stony Mulga Mixed Shrubland. Palatable perennials include: <i>Eremophila compacta</i> , <i>Ptilotus obovatus</i> , <i>P. rotundifolius</i> , <i>Eragrostis eriopoda</i> . Pastoral use limitations: None under controlled grazing.
Unit 2: Gravelly plains (10%) Gently sloping gravelly surfaced plains occurring as remnants of old surfaces covering high parts of unit 1. Soils are probably gravelly loamy sands to sandy loams.	Scattered tall shrublands dominated by <i>Acacia aneura</i> and <i>A. linophylla</i> .	Traversed Vegetation type: Stony Mulga Mixed Shrubland. Pastoral use limitations: None under controlled grazing.
Unit 3: Hardpan plains (20%) Very gently sloping plains on red-brown hardpan. Soils are shallow hardpan loams locally with sparse quartz mantles, overlying hardpan.	Very scattered (PFC < 10%) mixed shrublands dominated by <i>Eremophila fraseri</i> or <i>Solanum lasiophyllum</i> . Trees (4-6 m): <i>Acacia pruinocarpa</i> , <i>A. aff. citrinoviridis</i> , <i>A. aneura</i> . Tall shrubs (> 2 m): <i>A. aff. citrinoviridis</i> . Mid shrubs (1-2 m): <i>E. fraseri</i> , <i>A. tetragonophylla</i> , <i>Cassia desolata</i> , <i>E. latrobei</i> . Low shrubs (< 1 m): <i>Ptilotus schwartzii</i> , <i>P. rotundifolius</i> , <i>P. obovatus</i> , <i>Solanum lasiophyllum</i> , <i>Rhagodia eremaea</i> .	1 condition site and traversed Vegetation type: Mulga Hardpan Shrubland. Palatable perennials include: <i>Eremophila latrobei</i> , <i>Ptilotus obovatus</i> , <i>P. schwartzii</i> , <i>P. rotundifolius</i> , <i>Rhagodia eremaea</i> . Pastoral use limitations: None under controlled grazing.
Unit 4: Saline plains (25%) Almost flat, saline, low lying plains (slopes < 0.5%) with variable mantles of mixed composition. Soils are hard-setting duplex types, reddish brown or dark red clay loams or sandy clay loams over light clay or light medium clay to 60 cm deep; pH 7.0-8.5 with an alkaline trend. Principal profile forms: Uf6.12, Dr2.53.	Scattered (PFC 10-20%) saline low shrublands dominated by <i>Halosarcia</i> spp. or scattered to moderately close (PFC 10-30%) mixed shrublands on partly saline areas dominated by <i>Acacia cuspidifolia</i> . Trees (2-4 m): <i>A. cuspidifolia</i> . Tall shrubs (> 2 m): <i>Eremophila</i> sp., <i>A. cuspidifolia</i> , <i>A. cuthbertsonii</i> . Mid shrubs (1-2 m): <i>E. sp.</i> , <i>A. cuspidifolia</i> , <i>A. tetragonophylla</i> . Low shrubs (< 1 m): <i>Halosarcia</i> spp., <i>Frankenia</i> spp., <i>Maireana pyramidata</i> , <i>Enchylaena tomentosa</i> , <i>Solanum lasiophyllum</i> .	3 inventory sites and traversed Vegetation type: Stony Snakewood and Samphire Shrublands. Palatable perennials include: <i>Frankenia</i> spp., <i>M. pyramidata</i> , <i>Enchylaena tomentosa</i> . Pastoral use limitations: None under controlled grazing.
Unit 5: Groves (3%) Irregularly shaped densely vegetated groves, situated in lower areas of unit 3 and 7, extending to 0.5 km long and < 200 m wide. Soils are red earths to > 100 cm; pH 6.0-7.0 with a neutral or acidic reaction trend. Principal profile forms: Um5.22, Gn2.12.	Closed woodlands (PFC > 50%) dominated by <i>Acacia aneura</i> . Trees (to 10 m): <i>A. aneura</i> , <i>A. pruinocarpa</i> , <i>Hakea suberea</i> . Tall shrubs (> 2 m): <i>A. kempeana</i> , <i>Canthium latifolium</i> , <i>A. aff. citrinoviridis</i> , <i>A. tetragonophylla</i> , <i>Santalum spicatum</i> . Mid shrubs (1-2 m): <i>Cassia oligophylla</i> , <i>Eremophila compacta</i> , <i>E. forrestii</i> , <i>E. spectabilis</i> , <i>E. latrobei</i> . Low shrubs (< 1 m): <i>Ptilotus obovatus</i> , <i>Spartothamnella teucriflora</i> , <i>Solanum lasiophyllum</i> , <i>Sida</i> spp. Perennial grasses: <i>Chrysopogon fallax</i> , <i>Eragrostis lanipes</i> , <i>Eriachne helmsii</i> .	1 inventory site and traversed Vegetation type: Mulga Grove Woodland. Palatable perennials include: <i>Eremophila forrestii</i> , <i>E. compacta</i> , <i>E. latrobei</i> , <i>Ptilotus obovatus</i> , <i>Sida</i> spp., <i>Chrysopogon fallax</i> , <i>Eragrostis lanipes</i> . Pastoral use limitations: None with controlled grazing.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 6: Drainage foci (< 2%) Restricted shallow non-saline depressions or weakly saline claypans generally < 200 m in diameter, and occurring within units 3 and 4. Soils are probably red clays similar to unit 4 but with a higher clay content.	 Moderately close mixed or low shrublands (PFC 20-30%) dominated by <i>Acacia tetragonophylla</i> ; or claypans bare of vegetation. Trees (4-6 m): <i>A. aneura</i> , <i>Grevillea striata</i> . Tall shrubs (< 2 m): <i>A. tetragonophylla</i> , <i>A. aneura</i> , <i>A. sclerosperma</i> , <i>Eremophila longifolia</i> . Mid shrubs (1-2 m): <i>A. tetragonophylla</i> , <i>Indigofera</i> sp., <i>Spartothamnella teucriflora</i> . Low shrubs (< 1 m): <i>Cassia hamersleyensis</i> , <i>Maireana pyramidata</i> , <i>Solanum lasiophyllum</i> , <i>Enchylaena tomentosa</i> , <i>Ptilotus obovatus</i> , <i>P. lazaridis</i> , <i>S. horridum</i> .	 1 inventory site and traversed Vegetation type: Mulga Grove Woodland or Unvegetated. Palatable perennials include: <i>Cassia hamersleyensis</i> , <i>Maireana pyramidata</i> , <i>Enchylaena tomentosa</i> , <i>Ptilotus lazaridis</i> , <i>P. obovatus</i> . Pastoral use limitations: None with controlled grazing.
Unit 7: Drainage tracts (10%) Gently sloping drainage tracts to 200 m wide, becoming broader downslope (up to 400 m) with transverse grove formations and infrequent channels. Soils are probably deep red earths, loams or clays similar to unit 4.	 Variable mixed shrublands.	 Traversed Vegetation type: Creekline Shrubland or Stony Mulga Mixed Shrubland. Pastoral use limitations: None under controlled grazing.

Jimba land system (G) 36 km² (0.04% of survey area)

Land type: 5; Pastoral potential: moderate.

Gently sloping mainly alluvial plains based on Permian sedimentary rocks with occasional stony plains and low rises, scattered sandy banks and complex saline drainage lines; supports mostly degraded chenopod shrublands with patchy acacia tall shrub layer.

Geology: Permian siltstone, quartz greywacke and shale, mainly of the Artinskian series, with Quaternary alluvium and colluvium.

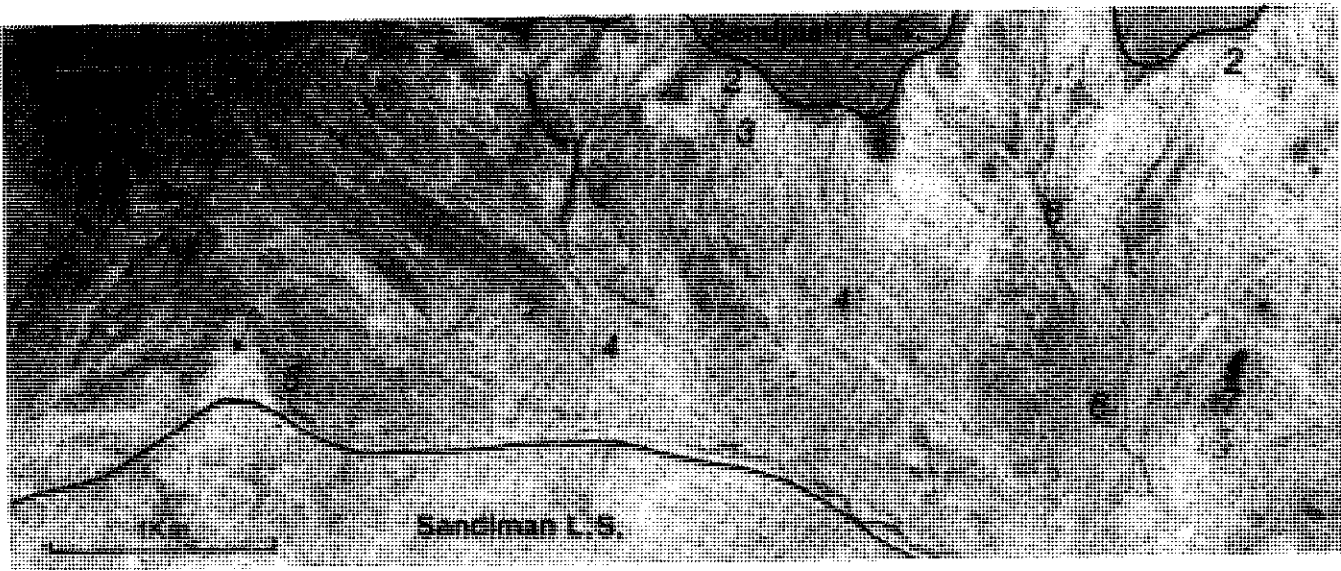
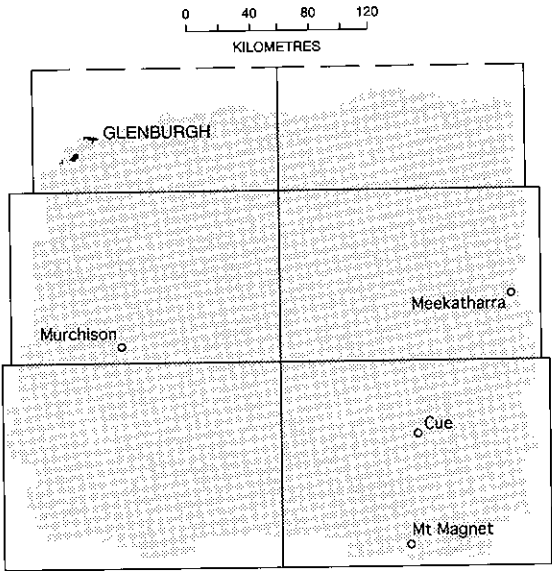
Geomorphology: Erosional and depositional surfaces; ridges and minor low hills above stony footslopes and lower drainage plains with or without light stony mantling; disorganised drainage tracts and low lying plains with large drainage foci; total relief is up to 40 m but mostly < 3 m on lower units.

Vegetation and pastoral use: A very minor system within the area, supporting moderately to highly productive halophytic (bluebush/saltbush) shrublands where in good condition; when degraded to predominantly annual herbage the pastoral value is reduced; parts of the system with unprotected duplex soils (e.g. unit 4) are highly susceptible to accelerated erosion.

Estimated carrying capacity, good condition: 12 ha/dse.

Range condition summary Not sufficiently sampled by traverse; Payne *et al.* (1987) report that in the Carnarvon Basin, 12% was in good condition, 33% fair and 55% in poor condition.

- Unit: 1. Low ridges and stony rises.
2. Upper slopes.
3. Lower slopes.
4. Diffuse drainage plains.
5. Sandy banks.
6. Unchannelled drainage floors.
7. Drainage foci.
8. Channels.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Low ridges and stony rises (15%) Ridges and rounded rises up to 40 m (but usually much less) above lower units, moderate to dense mantle of cobbles and pebbles with some rock outcrop, shallow, reddish brown or red, alkaline sandy loam to sandy clay loam soils.	Scattered (PFC 10-20%) tall shrublands dominated by <i>Acacia xiphophylla</i> with low shrubs dominated by <i>Cassia</i> and <i>Eremophila</i> spp. Tall shrubs (2-3 m): <i>Acacia xiphophylla</i> , <i>A. victoriae</i> , <i>A. tetragonophylla</i> . Low shrubs (< 1 m): <i>Eremophila cuneifolia</i> , <i>E. latrobei</i> , <i>Cassia desolata</i> , <i>C. helmsii</i> , <i>Ptilotus obovatus</i> , <i>Enchylaena tomentosa</i> , <i>Rhagodia eremaea</i> .	Vegetation type: Rocky Hill Mixed Shrubland or Stony Snakewood Shrubland. Palatable perennials include: <i>Ptilotus obovatus</i> , <i>Eremophila latrobei</i> , <i>Enchylaena tomentosa</i> . Pastoral use limitations: None under controlled grazing.
Unit 2: Upper slopes (10%) Short, concave slopes below crests and rises, moderate to dense mantle of cobbles and pebbles, variable depth reddish brown or red alkaline sandy loam to sandy clay loam soils. Principal profile form: Gc1.22.	As for unit 1.	As for unit 1.
Unit 3: Lower slopes (15%) Gentle, sometimes terraced slopes (0.5 to 1.5%) extending for up to 2 km below units 1 and 2, often dissected by shallow, parallel creeklines; moderate mantle of pebbles or gravel, soils are reddish brown or red duplex 70 cm to > 1 m deep, pH 7.0-8.5 with an alkaline trend. Principal profile forms: Dr1.13, Dr4.13.	Scattered (PFC 10-20%) low woodland of <i>Acacia cuspidifolia</i> with <i>Eremophila</i> spp. or low chenopodiaceous shrublands. Trees (4-6 m): <i>Acacia cuspidifolia</i> , <i>Hakea preissii</i> . Tall shrubs (2-3 m): <i>A. xiphophylla</i> . Low shrubs (< 1.5 m): <i>Eremophila cuneifolia</i> , <i>Scaevola spinescens</i> , <i>Ptilotus polakii</i> , <i>Maireana polypterygia</i> , <i>Enchylaena tomentosa</i> , <i>Rhagodia eremaea</i> .	Vegetation type: Stony Snakewood Shrubland. Palatable perennials include: <i>Ptilotus polakii</i> , <i>Maireana polypterygia</i> , <i>Enchylaena tomentosa</i> , <i>Rhagodia eremaea</i> . Pastoral use limitations: None under controlled use.
Unit 4: Diffuse drainage plains (40%) Broad, gently sloping (0.2 to 1.2%) plains receiving sheet and channelled flow, stony mantle absent or sparse; mounded surfaces and zones with parallel or anastomosing gutters, runnels and channels incised up to 1 m; soils are reddish brown, red or dark red, predominantly duplex types mostly > 1 m deep and often with calcrete or gypsiferous inclusions, pH 6.5-8.5 with alkaline reaction trend. Principal profile forms: Dr1.12, Dr1.13, Dr1.53, Dr2.12, Dr4.12.	Very scattered to scattered (PFC < 20%) tall and low shrublands dominated by <i>Acacia victoriae</i> , <i>Cassia</i> spp., <i>Eremophila</i> spp. or chenopods. Trees (2-4 m): <i>Acacia cuspidifolia</i> . Tall shrubs (2-4 m): <i>A. victoriae</i> , <i>A. xiphophylla</i> , <i>A. tetragonophylla</i> . Low shrubs (< 1 m): <i>Cassia desolata</i> , <i>Eremophila cuneifolia</i> , <i>E. pterocarpa</i> , <i>Ptilotus polakii</i> , <i>P. obovatus</i> , <i>Maireana polypterygia</i> , <i>M. pyramidata</i> , <i>Atriplex bunburyana</i> , <i>Scaevola spinescens</i> , <i>Enchylaena tomentosa</i> , <i>Solanum lasiophyllum</i> . Perennial grasses: <i>Eragrostis xerophila</i> , <i>Enteropogon acicularis</i> .	Vegetation type: Stony Snakewood or Saltbush/Bluebush Shrublands. Palatable perennials include: <i>Ptilotus polakii</i> , <i>Maireana polypterygia</i> , <i>M. pyramidata</i> , <i>Atriplex bunburyana</i> , <i>Enchylaena tomentosa</i> . Pastoral use limitations: Highly susceptible to accelerated erosion when degraded, susceptible to shrub invasion by <i>Acacia victoriae</i> , <i>A. cuspidifolia</i> .
Unit 5: Sandy banks (10%) Linear banks up to 500 m long and 50 m wide arranged transverse and elongate to water flow on unit 4, hummocky surfaces up to 2 m above surrounding plains, reddish brown or red loamy sand soils > 1 m deep, pH 6.0-7.5. Principal profile forms: Uc1.21, Uc5.21.	Scattered (PFC 10-20%) tall shrublands dominated by <i>Acacia ramulosa</i> , <i>A. sclerosperma</i> and other <i>Acacia</i> spp. Trees (infrequent): <i>Acacia cuspidifolia</i> . Tall shrubs (2-4 m): <i>Acacia ramulosa</i> , <i>A. sclerosperma</i> , <i>A. tetragonophylla</i> , <i>A. wiseana</i> , <i>A. victoriae</i> , <i>Stylobasium spathulatum</i> , <i>Hakea preissii</i> . Low shrubs (< 1.5 m): <i>Cassia helmsii</i> , <i>C. desolata</i> , <i>Rhagodia eremaea</i> , <i>Scaevola spinescens</i> , <i>Enchylaena tomentosa</i> , <i>Corchorus walcottii</i> , <i>Pimelea microcephala</i> . Perennial grasses: <i>Eragrostis eriopoda</i> , <i>Cenchrus ciliaris</i> , <i>Triodia</i> sp.	Vegetation type: Sandplain Acacia Shrubland. Palatable perennials include: <i>Enchylaena tomentosa</i> , <i>Rhagodia eremaea</i> , <i>Scaevola spinescens</i> , <i>Eragrostis eriopoda</i> , <i>Cenchrus ciliaris</i> . Pastoral use limitations: Slight susceptibility to erosion when vegetation degraded.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 6: Unchannelled drainage floors (6%)</p> <p>Stable unchannelled drainage zones up to 500 m wide with slopes < 0.5%, soils are duplex or clay types > 1 m deep, pH 7.0-8.0. Principal profile forms: Dr4.12, Uf6.33.</p>	<p>Moderately close <i>Acacia</i> woodland with tussock grass understorey; also tussock grasslands with sparse shrubs. Trees (4-6 m): <i>Acacia subtessarogona</i>. Tall shrubs: <i>Acacia farnesiana</i>, <i>A. sclerosperma</i>. Low shrubs: <i>Cassia luerseii</i>, <i>C. helmsii</i>, <i>Scaevola spinescens</i>, <i>Rhagodia eremaea</i>. Perennial grasses: <i>Eragrostis xerophila</i>, <i>Eriachne benthamii</i>, <i>Chrysopogon fallax</i>, <i>Eulalia fulva</i>, some introduced <i>Cenchrus ciliaris</i>, <i>C. setiger</i> with basal cover 1 to 5%.</p>	<p>Vegetation type: Creekline Grassy Shrubland. Palatable perennials include: <i>Scaevola spinescens</i>, <i>Rhagodia eremaea</i>, and perennial grasses. Pastoral use limitations: None under controlled grazing.</p>
<p>Unit 7: Drainage foci (2%)</p> <p>Discrete elliptical drainage foci up to 300 m in length by 100 m wide sparsely distributed over units 3 and 4, soils are reddish brown duplex types > 1 m deep, pH 7.0. Principal profile form: Dr1.12.</p>	<p>Close (PFC 30-50%) tall shrublands with <i>Acacia tetragonophylla</i> and numerous other <i>Acacia</i> spp. and numerous low shrubs. Trees (6-8 m): <i>Acacia citrinoviridis</i>, <i>A. coriacea</i>. Tall shrubs (4-6 m): <i>Acacia tetragonophylla</i>, <i>A. xiphophylla</i>, <i>A. victoriae</i>, <i>A. sclerosperma</i>, <i>Heterodendrum oleaefolium</i>. Low shrubs (< 2 m): <i>Cassia desolata</i>, <i>C. helmsii</i>, <i>C. chatelainiana</i>, <i>Eremophila cuneifolia</i>, <i>E. latrobei</i>, <i>Rhagodia eremaea</i>, <i>Enchylaena tomentosa</i>, <i>Ptilotus obovatus</i>, <i>Pimelea microcephala</i>, <i>Maireana planifolia</i>. Perennial grasses: <i>Cenchrus ciliaris</i> (basal cover 1 to 3%) <i>Enteropogon acicularis</i>, <i>Chrysopogon fallax</i>.</p>	<p>Vegetation type: Creekline Grassy Shrubland. Palatable perennials include: <i>Cassia chatelainiana</i>, <i>Rhagodia eremaea</i>, <i>Eremophila latrobei</i>, <i>Enchylaena tomentosa</i>, <i>Ptilotus obovatus</i> and perennial grasses. Pastoral use limitations: None under controlled grazing.</p>
<p>Unit 8: Channels (2%)</p> <p>Major channels and creeks, usually < 30 m wide and incised up to 3 m, sandy banks and bedloads.</p>	<p>Banks support moderately close tall shrublands or low woodlands <i>Acacia citrinoviridis</i>, <i>A. subtessarogona</i>, <i>A. tetragonophylla</i>, <i>Eucalyptus coolabah</i> with numerous low shrubs and grasses as for unit 7.</p>	<p>Vegetation type: Creekline Grassy Shrubland. Palatable perennials include: As for unit 7. Pastoral use limitations: None under controlled grazing.</p>

Jundee land system (W) 1346 km² (1.57% of survey area)

Land type: 14; Pastoral potential: low.
Hardpan wash plains with variable dark gravelly mantling and weakly groved vegetation; minor sandy banks; supports scattered mulga shrublands.

Geology: Cemented Quaternary alluvium derived mainly from greenstone.

Geomorphology: Depositional surfaces carrying sheet drainage; broad plains with variable, but frequently dense, mantles of gravel and pebbles and occasional small groves and sandy banks; higher marginal stony plains on weathered greenstones; drainage tracts receiving more concentrated flow and with some gutters and channels. Relief mostly < 10 m.

Vegetation and pastoral use: Mainly Hardpan Mulga Shrubland of low to moderate productivity; groves and drainage tracts receive more lasting soil moisture for plant growth than wash plains; palatable perennials widely reduced through overgrazing; concentrated drainage zones are mildly susceptible to accelerated erosion when degraded; hardpan plains otherwise not normally susceptible to erosion unless severely degraded.

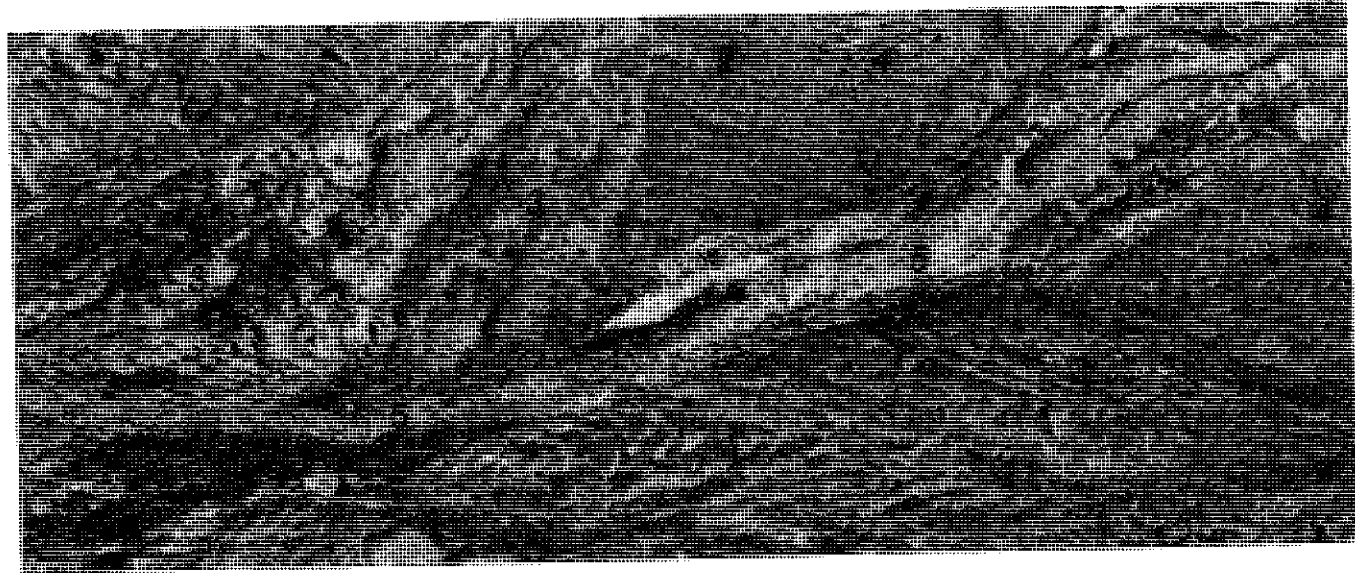
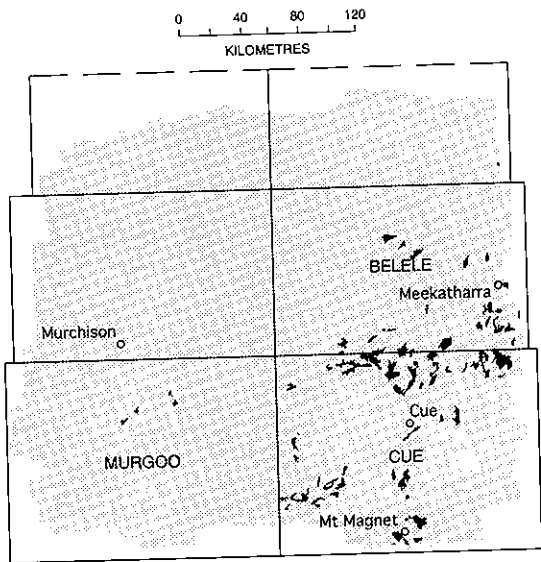
Estimated carrying capacity, good condition: 20 ha/dse.

Range condition summary (328 traverse observations):

(a) Erosion status (%)			
Nil	Min.	Mod.	Sev.
91	7	2	0

(b) Vegetation condition (%)		
Good	Fair	Poor
16	34	50

- Unit: 1. Isolated sandy banks.
2. Stony plains.
3. Hardpan plains.
4. Groves.
5. Drainage tracts.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 1: Isolated sandy banks (5%)</p> <p>Low sandy banks (usually < 0.5 m high) arranged either in a linear or reticulate pattern; extending up to 1 km long and 100 m wide on unit 3. Soils are red earths with ironstone gravel throughout profile overlying hardpan at about 60 cm deep; pH 5.5 with either acidic or neutral reaction trend. Principal profile form: Um5.22.</p>	<p>Scattered to moderately close (PFC 10-30%) mixed shrublands dominated by <i>Acacia aneura</i>, <i>Eremophila forrestii</i> or <i>E. fraseri</i>. Trees (4-6 m): <i>A. aneura</i>. Tall shrubs (> 2 m): <i>A. aneura</i>, <i>Canthium latifolium</i>, <i>C. lineare</i>. Mid shrubs (1-2 m): <i>E. forrestii</i>, <i>E. fraseri</i>, <i>E. tetragonophylla</i>, <i>A. ramulosa</i>. Low shrubs (< 1 m): <i>E. fraseri</i>, <i>E. granitica</i>, <i>Solanum lasiophyllum</i>, <i>Sida calyxhymenia</i>, <i>Ptilotus schwartzii</i>. Perennial grasses: <i>Eriachne helmsii</i>, <i>Eragrostis eriopoda</i>, <i>E. lanipes</i>, <i>Monachather paradoxa</i>.</p>	<p>2 inventory sites and traversed</p> <p>Vegetation type: Wanderrrie Bank Grassy Shrubland. Palatable perennials include: <i>Sida calyxhymenia</i>, <i>Ptilotus schwartzii</i>, <i>Eremophila forrestii</i>, <i>Eragrostis eriopoda</i>, <i>E. lanipes</i>, <i>Monachather paradoxa</i>. Pastoral use limitations: None with controlled grazing.</p>
<p>Unit 2: Stony plains (10%)</p> <p>Broad, gently sloping plains (< 1%) on weathered metamorphic rocks, with a dense or moderately dense ironstone mantle. Soils are red earths or hardpan loams to 70 cm deep; pH 5.0-5.5 with an acidic or neutral trend. Principal profile forms: Um5.51, Uc5.11.</p>	<p>Very scattered or scattered (PFC < 20%) mixed shrublands dominated by <i>Acacia aneura</i>. Trees (4-6 m): <i>A. aneura</i>, <i>A. pruinocarpa</i>, <i>Brachychiton gregorii</i>. Tall shrubs (> 2 m): <i>A. aneura</i>, <i>Canthium lineare</i>, <i>C. latifolium</i>. Mid shrubs (1-2 m): <i>A. aneura</i>, <i>Eremophila latrobei</i>, <i>A. tetragonophylla</i>, <i>A. ramulosa</i>. Low shrubs (< 1 m): <i>Ptilotus schwartzii</i>, <i>Maireana convexa</i>, <i>Solanum lasiophyllum</i>. Perennial grasses: <i>Monachather paradoxa</i>, <i>Eragrostis eriopoda</i>.</p>	<p>4 inventory sites, 6 condition sites and traversed</p> <p>Vegetation types: Stony Mulga Mixed Shrubland. Palatable perennials include: <i>Ptilotus schwartzii</i>, <i>Eremophila latrobei</i>, <i>Maireana convexa</i>, <i>Monachather paradoxa</i>, <i>Eragrostis eriopoda</i>. Pastoral use limitations: None with controlled grazing. Vegetation condition %: VG/G 29, F 41, P/VP 30. 63 obs.</p>
<p>Unit 3: Hardpan plains (60%)</p> <p>Extensive uniform flat plains (slopes < 0.3%) with mantles of ironstone pebbles and carrying sheet flow to units 4 and 5. Soils are dark red hardpan sandy clay loams or shallow red earths generally overlying hardpan at < 50 cm; pH 6.5-7.0 with a neutral trend. Principal profile forms: Um5.51, Um5.31.</p>	<p>Very scattered to scattered (PFC < 20%) mixed shrublands or moderately close (PFC 20-30%) low woodlands dominated by <i>Acacia aneura</i>. Trees (4-8 m): <i>A. aneura</i>, <i>A. pruinocarpa</i>. Tall shrubs (> 2 m): <i>A. aneura</i>, <i>Canthium latifolium</i>, <i>C. lineare</i>. Mid shrubs (1-2 m): <i>A. aneura</i>, <i>A. craspedocarpa</i>, <i>A. ramulosa</i>, <i>A. tetragonophylla</i>. Low shrubs (< 1 m): <i>Ptilotus schwartzii</i>, <i>Solanum lasiophyllum</i>, <i>Eremophila punicea</i>, <i>Sida sp.</i>, <i>E. latrobei</i>, <i>Rhagodia eremaea</i>, <i>Spartothamnella teucriflora</i>. Perennial grasses: <i>Monachather paradoxa</i>, <i>E. eriopoda</i>.</p>	<p>3 inventory sites, 26 condition sites and traversed</p> <p>Vegetation type: Hardpan Mulga Shrubland. Perennials of variable quantity and quality supplemented by annual forbs and grasses in good seasons. Palatable perennials include: <i>Ptilotus schwartzii</i>, <i>Eremophila latrobei</i>, <i>Rhagodia eremaea</i>, <i>Maireana convexa</i>, <i>Monachather paradoxa</i>, <i>M. planifolia</i>. Pastoral use limitations: Mildly susceptible to erosion when degraded. Vegetation condition %: VG/G 15, F 30, P/VP 55. Erosion incidence %: min 6. 223 obs.</p>
<p>Unit 4: Groves (5%)</p> <p>Narrow, elliptical grove formations (up to 100 m wide and 400 m long) arranged transversely to direction of flow on unit 3. Soils are red earths to 1 m deep; pH 6.0-7.0 with an acidic or neutral trend. Principal profile forms: Um1.43, Um5.52.</p>	<p>Moderately close to closed (PFC 20- > 50%) woodlands dominated by <i>Acacia aneura</i>. Trees (to 8 m): <i>A. aneura</i>, <i>A. pruinocarpa</i>. Tall shrubs (> 2 m): <i>A. aneura</i>, <i>Canthium latifolium</i>, <i>C. lineare</i>. Mid shrubs (1-2 m): <i>A. aneura</i>, <i>Eremophila forrestii</i>, <i>E. gilesii</i>, <i>E. fraseri</i>, <i>E. latrobei</i>. Low shrubs (< 1 m): <i>Solanum lasiophyllum</i>, <i>E. georgei</i>, <i>Sida sp.</i>, <i>Ptilotus obovatus</i>. Perennial grasses: <i>Eragrostis eriopoda</i>, <i>Monachather paradoxa</i>.</p>	<p>2 inventory sites and traversed</p> <p>Vegetation type: Mulga Grove Woodland. Palatable perennials include: <i>Eremophila forrestii</i>, <i>E. latrobei</i>, <i>Ptilotus obovatus</i>, <i>Sida sp.</i>, <i>Canthium spp.</i>, <i>Monachather paradoxa</i>. Pastoral use limitations: None with controlled grazing.</p>

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 5: Drainage tracts (20%)</p> <p>Gently sloping (< 0.5%) drainage zones often with central rills, gutters and channels; occasionally saline particularly on calcareous sites. Soils are dark red hardpan types or red clays over hardpan at about 50 cm, with lateritic gravel throughout profile (sometimes over calcrete); pH 6.5-9.0 with neutral or alkaline trend. Principal profile forms: Um5.31, Uf6.12.</p>	<p>Scattered low shrublands (PFC 10-20%) on saline sites dominated by <i>Maireana pyramidata</i> or dense mixed woodlands dominated by <i>Acacia aneura</i> or <i>Grevillea striata</i>. Trees (to 6 m): <i>A. aneura</i>, <i>A. pruinocarpa</i>, <i>G. striata</i>, <i>Hakea suberea</i>. Tall shrubs (> 2 m): <i>A. victoriae</i> (on saline sites), <i>A. aneura</i>, <i>A. tetragonophylla</i>, <i>A. sclerosperma</i>. Mid shrubs (1-2 m): <i>A. victoriae</i>, <i>Eremophila fraseri</i>. Low shrubs (< 1 m): <i>M. pyramidata</i>, <i>Ptilotus obovatus</i>, <i>Lycium australe</i>. Perennial grass: <i>Eriachne flaccida</i>.</p>	<p>2 inventory sites and traversed</p> <p>Vegetation type: Creekline Grassy Shrubland or Bluebush shrubland (on saline sites). Palatable perennials include: <i>Maireana pyramidata</i>, <i>Ptilotus obovatus</i>, <i>Lycium australe</i>, <i>Eriachne flaccida</i>. Pastoral use limitations: Moderately susceptible to accelerated water erosion where perennials are degraded. Vegetation condition %: VG/G 7, F 21, P/VP 72. Erosion incidence %: min 36, mod 21, sev 4.</p>

Kalli land system (W) 6097 km² (7.10% of survey area)

Land type: 10; Pastoral potential: low (locally moderate).

Elevated, gently undulating red sandplains edged by stripped surfaces on laterite and granite; tall acacia shrublands and understorey of wanderrie grasses (and spinifex locally); replaced by more extensive areas of Bullimore land system to the south-east and Sandplain land system to the west.

Geology: Quaternary aeolian sand derived from Archaean gneiss and granite, overlying Tertiary laterite.

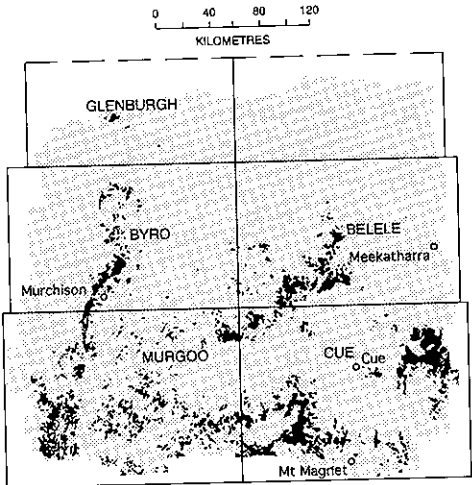
Geomorphology: Fragmented 'old plateau' depositional surfaces overlying mainly granites; broad, gently undulating sandplains high in the landscape, with occasional low linear dunes, and edged by exposed laterite and other stripped surfaces; infrequent drainage, mostly diffuse and internal, but with some broad lightly stripped tracts with groved vegetation draining onto wash systems below the old plateau. Overall relief mainly about 10 m or less.

Vegetation and pastoral use: Poorly to moderately productive Sandplain Wanderrie Grassy Shrublands with minor Lateritic Acacia Shrubland; some areas apparently inherently deficient in wanderrie grasses, regardless of condition; other areas (e.g. in far south-west) dominated by poorly productive Sandplain Acacia Shrubland; supports Sandplain Mallee-Acacia-Spinifex locally in the south. System not normally susceptible to accelerated erosion when degraded, although undrained vehicular tracks cause local gulying on steeper gradients.

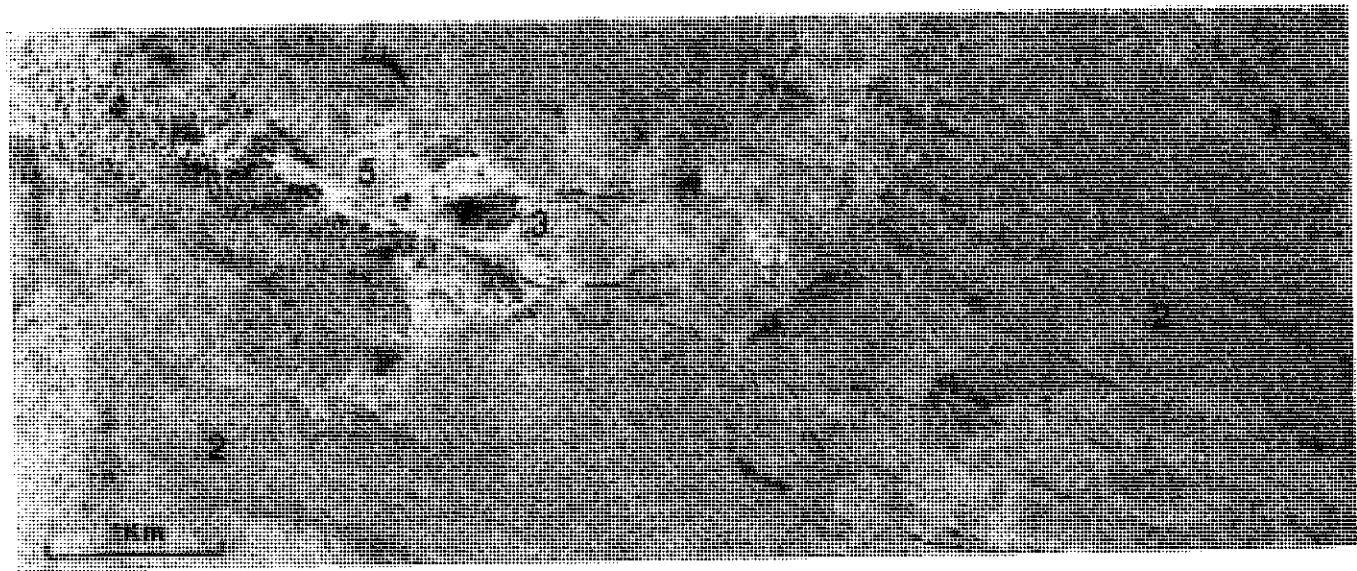
Estimated carrying capacity, good condition: 20 ha/dse.

Range condition summary (704 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
99	1	0	0	40	42	18



- Unit: 1. Sand dunes.
2. Sand plains.
3. Lateritic plains.
4. Groved drainage tracts.
5. Stripped stony surfaces.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 1: Sand dunes (< 2%)</p> <p>Sand dunes up to 200 m wide, 6 m high and 2 km in length. Soils are dark red, deep earthy or siliceous sands, pH 6.0 with an acidic reaction trend. Principal profile forms: Uc1.23, Uc5.21.</p>	<p>Scattered to moderately close (PFC 20-30%) woodlands or tall shrublands dominated by <i>Acacia ramulosa</i> and <i>Eucalyptus oldfieldii</i>. Trees: <i>E. oldfieldii</i>, <i>A. aneura</i>, <i>Santalum lanceolatum</i>. Tall shrubs (> 2 m): <i>A. ramulosa</i>, <i>A. aneura</i>. Mid shrubs (1-2 m): <i>Eremophila forrestii</i>, <i>E. georgei</i>, <i>E. granitica</i>, <i>Grevillea eriostachya</i>. Low shrubs (< 1 m): <i>Thryptomene</i> sp. Perennial grasses: <i>Monachather paradoxa</i>, <i>Stipa elegantissima</i>.</p>	<p>1 inventory site and traversed</p> <p>Vegetation type: Sand Dune Shrubland. Palatable perennials include: <i>Eremophila forrestii</i>, <i>Monachather paradoxa</i>, <i>Stipa elegantissima</i>. Pastoral use limitations: Susceptible to wind erosion if denuded of vegetation.</p>
<p>Unit 2: Sand plains (78%)</p> <p>Extensive, gently sloping (< 1%) or gently undulating sand plains with local relief to 5 m. Soils are dark red to yellowish red earthy or loamy sands, pH 5.5-6.0 with an acidic reaction trend, depth mostly > 1 m, occasionally overlying ferruginous gravels at < 1 m. Principal profile forms: Uc5.21, Uc5.22.</p>	<p>Moderately close to close (PFC 20-50%) tall shrublands dominated by <i>Acacia ramulosa</i>. Trees: <i>Acacia aneura</i>, <i>Callitris columellaris</i>, <i>Eucalyptus leptopoda</i>, <i>E. kingsmillii</i>. Tall shrubs > 2 m): <i>A. ramulosa</i>, <i>A. aneura</i>, <i>A. murrayana</i>, <i>Grevillea eriostachya</i>, <i>A. cuthbertsonii</i>, <i>A. kempeana</i>. Mid shrubs (1-2 m): <i>A. aff. coolgardiensis</i>, <i>A. ramulosa</i>, <i>A. tetragonophylla</i>, <i>A. acuminata</i>, <i>A. aff. adsurgens</i>, <i>Eremophila forrestii</i>. Low shrubs (< 1 m): <i>Eremophila forrestii</i>, <i>E. gilesii</i>, <i>E. margarethae</i>, <i>E. granitica</i>, <i>E. georgei</i>, <i>E. spectabilis</i>, <i>Ptilotus obovatus</i>, <i>Thryptomene decussata</i>, <i>Hakea</i> sp. Perennial grasses: <i>Thyridolepis multiculmis</i>, <i>Monachather paradoxa</i>, <i>Eriachne helmsii</i>, <i>Eragrostis eriopoda</i>, <i>Triodia</i> sp., <i>Plectrachne melvillei</i>.</p>	<p>14 inventory sites, 67 condition sites and traversed</p> <p>Vegetation type: Sandplain Wanderrie Grassy Shrubland and Sandplain Acacia Shrubland. Palatable perennials include: <i>Thyridolepis multiculmis</i>, <i>Monachather paradoxa</i>, <i>Eremophila forrestii</i>, <i>Ptilotus obovatus</i>, <i>P. schwartzii</i>, <i>Maireaana aff. villosa</i>. Pastoral use limitations: None under controlled grazing. Vegetation condition %: VG/G 48, F 37, P/VP 15. 538 obs.</p>
<p>Unit 3: Lateritic plains (10%)</p> <p>Gently sloping (< 1%) plains with moderately dense mantles of ironstone and lateritic gravels and pebbles. Soils are reddish or red brown, gravelly sandy loams or clayey sands of variable depth over laterite or deeply weathered granite; laterite gravels occur throughout the profile, pH 6.0 with an acidic reaction trend. Principal profile forms: Uc5.21, Um1.43, Um5.51.</p>	<p>Very scattered to moderately close (PFC < 30%) tall shrublands dominated by <i>Acacia ramulosa</i>, <i>A. aneura</i> or <i>A. grasbyi</i>. On very shallow soils over laterite or deeply weathered granite, <i>A. grasbyi</i> and <i>Thryptomene decussata</i> dominate while on deeper sandy soils <i>A. ramulosa</i> is dominant. Trees (2-4 m): <i>A. aneura</i>. Tall shrubs (> 2 m): <i>A. aneura</i>, <i>A. ramulosa</i>, <i>A. grasbyi</i>, <i>A. quadrimarginea</i>. Mid shrubs (1-2 m): <i>A. aneura</i>, <i>Thryptomene decussata</i>, <i>Eremophila forrestii</i>. Low shrubs (< 1 m): <i>Ptilotus schwartzii</i>, <i>T. decussata</i>, <i>Eremophila latrobei</i>, <i>Sida rohlenae</i>. Perennial grasses: <i>Monachather paradoxa</i>, <i>Thyridolepis multiculmis</i>.</p>	<p>3 inventory sites and traversed</p> <p>Vegetation type: Granitic Mulga Shrubland. Palatable perennials include: <i>Ptilotus schwartzii</i>, <i>Eremophila latrobei</i>, <i>E. compacta</i>. Pastoral use limitations: None under controlled grazing. Vegetation condition %: VG/G 10, F 54, P/VP 36. 72 obs.</p>

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 4: Drainage tracts with groves and intergroves (5%)	<p>a) Groves; Closed woodlands (PFC > 50%) dominated by <i>Acacia aneura</i>, <i>A. ramulosa</i> and <i>A. craspedocarpa</i>. Trees (4-6 m): <i>A. aneura</i>. Tall shrubs (> 2 m): <i>A. aff. citrinoviridis</i>, <i>A. craspedocarpa</i>, <i>A. ramulosa</i>, <i>A. tetragonophylla</i>. Mid shrubs (1-2 m): <i>A. craspedocarpa</i>, <i>A. daviesoides</i>. Low shrubs (< 1 m): <i>Maireana villosa</i>, <i>Rhagodia eremaea</i>, <i>Ptilotus obovatus</i>, <i>Solanum lasiophyllum</i>. Perennial grass: <i>Stipa</i> spp.</p> <p>b) Intergroves; Scattered shrublands (PFC 10-20%) dominated by <i>Acacia aneura</i>. Trees: <i>A. aneura</i>. Tall shrubs (> 2 m): <i>A. aneura</i>. Mid shrubs (1-2 m): <i>A. craspedocarpa</i>, <i>Rhagodia eremaea</i>. Low shrubs (< 1 m): <i>Maireana lanosa</i>, <i>M. triptera</i>, <i>Ptilotus obovatus</i>, <i>Solanum lasiophyllum</i>.</p>	4 inventory sites, 3 condition sites and traversed
<p>Gently sloping broad fans and unchannelled drainage tracts, with areas of sheet flow up to 200 m wide (between groves) and 2 km in length. Some sites have sparse gravelly surface mantles. Soils are red earths, sandy clay loams and clay loams 0.6 to > 1 m deep, pH 5.5 with an acidic reaction trend. Principal profile form: Um5.52.</p>	<p>Very scattered (PFC < 10%) low or mid shrublands. Trees: <i>A. aneura</i>. Tall shrubs (> 2 m): <i>A. aneura</i>. Mid shrubs (1-2 m): <i>A. grasbyi</i>, <i>A. victoriae</i>, <i>A. tetragonophylla</i>, <i>Eremophila latrobei</i>, <i>E. platycalyx</i>. Low shrubs (< 1 m): <i>A. grasbyi</i>, <i>Ptilotus obovatus</i>, <i>Cassia sturtii</i>, <i>C. helmsii</i>, <i>Solanum lasiophyllum</i>, <i>Calytrix</i> spp. <i>Borya nitida</i>, <i>Thryptomene</i> spp.</p>	1 inventory site and traversed
Unit 5: Stripped stony surfaces (5%)	<p>Gently sloping stony plains with outcrops of ferricrete, silcrete and weathered granite and a moderately dense mantle of silcrete or ironstone gravels, pebbles and rocks; locally with low breakaways. Soils are very shallow, dark red earths overlying silcrete or laterite. Principal profile form: Um5.51.</p>	<p>Vegetation type: Has similarities to Stony Mulga Mixed Shrubland. Palatable shrubs include: <i>Ptilotus obovatus</i>, <i>P. schwartzii</i>. Pastoral use limitations: None under controlled grazing.</p>

Koonmarra land system (W) 5335 km² (6.21% of survey area)

Land type: 3; **Pastoral potential:** low.

Quartz-strewn stony plains and low rises with outcropping granite, gneiss and schists; supports scattered mulga and other mainly non-saline shrubs.

Geology: Gneiss and granite of Archaean age, with occasional quartz intrusives; mostly covered by Quaternary colluvium and minor alluvium.

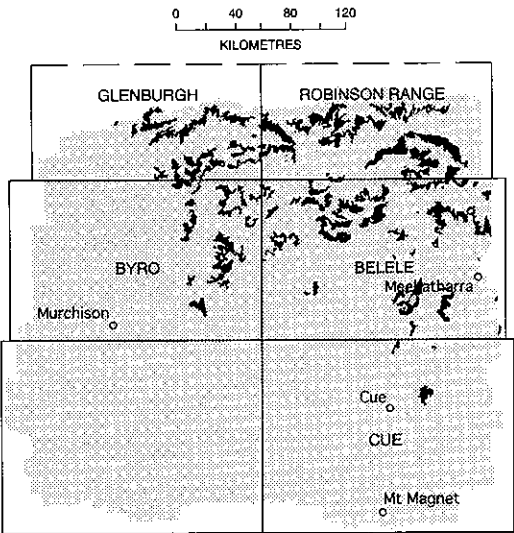
Geomorphology: Mostly erosional surfaces; broad stony plains and interfluves up to 3 km in extent with occasional rounded stony rises with rock outcrop to 10 m above plains; through going dendritic to sub-parallel drainage tracts with occasional channels; overall relief mostly < 10 m.

Vegetation and pastoral use: Predominantly Stony Mulga Mixed Shrubland of low productivity with sparse palatable perennials including small bluebushes when in good condition; not normally susceptible to accelerated erosion, even where severely degraded, except for minor accelerated streamline erosion along major drainage tracts.

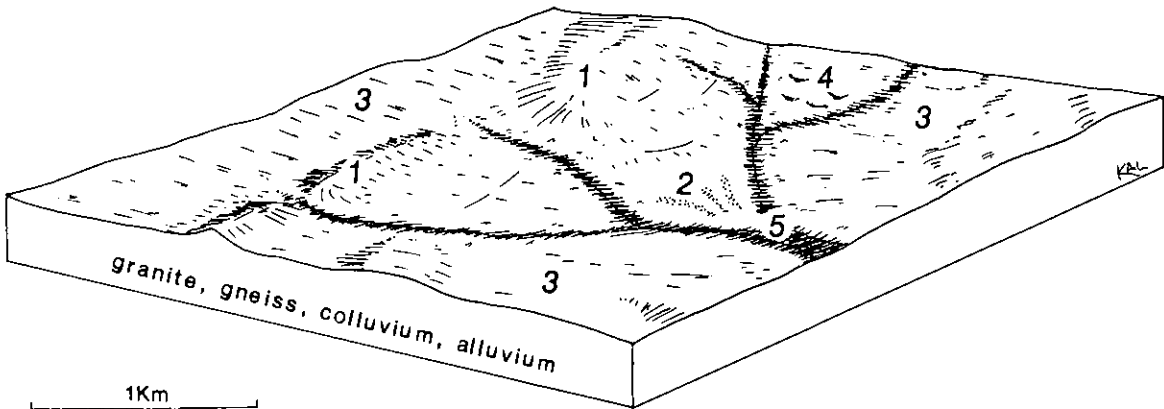
Estimated carrying capacity, good condition: 20 ha/dse.

Range condition summary (696 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
96	4	0	0	10	32	58



- Unit: 1. Low ridges and rises.
2. Sandy banks.
3. Stony plains and interfluves.
4. Mulga groves.
5. Drainage floors and channels.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 1: Low ridges and rises (8%)</p> <p>Ridges and low rises with dense mantles and frequent outcrops of gneiss, granite or quartz; relief to 10 m; occasional hills to 30 m. Soils are dark red stony lithosols to 10 cm deep, overlying parent material; pH 6.0-6.5 with a neutral trend. Principal profile form: Um5.41.</p>	<p>Very scattered (PFC < 10%) mixed shrublands often dominated by low <i>Acacia victoriae</i>. Tall shrubs (> 2 m): <i>A. aneura</i>, <i>A. xiphophylla</i>. Mid shrubs (1-2 m): <i>A. tetragonophylla</i>, <i>A. victoriae</i>, <i>Cassia desolata</i>, <i>Eremophila spathulata</i>. Low shrubs (< 1 m): <i>A. victoriae</i>, <i>Ptilotus rotundifolius</i>, <i>Solanum lasiophyllum</i>, <i>Eremophila freelingii</i>.</p>	<p>1 inventory site, 6 condition sites and traversed</p> <p>Vegetation type: Stony Mulga Mixed Shrubland. Palatable perennials include: <i>Ptilotus</i> spp. <i>Eremophila compacta</i>. Pastoral use limitations: None under controlled grazing. Vegetation condition %: VG/G 0, F 29, P/VP 71. 21 obs.</p>
<p>Unit 2: Sandy banks (< 2%)</p> <p>Infrequent low sandy banks < 300 m long and 100 m wide, usually < 1 m high and in reticulate patterns although occasionally more transverse to the direction of flow. Soils are probably deep earthy sands.</p>	<p>Scattered to moderately close (PFC 10-30%) mixed grassy shrublands characterised by tall shrubs <i>Acacia aneura</i>, <i>A. ramulosa</i>, mid and low shrubs <i>Eremophila margarethae</i>, <i>E. forrestii</i>, <i>Ptilotus obovatus</i>, and perennial grasses <i>Monachather paradoxa</i>, <i>Eriachne helmsii</i>, <i>Eragrostis lanipes</i>.</p>	<p>1 condition site and traversed</p> <p>Vegetation type: Wanderrie Bank Grassy Shrubland. Palatable perennials include: <i>Eremophila forrestii</i>, <i>Ptilotus obovatus</i>, <i>Monachather paradoxa</i>. Pastoral use limitations: None with controlled grazing.</p>
<p>Unit 3: Stony plains and interfluves (80%)</p> <p>Extensive, gently rounded interfluves with slopes < 1% and relief to 3 m; up to 2 km in width and > 3 km in length. Generally mantled with moderately dense to dense quartz, gneiss or granite pebbles and gravels. Soils are dark red hardpan loams or red earths overlying gneiss or granite (locally with veneers of red-brown hardpan) at < 30 cm; pH 5.5-7.0 with variable reaction trends. Principal profile forms: Um5.31, Um5.51.</p>	<p>Very scattered to scattered (PFC < 20%) low or mixed shrublands dominated by associations of <i>Acacia</i>, <i>Eremophila</i>, and <i>Ptilotus</i> species. Trees (to 6 m): <i>A. aneura</i>, <i>A. pruinocarpa</i>. Tall shrubs (> 2 m): <i>A. aneura</i>, <i>A. victoriae</i>, <i>Eremophila fraseri</i>, <i>Canthium lineare</i>, <i>A. tetragonophylla</i>. Mid shrubs (1-2 m): <i>E. spathulata</i>, <i>A. aneura</i>, <i>A. aff. quadrimarginea</i>, <i>E. macmillaniana</i>, <i>E. aff. latrobei</i>, <i>C. helmsii</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>P. rotundifolius</i>, <i>P. schwartzii</i>, <i>C. desolata</i>, <i>C. helmsii</i>, <i>Maireana triptera</i>, <i>M. georgei</i>, <i>M. convexa</i>, <i>M. planifolia</i>, <i>M. melanocoma</i>, <i>Solanum lasiophyllum</i>, <i>Rhagodia eremaea</i>.</p>	<p>6 inventory sites, 84 condition sites and traversed</p> <p>Vegetation type: Stony Mulga Mixed Shrubland. Palatable perennials include: <i>Maireana georgei</i>, <i>M. planifolia</i>, <i>M. convexa</i>, <i>M. melanocoma</i>, <i>Ptilotus obovatus</i>, <i>P. schwartzii</i>, <i>P. rotundifolius</i>, <i>Rhagodia eremaea</i>. Pastoral use limitations: Prone to increases in cover by unpalatable species, particularly <i>Eremophila fraseri</i>, <i>E. spathulata</i> and <i>E. macmillaniana</i> were vegetation is degraded; not susceptible to accelerated erosion. Vegetation condition %: VG/G 12, F 32, P/V P56. 514 obs.</p>
<p>Unit 4: Mulga groves (< 2%)</p> <p>Infrequent grove formations mainly situated within unit 3; usually < 30 m wide and < 100 m long and arranged transverse to the direction of flow. Soils are red earths or red clays usually > 1 m; pH 6.0-7.0 with a neutral or acidic trend. Principal profile forms: Gn2.12, Uf6.71.</p>	<p>Moderately close (PFC 20-30%) tall shrublands or closed (PFC > 50%) woodlands dominated by <i>Acacia aneura</i>. Trees (to 10 m): <i>A. aneura</i>, <i>A. pruinocarpa</i>, <i>A. aff. citrinoviridis</i>, <i>Canthium latifolium</i>, <i>Hakea suberea</i>. Tall shrubs (> 2 m): <i>A. kempeana</i>, <i>A. linophylla</i>, <i>A. sclerosperma</i>. Mid shrubs (1-2 m): <i>Eremophila forrestii</i>, <i>Cassia desolata</i>. Low shrubs (< 1 m): <i>Solanum lasiophyllum</i>, <i>Maireana planifolia</i>, <i>M. tomentosa</i>, <i>Enchylaena tomentosa</i>, <i>Rhagodia eremaea</i>, <i>Ptilotus obovatus</i>, <i>P. rotundifolius</i>. Perennial grass: <i>Eriachne</i> sp.</p>	<p>3 inventory sites and traversed</p> <p>Vegetation type: Mulga Grove Woodland. Palatable perennials include: <i>Eremophila forrestii</i>, <i>Maireana planifolia</i>, <i>M. tomentosa</i>, <i>Enchylaena tomentosa</i>, <i>Rhagodia eremaea</i>, <i>Ptilotus obovatus</i>, <i>P. rotundifolius</i>, <i>Chrysopogon fallax</i>. Pastoral use limitations: None under controlled grazing.</p>

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 5: Drainage floors and channels (8%)</p> <p>Dendritic drainage tracts carrying through drainage and run-off from higher units originating as dendritic to parallel lines of low intensity developing into broad alluvial flow zones to 500 m wide downslope; often with channels (< 30 wide) incised up to 2 m in alluvium or red-brown hardpan. Soils vary from red earthy sands to shallow and deep red earths overlying granitic or alluvial material; pH 6.0-7.5 with a neutral trend. Principal profile forms: Gn2.12, Uc5.21, Um1.43, Um5.51.</p>	<p>Variable and patchy scattered to closed (PFC 10- > 50%) low woodlands or tall shrublands mostly dominated by <i>Acacia aneura</i>, <i>A. citrinoviridis</i>, <i>A. craspedocarpa</i>, <i>Cassia helmsii</i> or <i>Ptilotus obovatus</i>. Trees (to 12 m): <i>A. aneura</i>, <i>A. aff. rhodophloia</i>, <i>Eucalyptus camaldulensis</i>, <i>A. pruinocarpa</i>, <i>Grevillea striata</i>, <i>Santalum spicatum</i>. Tall shrubs (> 2 m): <i>A. citrinoviridis</i>, <i>A. aneura</i>, <i>A. craspedocarpa</i>, <i>A. tetragonophylla</i>, <i>A. sclerosperma</i>, <i>Exocarpus aphyllus</i>. Mid shrubs (1-2 m): <i>A. cuthbertsonii</i>, <i>Cassia helmsii</i>, <i>Eremophila linearis</i>, <i>E. fraseri</i>, <i>E. forrestii</i>. Low shrubs (< 1 m): <i>C. helmsii</i>, <i>P. obovatus</i>, <i>Sida calyxhymenia</i>, <i>Rhagodia eremaea</i>, <i>Spartothamnella teucriflora</i>. Perennial grasses (occasional): <i>Themeda australis</i>, <i>Cymbopogon</i> spp.</p>	<p>8 inventory sites and traversed</p> <p>Vegetation type: Creekline Shrubland or Creekline Grassy Shrubland.</p> <p>Palatable perennials include: <i>Ptilotus obovatus</i>, <i>Sida calyxhymenia</i>, <i>Rhagodia eremaea</i>, <i>Eremophila forrestii</i>, <i>Monachather paradoxa</i>, <i>Eriachne flaccida</i>, <i>Cyperus bifax</i>.</p> <p>Pastoral use limitations: Moderately susceptible to accelerated water erosion where degraded.</p> <p>Vegetation condition %: VG/G 16, F 34, P/NP 60.</p> <p>Erosion incidence %: min 23, mod 3. 69 obs.</p>

Liver land system 752 km² (0.88% of survey area)

Land type: 12; **Pastoral potential:** moderate.

Restricted sandplains and low dunes with tall acacia shrublands interrupted by reticulate saline alluvial drainage plains and numerous claypans and saline lake beds with low fringing halophytic shrublands.

Geology: Quaternary aeolian playa-dune deposits of sand, clay and gypsum; alluvium in lower units.

Geomorphology: Depositional surfaces; reticulate or lunette sand dunes, low banks and sandplain interrupted by sluggish drainages (partly internal and part through), as complex networks of interconnecting saline drainage floors (locally strewn with light mantles), discrete ephemeral lakes, claypans (some rock-strewn) and drainage foci; overall relief is 10 to 12 m.

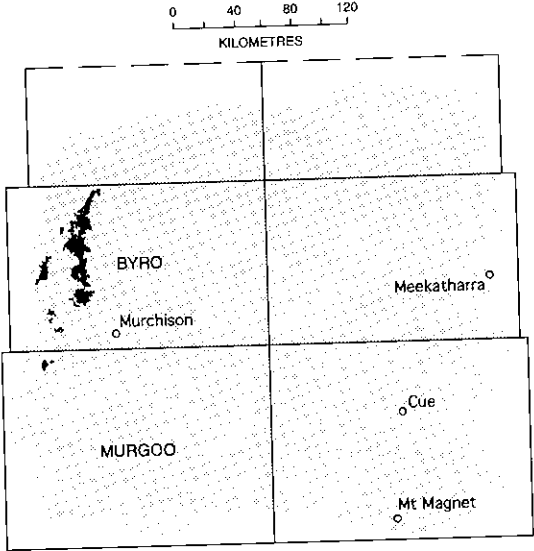
Vegetation and pastoral use: Sandplain Wanderrie Grassy Shrubland of moderate productivity and with reasonable perennial reserves; overgrazed windward slopes are slightly susceptible to wind erosion. Saltbush, Bluebush and Mixed Halophytic Shrublands of high value provide the bulk of palatable perennial forage on lower saline plains; locally, lake floors support Alluvial Tussock Grassland. Mild susceptibility to accelerated erosion on units 3 and 4.

Estimated carrying capacity, good condition: 12 ha/dse.

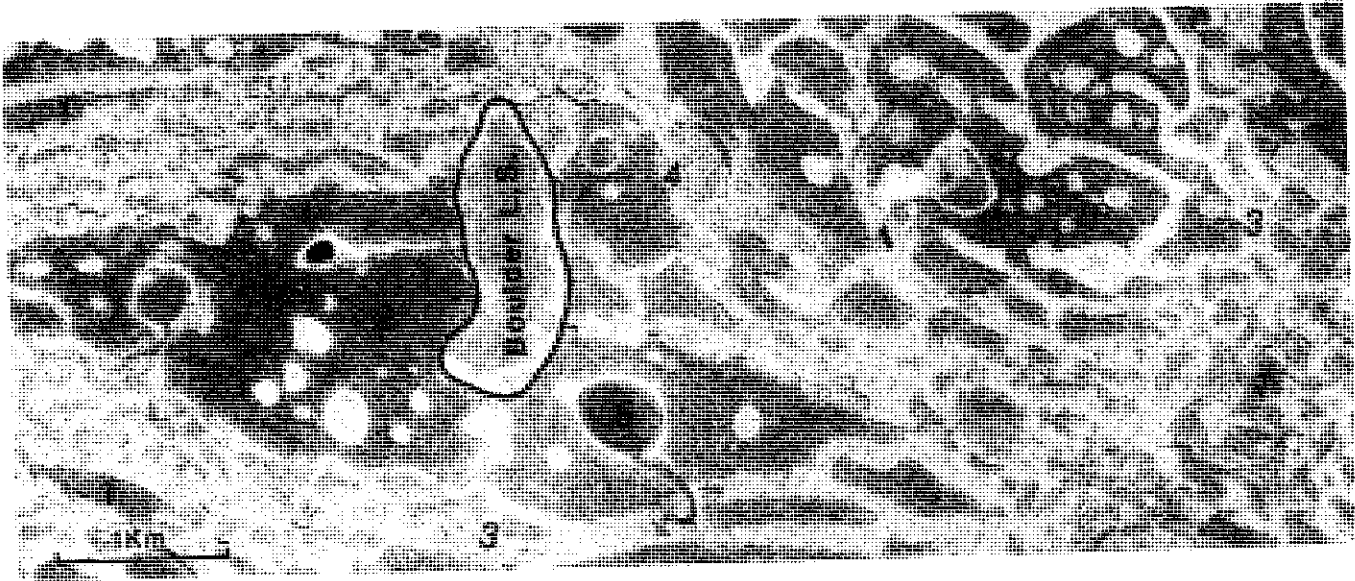
Range condition summary (91 traverse observations):

(a) Erosion status (%)			
Nil	Min.	Mod.	Sev.
70	24	6	0

(b) Vegetation condition (%)		
Good	Fair	Poor
29	45	26



- Unit: 1. Dunes and sandy banks.
2. Sand sheets.
3. Saline swales and alluvial plains.
4. Drainage tracts.
5. Saline lakes.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Dunes and sandy banks (25%) Low reticulate dunes and sandy banks sloping 1.5% to 7.5% and up to 10 m high; mostly fringing lakes or claypans. Dunes marginal to lakes are frequently saline; up to 150 m wide and 1 km long, reticulate and linear to direction of flow. Soils are siliceous or earthy red sands > 1 m deep with a neutral trend. Principal profile forms: Uc1.23, Uc5.21.	a) Non-saline higher communities on crests: moderately close (PFC 20-30%) shrublands dominated by <i>Acacia ramulosa</i> . Tall shrubs (> 2 m): <i>A. ramulosa</i> , <i>A. sclerosperma</i> . Mid shrubs (1-2 m): <i>Cassia phyllodinea</i> , <i>Eremophila maitlandii</i> . Low shrubs (< 1 m): <i>Solanum lasiophyllum</i> , <i>Rhagodia eremaea</i> . Perennial grasses: <i>Eragrostis lanipes</i> , <i>Thyridolepis multiculmis</i> . b) Saline lower fringing communities: scattered (PFC 10-20%) shrublands dominated by <i>Maireana pyramidata</i> or <i>Acacia sclerosperma</i> . Tall shrubs (> 2 m): <i>Grevillea stenobotrya</i> . Mid shrubs (1-2 m): <i>Hakea preissii</i> . Low shrubs (< 1 m): <i>Maireana pyramidata</i> , <i>M. atkinsiana</i> , <i>Haloscarchia</i> sp., <i>Frankenia pauciflora</i> , <i>Atriplex vesicaria</i> .	2 inventory sites, 1 condition site and traversed Vegetation type: Wanderrie Bank Grassy Shrubland or Bluebush/Saltbush Shrublands. Palatable shrublands include: <i>Rhagodia eremaea</i> , <i>Thyridolepis multiculmis</i> , <i>Eragrostis lanipes</i> . Pastoral use limitations: None under controlled grazing.
Unit 2: Sand sheets (30%) Flat to very gently undulating sand plains, up to 1 km wide and 2 km long. Soils are similar to unit 1.	Moderately close (PFC 20-30%) mid to low shrublands dominated mostly by low <i>Acacia aneura</i> , <i>A. ramulosa</i> and <i>Monachather paradoxa</i> . Tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. wiseana</i> , <i>A. murrayana</i> . Low shrubs (1-2 m): <i>Hemigenia</i> sp. Perennial grasses: <i>Eragrostis eriopoda</i> , <i>E. lanipes</i> , <i>Eriachne helmsii</i> , <i>Monachather paradoxa</i> , <i>Thyridolepis multiculmis</i> .	1 inventory site, 1 condition site and traversed Vegetation type: Sandplain Wanderrie Grassy Shrubland. Palatable perennials include: <i>Eragrostis lanipes</i> , <i>Monachather paradoxa</i> , <i>Thyridolepis multiculmis</i> . Pastoral use limitations: None under controlled grazing.
Unit 3: Saline swales and alluvial plains (35%) Interconnecting interdunal swales and plains carrying sluggish flow; strongly saline with marginal slopes < 1.5%; extending to 1 km wide and up to 3 m below adjoining unit 2. Soils are red duplex, loamy or clayey sands over loamy or sandy clay, pH 6.5-7.5 with an alkaline trend. Principal profile form: Dr1.16.	Scattered (PFC 10-20%) low shrublands dominated by <i>Maireana glomerifolia</i> , <i>Ptilotus beardii</i> and <i>Frankenia magnifica</i> . Tall shrubs (> 2 m): <i>Hakea preissii</i> . Low shrubs (< 1 m): <i>Frankenia magnifica</i> , <i>Maireana amoena</i> , <i>M. glomerifolia</i> , <i>M. platycarpa</i> , <i>Cassia phyllodinea</i> .	3 inventory sites, 7 condition sites and traversed Vegetation type: Bluebush or Mixed Halophyte Shrublands. Palatable perennials include: <i>Maireana amoena</i> , <i>M. glomerifolia</i> , <i>M. platycarpa</i> , <i>Frankenia magnifica</i> , <i>Ptilotus beardii</i> . Pastoral use limitations: High salinity levels of pasture plants; susceptible to erosion where degraded. Vegetation condition %: VG/G 40, F 36, P/VP 24. Erosion incidence %: min 31, mod 11. 25 obs.
Unit 4: Drainage tracts (5%) Drainage tracts, locally channelled, to 0.5 km wide and incised to 2 m below adjoining units 1 and 2. Soils are probably deep duplexes.	Moderately close (PFC 20-30%) mixed shrublands dominated by <i>Atriplex amnicola</i> , <i>Scaevola spinescens</i> , and <i>Melaleuca uncinata</i> . Tall shrubs (> 2 m): <i>Eucalyptus coolabah</i> , <i>Melaleuca uncinata</i> , <i>Acacia murrayana</i> . Low shrubs (< 1 m): <i>Scaevola spinescens</i> , <i>Atriplex amnicola</i> , <i>Haloscarchia</i> sp., <i>Enchylaena tomentosa</i> , <i>Cratystylis subspinescens</i> .	1 inventory site and traversed Vegetation type: Saltbush Shrubland. Palatable perennials include: <i>Atriplex amnicola</i> , <i>Enchylaena tomentosa</i> , <i>Cratystylis subspinescens</i> , <i>Scaevola spinescens</i> . Pastoral use limitations: Moderately susceptible to accelerated water erosion where degraded.
Unit 5: Saline lakes (5%) Saline (and some non-saline) lakes and claypans up to 1.5 km in diameter but usually < 0.5 km; to 3 m below unit 2. Occasionally with a very sparse mantle of silcrete pebbles and rocks. Soils are clays or deep yellowish-red duplexes, fine sand over loamy clay, pH 6.5 with an alkaline trend. Principal profile form: Dy3.43.	Bare to open tussock grassland dominated by <i>Sporobolus virginicus</i> or low shrubland <i>Meuhlenbeckia cunninghamii</i> on less saline sites; <i>Frankenia</i> spp. or <i>Haloscarchia</i> spp. on more saline sites. Low shrubs (< 1 m): <i>Frankenia magnifica</i> , <i>Haloscarchia indica</i> . Perennial grasses: <i>Sporobolus virginicus</i> , <i>Eragrostis dielsii</i> .	1 inventory site and traversed Vegetation type: Tussock Grassland or Samphire Shrubland. Palatable perennials include: <i>Eragrostis dielsii</i> , <i>Frankenia magnifica</i> , <i>Sporobolus virginicus</i> . Pastoral use limitations: Subject to seasonal inundation; high salinity levels of most palatable plants.

Mantle land system (G) 155 km² (0.18% of survey area)

Land type: 6; Pastoral potential: low.

Gently undulating stony plains, low hills and rises with saline alluvial lower plains and sluggish drainage zones; poorly vegetated landscapes supporting clumped or patchy acacia and very low halophytic shrubs.

Geology: Permian sandstone, siltstone, shale and greywacke of the Byro group, belonging to the Artinskian series; minor Quaternary alluvium.

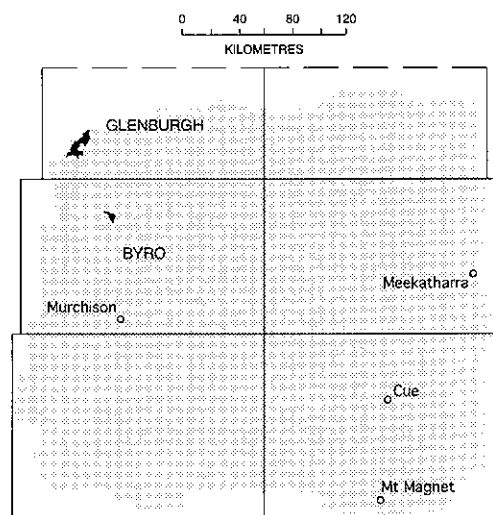
Geomorphology: Erosional surfaces; extensively weathered soft Permian beds with only the flattened remnants of crests remaining above level or mostly gently undulating stony plains and interfluvies. Minor depositional surfaces; drainage partly internal and disorganised, more or less channelled with through drainage lines; overall relief up to 30 m.

Vegetation and pastoral use: Curiously patchy and irregular saline and non-saline shrublands with extensive areas of stony plains and rises being virtually unvegetated, sometimes with no clear evidence of degradation effects and on moderately deep soils. The quantity and type of annual production may be more useful and typical of a stony system of saline plains; the alluvial plains and drainage tracts support Mixed Halophytic Shrubland of moderate to high productivity. Some drainage areas have been overgrazed and show minor water erosion; the system is otherwise not usually susceptible to accelerated erosion and is best suited to grazing only after seasonal growth.

Estimated carrying capacity, good condition: 20 ha/dse.

Range condition summary (6 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
83	17	0	0	50	17	33



- Unit: 1. Low hill crests and stony rises.
 2. Saline stony plains.
 3. Alluvial plains.
 4. Drainage tracts and channels.



Mantle I.s.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 1: Low hill crests and stony rises (15%)</p> <p>Gently sloping (< 5%) and undulating rounded stony rises to 15 m above surrounding unit 2. Mantled by dense cover of sandstone pebbles and cobbles. Soils are probably alkaline duplex types or alkaline red earths < 1 m deep.</p>	<p>Very scattered (PFC < 10%) mainly annual and semi-perennial herb fields with very few perennials. Tall shrubs (> 2 m): <i>Acacia cuspidifolia</i>, <i>Hakea preissii</i>. Low shrubs (< 1 m): <i>Ptilotus polakii</i>, <i>Rhagodia eremaea</i>.</p>	<p>1 inventory site</p> <p>Vegetation type: Mulga Mixed Shrubland. Sparse perennials supplemented by numerous and abundant annual grasses and forbs in season, particularly <i>Sclerolaena</i> spp. Palatable perennials include: <i>Rhagodia eremaea</i>, <i>Ptilotus polakii</i>. Pastoral use limitations: Areas without protective surface mantle may be susceptible to erosion on sloping sites.</p>
<p>Unit 2: Saline stony plains (70%)</p> <p>Undulating stony plains and flats sloping < 0.5%, mantled with moderately dense to dense mixed pebbles and gravels. Soils are red duplex types, loamy sands or fine sandy loams over clay loams, often over a weathered sedimentary substrate to 1 m; pH 6.0-8.0 with an alkaline trend. Principal profile forms: Dr4.13, Dr4.33.</p>	<p>Very scattered (PFC < 10%) open low shrublands dominated by <i>Ptilotus polakii</i> and <i>Halosarcia</i> spp. amid much bare ground. Tall shrubs (> 2 m): <i>Acacia cuspidifolia</i>. Mid shrubs (1-2 m): <i>A. tetragonophylla</i>, <i>A. victoriae</i>, <i>Cassia desolata</i>. Low shrubs (< 1 m): <i>Solanum lasiophyllum</i>, <i>Halosarcia</i> sp., <i>Rhagodia eremaea</i>, <i>Ptilotus polakii</i>, <i>Eremophila crenulata</i>.</p>	<p>3 inventory sites and traversed</p> <p>Vegetation type: Mixed Halophyte or Samphire Shrublands or Stony Mulga Mixed Shrubland. Sparse perennials augmented by extensive <i>Sclerolaena</i> spp., annual forbs and grasses in favourable seasons. Palatable perennials include: <i>Rhagodia eremaea</i>, <i>Ptilotus polakii</i>. Pastoral use limitations: None under controlled grazing.</p>
<p>Unit 3: Alluvial plains (10%)</p> <p>Saline alluvial plains subject to sheet flow, flanking channels and major drainage tracts, often with a mantle similar to unit 2. Soils are probably deep red duplex types.</p>	<p>Patches of very scattered mixed halophytic shrublands (PFC < 10%) with abundant annual herbs and grasses in season.</p>	<p>Traversed</p> <p>Vegetation type: Probably Mixed Halophyte Shrubland, supplemented by abundant annuals. Pastoral use limitations: Dispersible soils without mantles may be susceptible to water erosion.</p>
<p>Unit 4: Drainage tracts and channels (5%)</p> <p>Major flow zones to 1 km wide with incised channels in units 2 and 3. Margins of channels have braided tributaries or sluggish ill-defined saline flow zones. Soils are probably deep clays and duplex types.</p>	<p>Probably moderately close (PFC 20-30%) mixed woodlands fringing channels or mixed shrublands on marginal drainage tracts. Channels: Occasional <i>Eucalyptus camaldulensis</i> with understorey of mixed shrubs <i>Rhagodia</i>, <i>Atriplex</i> or <i>Maireana</i> spp. Fringing communities; more frequent tall and mid shrubs <i>Acacia tetragonophylla</i>, <i>A. victoriae</i> and occasional perennial grasses <i>Cenchrus</i> spp., <i>Eragrostis setifolia</i>.</p>	<p>Traversed</p> <p>Vegetation type: Riverine Mixed Shrubland.</p>

Merbla land system 76 km² (0.09% of survey area)

Land type: 18; Pastoral potential: very high.

Alluvial plains with clayey soils and partly gilgai (crabhole) surfaces; found very locally below gabbro hills in far south-east; supports halophytic shrubland and tussock grassland.

Geology: Quaternary alluvium and colluvium derived from Archaean gabbro.

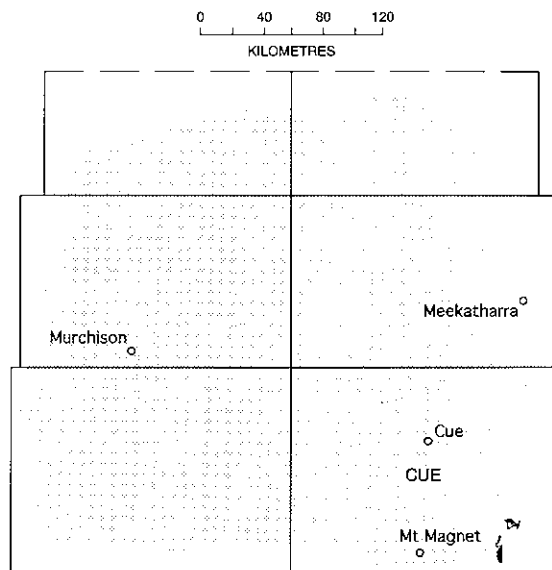
Geomorphology: Depositional surfaces; alluvial plains with gilgai-surfaced depressions interconnected by complex mainly sluggish internal drainage; higher more stony marginal plains draining internally through incised, channelled meandering flow-lines. Surfaces are self-mulching and mostly stable; relief is mostly < 2 m.

Vegetation and pastoral use: Highly productive Bluebush Shrubland and Alluvial Tussock Grassland, conferring very good perennial reserves, but preferential grazing and the restricted extent of the system necessitates strict and responsive control of grazing; some areas would be mildly susceptible to accelerated erosion if degraded, especially units 2 and 4.

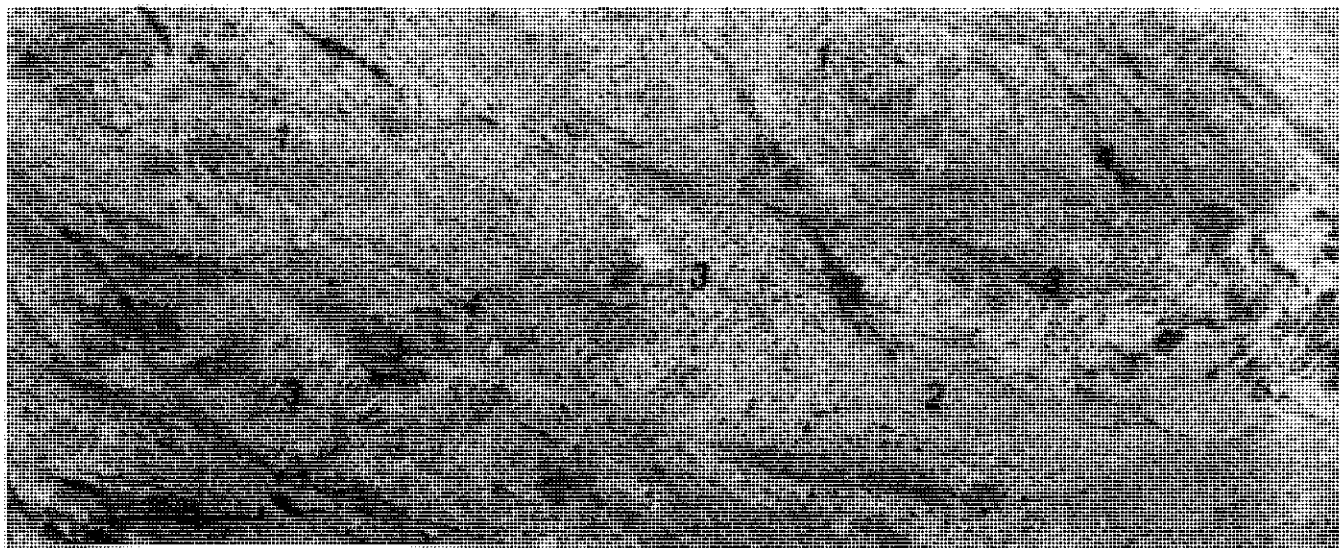
Estimated carrying capacity, good condition: 5 ha/dse.

Range condition summary (19 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
74	26	0	0	58	37	5



- Unit: 1. Stony plains.
 2. Alluvial plains.
 3. Gilgai plains.
 4. Minor channels and sluggish drainage tracts.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Stony plains (10%) Slightly saline stony plains with occasional gabbro outcrops, slightly higher than units 2 and 3 and marginal to Challenge and Naluthanna land systems; often with dense mantles of quartz. Soils are probably non-cracking red or brown clays.	Scattered (PFC 10-20%) shrublands dominated by <i>Maireana pyramidata</i> . Trees (2-4 m): <i>Pittosporum phylliraeoides</i> . Tall shrubs (> 2 m): <i>Hakea preissii</i> , <i>Heterodendrum oleaefolium</i> . Low shrubs (< 1 m): <i>M. pyramidata</i> , <i>M. trichoptera</i> , <i>Rhagodia eremaea</i> , <i>Enchylaena tomentosa</i> , <i>Scaevola spinescens</i> , <i>Solanum orbiculatum</i> .	1 condition site and traversed Vegetation type: Bluebush Shrubland. Palatable perennials include: <i>Maireana pyramidata</i> , <i>M. trichoptera</i> , <i>Rhagodia eremaea</i> , <i>Enchylaena tomentosa</i> . Increaser species include: <i>Hakea preissii</i> , <i>Solanum orbiculatum</i> . Pastoral use limitations: None under controlled grazing.
Unit 2: Alluvial plains (25%) Mostly flat and partly saline alluvial plains adjacent to Mileura land system. Soils are dark red loamy clays over light medium clays to > 1 m, pH 9.0 with an alkaline trend. Principal profile form: Uf6.71.	Scattered (PFC 10-20%) mixed shrublands, dominated by <i>Cassia nemophila</i> and <i>Maireana pyramidata</i> . Trees (4-6 m): <i>Acacia sibilans</i> , <i>A. aneura</i> . Tall shrubs (> 2 m): <i>A. aneura</i> . Mid shrubs (1-2 m): <i>A. victoriae</i> . Low shrubs (< 1 m): <i>Cassia nemophila</i> , <i>Maireana pyramidata</i> , <i>M. convexa</i> , <i>Eremophila maculata</i> , <i>Scaevola spinescens</i> , <i>Ptilotus divaricatus</i> . Perennial grass: <i>Eragrostis setifolia</i> .	1 inventory site and traversed Vegetation type: Bluebush Shrubland. Palatable perennials include: <i>Maireana pyramidata</i> , <i>M. convexa</i> , <i>Eremophila maculata</i> , <i>Scaevola spinescens</i> , <i>Ptilotus divaricatus</i> , <i>Eragrostis setifolia</i> . Pastoral use limitations: None under controlled grazing.
Unit 3: Gilgai plains (60%) Extensive and somewhat saline alluvial plains with patchy gilgai micro-relief and self-mulching surfaces. Soils are dark red cracking clays > 1 m deep; pH 9.0 with an alkaline trend. Principal profile form: Ug5.36.	Very scattered to scattered (PFC < 20%) grassy low shrubland dominated by <i>Maireana pyramidata</i> , <i>Atriplex amnicola</i> and <i>Eragrostis setifolia</i> . Trees (6-8 m): <i>Acacia sibilans</i> . Tall shrubs (> 2 m): <i>A. victoriae</i> , <i>Heterodendrum oleaefolium</i> . Mid shrubs (1-2 m): <i>Atriplex amnicola</i> , <i>Acacia tetragonophylla</i> . Low shrubs (< 1 m): <i>A. amnicola</i> , <i>A. bunburyana</i> , <i>M. pyramidata</i> , <i>Eremophila maculata</i> , <i>Rhagodia</i> sp., <i>Ixiolaena leptolepis</i> . Perennial grasses: <i>Eragrostis setifolia</i> , <i>Eriachne flaccida</i> .	3 inventory sites, 2 condition sites and traversed Vegetation type: Saltbush/Bluebush Shrubland with Alluvial Tussock Grassland. Palatable perennials include: <i>Atriplex amnicola</i> , <i>Maireana pyramidata</i> , <i>Eremophila maculata</i> , <i>Rhagodia</i> sp., <i>Eragrostis setifolia</i> , <i>Eriachne flaccida</i> . Pastoral use limitations: None under controlled grazing.
Unit 4: Minor channels and sluggish drainage tracts (< 5%) Meandering channels incised through units 2 and 3, carrying through flow from adjacent Naluthanna and Challenge land systems; draining mainly into unchannelled internal drainage zones. Soils are probably red or brown clays.	Scattered mixed shrublands supporting tall and mid shrubs <i>Acacia victoriae</i> and perennial grasses <i>Eragrostis setifolia</i> , <i>Eriachne flaccida</i> on channel margins.	Traversed Vegetation type: Creekline Grassy Shrubland. Pastoral use limitations: Unconsolidated soils may be prone to erosion if exposed in flow zones.

Mileura land system (W) 1007 km² (1.17% of survey area)

Land type: 15; **Pastoral potential:** high.

Saline and non-saline calcreted river plains, with clayey flood plains interrupted by raised calcrete platforms supporting diverse and very variable tall shrublands, mixed halophytic shrublands and shrubby grasslands.

Geology: Tertiary calcrete with opaline silica and fine gravel at depth; partly overlain by Quaternary alluvium.

Geomorphology: Depositional surfaces; calcreted valley fills with a mosaic of dissected calcrete platforms usually 1 to 10 km wide and 2 to 5 m high; alluvial plains, underlain by hardpan on margins; central plains and flow zones between platforms often highly saline; river channels (with isolated semi-permanent pools) to 100 m wide, incised and carrying bedloads of coarse materials: frequent drainage foci with minor internal drainage; overall relief < 6 m.

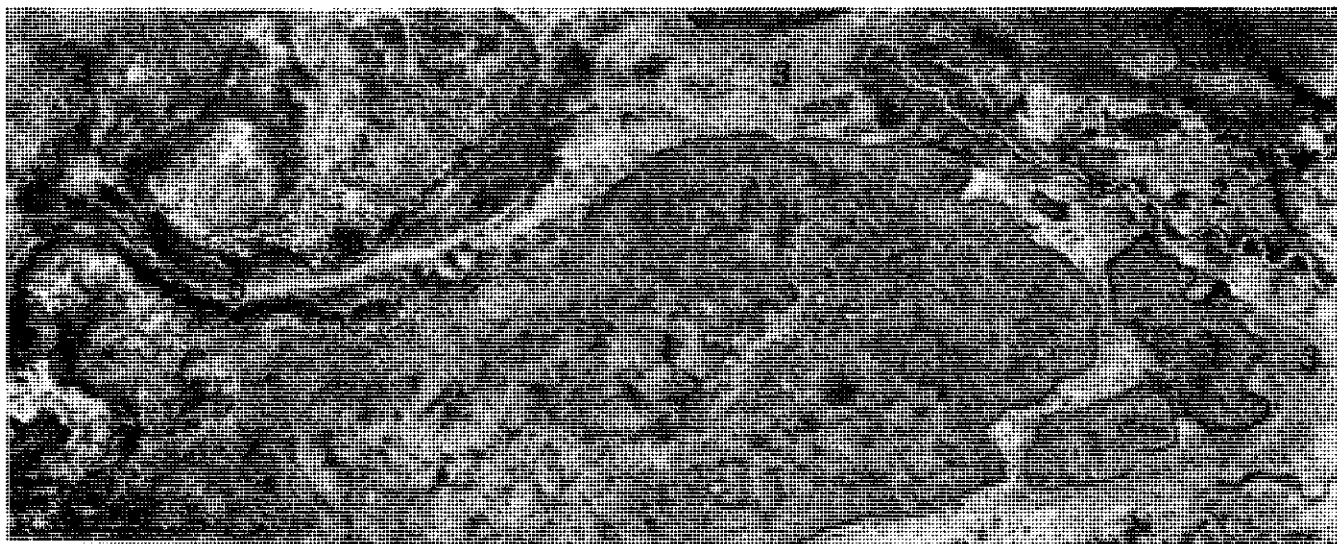
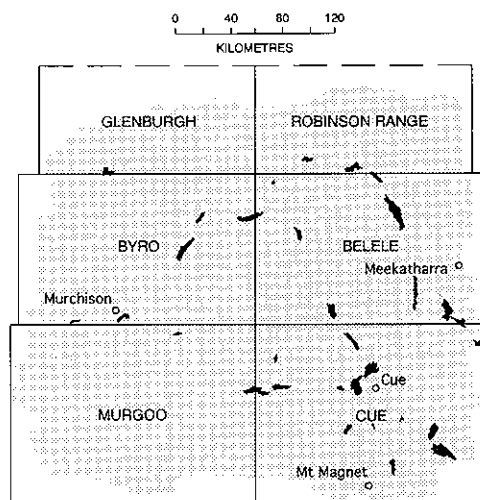
Vegetation and pastoral use: Moderately to highly productive saline and non-saline shrublands, mainly Bluebush, Saltbush, Mixed Halophytic, Samphire and Riverine Mixed Shrublands with good perennial reserves when in good condition; also Calcrete Shrubby Grassland and Bluebush Shrubland on calcrete platforms; frequently degraded with invasions of unpalatable shrubs. The system is preferentially grazed (especially unit 1) by kangaroos, feral animals and domestic stock; units with duplex soils moderately to highly susceptible to erosion, those with loam over hardpan less susceptible, calcrete platforms not normally susceptible, though widely degraded.

Estimated carrying capacity, good condition: 7 ha/dse.

Range condition summary (301 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
74	19	6	1	31	37	32

- Unit: 1. Calcrete platforms.
 2. Drainage foci.
 3. Alluvial plains.
 4. Lower saline plains.
 5. Major drainage tracts.
 6. Channels.



Mileura I.s.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 1: Calcrete platforms (33%)</p> <p>Calcrete platforms mainly 0.5-3 km long, with little slope (< 0.5%); usually elevated 2-3 metres above adjoining units and fragmented by flow zones (unit 5); very sparse to moderate mantling of calcrete fragments with occasional outcrop of opaline rocks. Soils are mostly calcareous sands, red or brown calcareous sandy loams or alkaline red earths with frequent calcareous nodules and fragments of calcrete through the profile, over calcrete at < 50 cm; pH 7.5-9.5 with an alkaline trend. Principal profile forms: Uc1.12, Uc1.13, Uc5.12, Um1.33, Gc1.12.</p>	<p>a) Very scattered to scattered (PFC < 20%) tall shrublands dominated by <i>Acacia sclerosperma</i>, <i>A. aneura</i> and <i>Cassia</i> spp. Trees (4-8 m): <i>A. aneura</i>, <i>A. sibilans</i>, <i>Codonocarpus cotinifolius</i>, <i>Pittosporum phylliraeoides</i>. Tall shrubs (> 2 m): <i>A. sclerosperma</i>, <i>A. tysonii</i>, <i>A. victoriae</i>, <i>Grevillea</i> aff. <i>stenobotrya</i>, <i>Eremophila miniata</i>. Mid shrubs (1-2 m): <i>A. sclerosperma</i>, <i>A. victoriae</i>, <i>Lycium australe</i>. Low shrubs (< 1 m): <i>Cassia nemophila</i>, <i>Cratystylis subspinescens</i>, <i>Maireana pyramidata</i>, <i>M. trichoptera</i>, <i>Atriplex bunburyana</i>, <i>Rhagodia eremaea</i>, <i>Enchylaena tomentosa</i>. Perennial grass (up to 2% basal cover): <i>Enneapogon nigricans</i>, <i>E. sp.</i>, <i>Eragrostis falcata</i>, <i>E. pergracilis</i>.</p> <p>b) In south-east of area only: Moderately close (PFC 20-30%) woodland dominated by <i>Eucalyptus striatacalyx</i>. Trees (to 14 m): <i>E. striatacalyx</i>. Tall shrubs (> 2 m): <i>A. ligulata</i>, <i>A. sclerosperma</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>Cassia nemophila</i>, <i>Atriplex bunburyana</i>, <i>A. aff. nummularia</i>, <i>Lycium australe</i>, <i>Enchylaena tomentosa</i>. Perennial grass: <i>Stipa</i> sp.</p>	<p>9 inventory sites, 17 condition sites and traversed</p> <p>Vegetation type: a) Calcrete Shrubby Grassland; or b) Bluebush or Saltbush Shrubland. Palatable perennials include: <i>Cratystylis subspinescens</i>, <i>Maireana trichoptera</i>, <i>M. pyramidata</i>, <i>Rhagodia eremaea</i>, <i>Atriplex bunburyana</i>, <i>Sclerolaena</i> spp., <i>Eragrostis</i> spp., <i>Enneapogon</i> spp. Pastoral use limitations: Perennial grasses invariably overutilised and more or less degraded through preferential grazing by stock, goats, kangaroos and rabbits; susceptible to shrub invasion by <i>Cassia</i> spp. and <i>Dissocarpus paradoxus</i> where perennials are degraded; not normally subject to accelerated erosion. Vegetation condition %: VG/G 28, F 45, P/VP 27. Erosion incidence %: min 3. 78 obs.</p>
<p>Unit 2: Drainage foci (< 2%)</p> <p>Flat, saline and non-saline depressions occurring as ephemeral swamps up to 1 km wide and 3 m below adjacent units 1 and 3. Soils are reddish brown or brown clays, hard-setting duplexes or calcareous red earths; mostly full-depth (some with calcrete at 30 cm), pH 7.0-9.0 with mainly alkaline soil reaction trend. Principal profile forms: Ug6.3, Uf6.71, Dr2.53, Gc1.22.</p>	<p>Scattered to close (PFC 10-50%) woodland or shrubland with <i>Grevillea striata</i>, <i>Eucalyptus camaldulensis</i>, <i>E. striatacalyx</i>, or mixed halophytes in more saline depressions, or lightly wooded tussock grasslands. Trees (to 14 m): <i>G. striata</i>, <i>E. camaldulensis</i>, <i>E. striatacalyx</i>, <i>Acacia aneura</i>. Tall shrubs (> 2 m): <i>Exocarpus aphylla</i>, <i>Melaleuca uncinata</i>. Low and mid shrubs: <i>Muehlenbeckia cunninghamii</i>, <i>Chenopodium nitrariaceum</i>, <i>Cratystylis subspinescens</i>, <i>Rhagodia eremaea</i>, <i>Ptilotus divaricatus</i>, <i>Atriplex amnicola</i>, <i>Lycium australe</i>. Perennial grasses: <i>Eriachne flaccida</i>, <i>Stipa elegantissima</i>.</p>	<p>5 inventory sites and traversed</p> <p>Vegetation type: Saltbush Shrubland or Mixed Halophyte Shrubland or Alluvial Tussock Grassland. Palatable perennials include: <i>Chenopodium nitrariaceum</i>, <i>Cratystylis subspinescens</i>, <i>Atriplex amnicola</i>, <i>Rhagodia eremaea</i>, <i>Eriachne flaccida</i>. Pastoral use limitations: Subject to seasonal inundation but otherwise none under controlled grazing.</p>
<p>Unit 3: Alluvial plains (35%)</p> <p>Almost flat (< 0.6% slope) alluvial floors and plains between units 1 and 4; sheet and rill erosion common with some areas of severe scalding, hummocking and wind piling evident. Soils are dark red, yellowish-red or brown duplex or clay types, clayey sands or clay loams over sandy or light clays with a scattered quartz or ironstone mantle and occasional calcrete or hardpan at 80-100 cm. pH 6.5-9.5 with a mainly alkaline trend. Principal profile forms: Dr1.33, Dr2.52, Dr2.53, Dr2.13, Uf6.71, Uf6.53, Gc1.21.</p>	<p>Very scattered to moderately close (PFC < 30%) tall, mid height or low shrublands or with shrub layers co-dominant, occasional prominent trees. Trees (to 8 m): <i>E. coolabah</i>, <i>Grevillea</i> aff. <i>stenobotrya</i>, <i>G. striata</i>, <i>Acacia aneura</i>, <i>A. sibilans</i>. Tall shrubs (> 2 m): <i>Melaleuca uncinata</i>, <i>A. tysonii</i>, <i>A. sclerosperma</i>, <i>A. xiphophylla</i>. Mid shrubs (1-2 m): <i>Cratystylis subspinescens</i>, <i>Lycium australe</i>, <i>Scaevola spinescens</i>, <i>Eremophila pterocarpa</i>, <i>Acacia victoriae</i>, <i>Hakea preissii</i>, <i>Cassia nemophila</i>, <i>C. sturtii</i>. Low shrubs (< 1 m): <i>Frankenia</i> spp., <i>C. subspinescens</i>, <i>Halosarcia</i> spp., <i>Atriplex amnicola</i>, <i>A. vesicaria</i>, <i>Maireana pyramidata</i>, <i>Ptilotus lazarides</i>, <i>P. beardii</i>. Perennial grasses: <i>Eragrostis</i> spp., <i>E. setifolia</i>, <i>E. dielsii</i>.</p>	<p>11 inventory sites, 15 condition sites and traversed</p> <p>Vegetation type: Riverine Mixed Shrubland or Mixed Halophyte Shrubland. Palatable perennials shrubs include: <i>Maireana pyramidata</i>, <i>Rhagodia eremaea</i>, <i>Ptilotus</i> spp., <i>Cratystylis subspinescens</i>, <i>Cassia chatelainiana</i>, <i>Atriplex vesicaria</i>, <i>Eremophila maculata</i>, <i>E. malacoides</i> and perennial grasses. Pastoral use limitations: Degraded areas are highly susceptible to sheet erosion, soil redistribution and subsequent invasion by <i>Acacia victoriae</i> and <i>Eremophila pterocarpa</i>. Vegetation condition %: VG/G 33, F 28, P/VP 39. Erosion incidence %: min 36, mod 10, sev 3. 115 obs.</p>

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
7 inventory sites and traversed		
Unit 4: Lower saline plains (18%) Flat low-lying strongly saline alluvial plains. Soils vary from hard-setting duplexes to red and brown clays and calcareous red earths, > 1 m deep, pH 7.0-9.0 with a mostly alkaline reaction trend. Principal profile forms: Dr2.52, Dr2.12, Gc1.2, Uf6.71, Uf5.12, Uf1.33, Uf6.53.	Very scattered (PFC < 10%) or moderately close (PFC 20-30%) low shrublands dominated by <i>Halosarcia</i> , <i>Atriplex</i> , <i>Frankenia</i> , <i>Cratystylis</i> and <i>Lawrencia</i> spp. Trees (4-6 m): <i>Grevillea</i> spp. Tall shrubs (> 2 m): <i>Melaleuca uncinata</i> , <i>Acacia tysonii</i> , <i>A. sclerosperma</i> . Mid shrubs (1-2 m): <i>Cratystylis subspinescens</i> , <i>Lycium australe</i> , <i>Scaevola spinescens</i> . Low shrubs (< 1 m): <i>Frankenia</i> spp., <i>F. setosa</i> , <i>C. subspinescens</i> , <i>Lawrencia chrysoderma</i> , <i>Halosarcia</i> spp., <i>Atriplex amnicola</i> . Perennial grasses: <i>Eragrostis</i> spp., <i>E. setifolia</i> , <i>E. dielsii</i> .	Vegetation type: Saltbush or Mixed Halophyte Shrublands. Palatable perennials include: <i>Atriplex amnicola</i> , <i>Cratystylis subspinescens</i> , <i>Lawrencia chrysoderma</i> , <i>Scaevola spinescens</i> , <i>Enchylaena tomentosa</i> , <i>Eragrostis setifolia</i> , <i>E. dielsii</i> . Pastoral use limitations: High levels of salinity in pasture plants; zones grading into unit 3 moderately susceptible to accelerated erosion where degraded.
4 inventory sites, 3 condition sites and traversed		
Unit 5: Major drainage tracts (10%) Almost flat drainage tracts up to 1 km wide and subject to concentrated sheet flow. Occasional small anastomosing channels to 1 m deep with local relief to 3 m. Soils are yellowish-red or dark red medium or heavy clays > 1 m deep, pH 7.0-9.0 with an alkaline trend. Principal profile forms: Ug5.36, Uf and juvenile alluvial types.	Moderately close to closed (PFC 20- > 50%) low woodland and tall shrublands dominated by <i>Acacia sibilans</i> , <i>Muehlenbeckia cunninghamii</i> and <i>Cratystylis subspinescens</i> . Trees (6-8 m): <i>A. sibilans</i> , <i>Eucalyptus camaldulensis</i> , <i>E. coolabah</i> . Tall shrubs (> 2 m): <i>A. sibilans</i> , <i>Hakea preissii</i> . Mid shrubs (1-2 m): <i>Eremophila</i> sp., <i>C. subspinescens</i> , <i>M. cunninghamii</i> . Perennial grasses: <i>Eriachne flaccida</i> , <i>Stipa elegantissima</i> .	Vegetation type: Riverine Mixed Shrubland or Mixed Halophyte Shrubland. Palatable perennials include: <i>Cratystylis subspinescens</i> , <i>Scaevola spinescens</i> , <i>Frankenia setosa</i> , <i>Rhagodia eremaea</i> , <i>Enchylaena tomentosa</i> . Increaser species include: <i>Hakea preissii</i> . Pastoral use limitations: minor susceptibility to erosion where perennials are degraded. Vegetation condition %: VG/G 63, F 19, P/VP 8. Erosion incidence %: min 8. 26 obs.
1 inventory site and traversed		
Unit 6: Channels (2%) Channels incised up to 3 m deep and 30 m wide within units 3 and 4 with bedloads of coarse sand on exposed red-brown hardpan and calcrete and often showing salt encrustations when dry.	Variable, moderately close (PFC 20-30%) fringing communities. Trees (6-8 m): <i>Eucalyptus camaldulensis</i> , <i>E. coolabah</i> , <i>Casuarina</i> sp. Tall shrubs (> 2 m): <i>Duboisia hopwoodii</i> , <i>Acacia sclerosperma</i> . Mid shrubs (1-2 m): <i>Atriplex amnicola</i> , <i>Eremophila pantonii</i> , <i>E. platycarpa</i> , <i>Halosarcia indica</i> , <i>Lycium australe</i> , <i>Scaevola spinescens</i> . Perennial grass: <i>Setaria</i> sp.	Palatable perennials include: <i>Atriplex amnicola</i> , <i>Lycium australe</i> , <i>Scaevola spinescens</i> , <i>Setaria</i> sp. Pastoral use limitations: Unconsolidated banks are susceptible to erosion if bare of vegetation.

Millex land system 500 km² (0.58% of survey area)

Land type: 5; Pastoral potential: moderate.

Plains on granite, with irregularly distributed low sandy banks and saline alluvial plains lightly strewn with quartz mantles; supports mulga shrublands and low halophytic shrublands.

Geology: Mixed Archaean porphyritic granites masked by Quaternary colluvium and alluvium with minor aeolian deposits.

Geomorphology: Mainly erosional surfaces: very gently sloping to flat plains, with sandy or loamy soils over more or less weathered rock and minor marginal red-brown hardpan; minor tracts of sandy banks; scattered low outcrops with 'onion' weathering; lower saline stony plains carrying sheet drainage, with duplex soils and quartz mantles especially below deeply weathered low outcrops; minor channelled drainage lines; relief mainly 5 to 10 m.

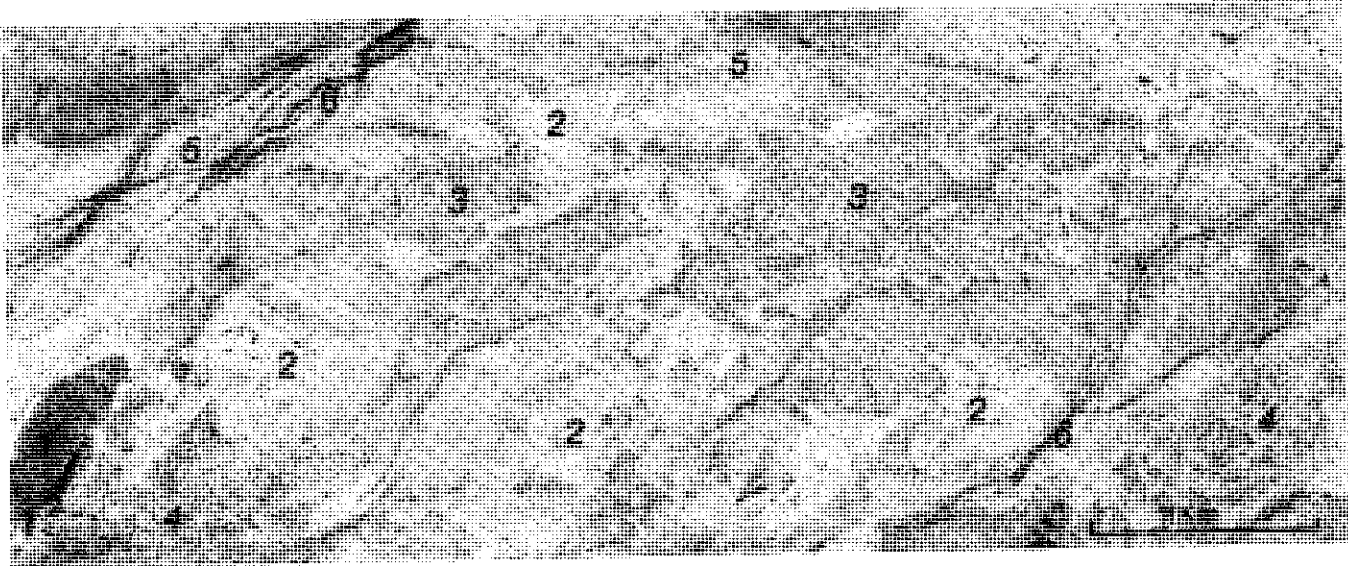
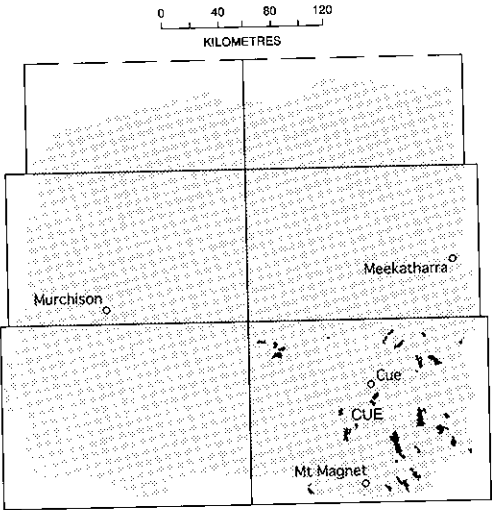
Vegetation and pastoral use: Moderately productive Granitic Mulga or Mixed Halophytic Shrublands, with the more productive saline units usually being preferentially grazed, and widely reduced in value towards mainly annual production; some wanderrie grasses on sandy banks; wash plains otherwise support Hardpan Mulga Shrubland; units 2, 5 and 6 moderately susceptible to water erosion when degraded.

Estimated carrying capacity, good condition: 12 ha/dse.

Range condition summary (87 traverse observations):

Nil	(a) Erosion status (%)			Good	(b) Vegetation condition (%)	
	Min.	Mod.	Sev.		Fair	Poor
83	14	3	0	29	39	32

- Unit: 1. Sand sheets and banks.
2. Saline stony plains.
3. Sandy-surfaced plains on granite.
4. Hardpan plains.
5. Alluvial plains.
6. Drainage tracts.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Sand sheets and banks (5%) Small sand sheets or isolated sand banks to 2 m above surrounding units 3 and 4. Soils are red, uniform earthy sands, mostly over granite at 35 cm to > 1 m. pH 5.5-6.0 with an acidic trend. Principal profile form: Uc5.21.	Scattered to moderately close (PFC 10-30%) low woodland or mixed shrubland dominated by <i>Acacia aneura</i> , <i>A. craspedocarpa</i> , <i>A. ramulosa</i> , <i>Ptilotus obovatus</i> and <i>Eremophila</i> aff. <i>punicea</i> . Trees (4-6 m): <i>Acacia aneura</i> . Tall shrubs (> 2 m): <i>A. ramulosa</i> , <i>A. aneura</i> , <i>A. craspedocarpa</i> , <i>A. tetragonophylla</i> . Mid shrubs (1-2 m): <i>Eremophila forrestii</i> , <i>A. aneura</i> , <i>A. grasbyi</i> , <i>A. ramulosa</i> . Low shrubs (< 1 m): <i>E. aff. punicea</i> , <i>E. forrestii</i> , <i>Ptilotus obovatus</i> , <i>Sida calyxhymenia</i> . Perennial grass: <i>Eragrostis eriopoda</i> .	4 inventory sites, 1 condition site and traversed Vegetation type: Granitic Mulga Shrubland or Wanderrie Bank Grassy Shrubland. Palatable perennials include: <i>Rhagodia eremaea</i> , <i>Maireana convexa</i> , <i>M. platycarpa</i> , <i>M. triptera</i> , <i>Scaevola spinescens</i> , <i>Eragrostis eriopoda</i> . Pastoral use limitations: None under controlled grazing.
Unit 2: Saline stony plains (40%) Flat to very gently undulating more or less saline plains, slopes < 0.3%, relief to 2 m, and generally covered with sparse to moderately dense ironstone and quartz pebbly mantle, overlying weathered granitic parent rock. Soils are red or dark red duplex types, loamy sands or sandy clay loams over light sandy clays < 40 m deep, pH 6.0-6.5 with a neutral trend. Principal profile forms: Dr2.52, Dr1.12, Um5.51.	Very scattered to scattered (PFC < 20%) open mixed shrublands generally dominated by low halophytic shrubs such as <i>Maireana</i> and <i>Ptilotus</i> spp; <i>Acacia aneura</i> dominant on non-saline margins. Trees (2-4 m): <i>A. aneura</i> . Tall shrubs (> 2 m): <i>A. xiphophylla</i> , <i>Eremophila linearis</i> , <i>E. youngii</i> , <i>E. fraseri</i> , <i>A. aneura</i> , <i>A. victoriae</i> . Mid shrubs (1-2 m): <i>E. pterocarpa</i> , <i>E. fraseri</i> , <i>Cassia helmsii</i> , <i>C. desolata</i> . Low shrubs (< 1 m): <i>Maireana pyramidata</i> , <i>M. tomentosa</i> , <i>M. glomerifolia</i> , <i>E. lachnocalyx</i> , <i>Ptilotus beardii</i> , <i>P. obovatus</i> .	6 inventory sites, 1 condition site and traversed Vegetation type: Bluebush or Mixed Halophytic Shrubland. Palatable perennials include: <i>Maireana pyramidata</i> , <i>M. platycarpa</i> , <i>M. georgei</i> , <i>Scaevola spinescens</i> , <i>Rhagodia eremaea</i> , <i>Ptilotus obovatus</i> , <i>P. beardii</i> . Pastoral use limitations: Slightly susceptible to accelerated erosion where degraded and lightly mantled. Vegetation condition %: VG/G 20, F 31, P/VP 49. Erosion incidence %: min 6. 35 obs.
Unit 3: Sandy plains on granite (25%) Gently sloping (< 1.2%) sandy surfaced, non-saline plains with low outcrops of unweathered granite, relief occasionally to 6 m. Generally covered with a moderately dense quartz or granite mantle. Soils are red granitic siliceous or earthy sands overlying granite at < 40 cm; pH 6.5-7.0 with a neutral trend. Principal profile forms: Uc5.21, Uc1.43.	Scattered to very scattered (PFC < 20%) mixed shrublands dominated by <i>Acacia aneura</i> , <i>Eremophila platycalyx</i> and <i>Ptilotus obovatus</i> . Trees (2-6 m): <i>A. aneura</i> . Tall shrubs (> 2 m): <i>A. aneura</i> , <i>E. platycalyx</i> . Mid shrubs (1-2 m): <i>E. platycalyx</i> , <i>E. fraseri</i> , <i>A. tetragonophylla</i> . Low shrubs (< 1 m): <i>P. obovatus</i> , <i>Solanum lasiophyllum</i> , <i>E. forrestii</i> , <i>Cassia helmsii</i> , <i>Maireana planifolia</i> , <i>M. triptera</i> .	5 inventory sites, 2 condition sites and traversed Vegetation type: Granitic Mulga Shrubland. Palatable perennials shrubs include: <i>Maireana planifolia</i> , <i>M. georgei</i> , <i>Ptilotus obovatus</i> , <i>P. schwartzii</i> , <i>Rhagodia eremaea</i> , <i>Eremophila compacta</i> , <i>E. latrobei</i> . Pastoral use limitations: None with controlled grazing.
Unit 4: Hardpan plain (10%) Flat plains subject to sheet flow, often on outer margins of system. Soils are red hardpan loams or shallow red earths to 50 cm deep over hardpan or granite with a neutral trend. Principal profile form: Um5.31.	Scattered (PFC 10-20%) low woodland dominated by <i>Acacia aneura</i> . Trees (4-6 m): <i>A. pruinocarpa</i> , <i>A. aneura</i> . Tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. craspedocarpa</i> . Mid shrubs (1-2 m): <i>A. tetragonophylla</i> , <i>Eremophila forrestii</i> . Low shrubs (< 1 m): <i>Ptilotus obovatus</i> , <i>Solanum lasiophyllum</i> , <i>P. schwartzii</i> , <i>Eremophila georgei</i> .	1 inventory site, 1 condition site and traversed Vegetation type: Hardpan Mulga Shrubland. Palatable perennials include: <i>Eremophila forrestii</i> , <i>Ptilotus obovatus</i> , <i>P. schwartzii</i> , <i>Maireana convexa</i> , <i>Rhagodia eremaea</i> . Pastoral use limitations: Slightly susceptible to accelerated erosion where degraded.
Unit 5: Alluvial plains (15%) Flat to very gently sloping (< 0.5%) mainly unmantled saline alluvial plains receiving run-on from units 2, 3 and 4. Soils are duplexes, red or dark red loamy sands or sandy clay loams over light clays to a depth of 45 cm, often over weathered granite; pH 6.0-7.0 with a neutral trend. Principal profile forms: Dr2.12, Dr2.52.	Very scattered to scattered (PFC < 20%) mixed or low shrubland dominated by <i>Maireana pyramidata</i> and <i>Ptilotus obovatus</i> . Trees (to 8 m): <i>Acacia pruinocarpa</i> , <i>A. aneura</i> . Tall shrubs (> 2 m): <i>A. craspedocarpa</i> . Mid shrubs (1-2 m): <i>A. tetragonophylla</i> , <i>Eremophila platycalyx</i> . Low shrubs (< 1 m): <i>M. pyramidata</i> , <i>Ptilotus obovatus</i> , <i>M. glomerifolia</i> , <i>M. triptera</i> , <i>M. aff. integra</i> , <i>Solanum lasiophyllum</i> .	2 inventory sites, 2 condition sites and traversed Vegetation type: Mulga Chenopod or Bluebush Shrubland. Palatable perennials include: <i>M. pyramidata</i> , <i>Rhagodia eremaea</i> , <i>M. aff. integra</i> , <i>P. obovatus</i> , <i>Cassia chatelainiana</i> , <i>Enchylaena tomentosa</i> . Pastoral use limitations: Moderately susceptible to accelerated erosion where degraded.

Millex I.s.—continued

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 6: Narrow drainage tracts (5%)</p> <p>Unchannelled drainage zones receiving concentrated flow mainly from units 2, 4 and 5. Soils are dark red hardpan sandy clay loams to 20 cm deep, overlying hardpan; pH 6.5-7.5 with a neutral trend. Principal profile form: Um5.31.</p>	<p>Moderately close (PFC 20-30%) shrubland dominated by <i>Acacia craspedocarpa</i> and <i>A. tetragonophylla</i>. Tall shrubs (> 2 m): <i>A. craspedocarpa</i>, <i>A. tetragonophylla</i>. Mid shrubs (1-2 m): <i>A. craspedocarpa</i>, <i>Eremophila latrobei</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>Sida calyxhymenia</i>, <i>Abutilon</i> sp., <i>Solanum lasiophyllum</i>.</p>	<p>1 inventory site and traversed</p> <p>Vegetation type: Hardpan Mulga Shrubland. Palatable perennials include: <i>Rhagodia eremaea</i>, <i>Ptilotus obovatus</i>, <i>Enchylaena tomentosa</i>. Pastoral use limitations: None under controlled grazing.</p>

Millrose land system (W) 535 km² (0.62% of survey area)

Land type: 3; Pastoral potential: low.

Level or very gently undulating stony plains on hardpan and granite with irregularly distributed sandy wanderrie banks, supporting mostly scattered mulga shrublands with minor wanderrie grasses.

Geology: Quaternary aeolian sand and alluvium on partly weathered Archaean gneiss and granite.

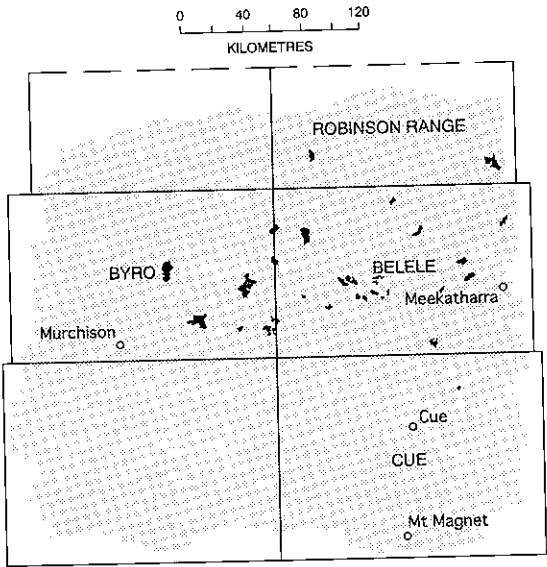
Geomorphology: Higher units with erosional surfaces; low stony outcrops and rises on very gently undulating interfluves; lower depositional surfaces over weathering granite and shallow red-brown hardpan: broad pebble and gravel-strewn plains on hardpan or granite; also sandy plains with granite outcropping; elongate sandy banks and sheets flanking ill defined drainage tracts; overall relief mostly < 6 m.

Vegetation and pastoral use: Stony Mulga Mixed Shrubland and Hardpan Mulga Shrublands of generally low productivity; minor patches of Wanderrie Grass Shrubland on units 2 and 3; some soils very acidic; scattered halophytes tend to be selectively grazed, particularly on units 1 and 4; condition often poorer on plains with shallow soils. Mild susceptibility to accelerated erosion on units 1, 4 and 5 when degraded.

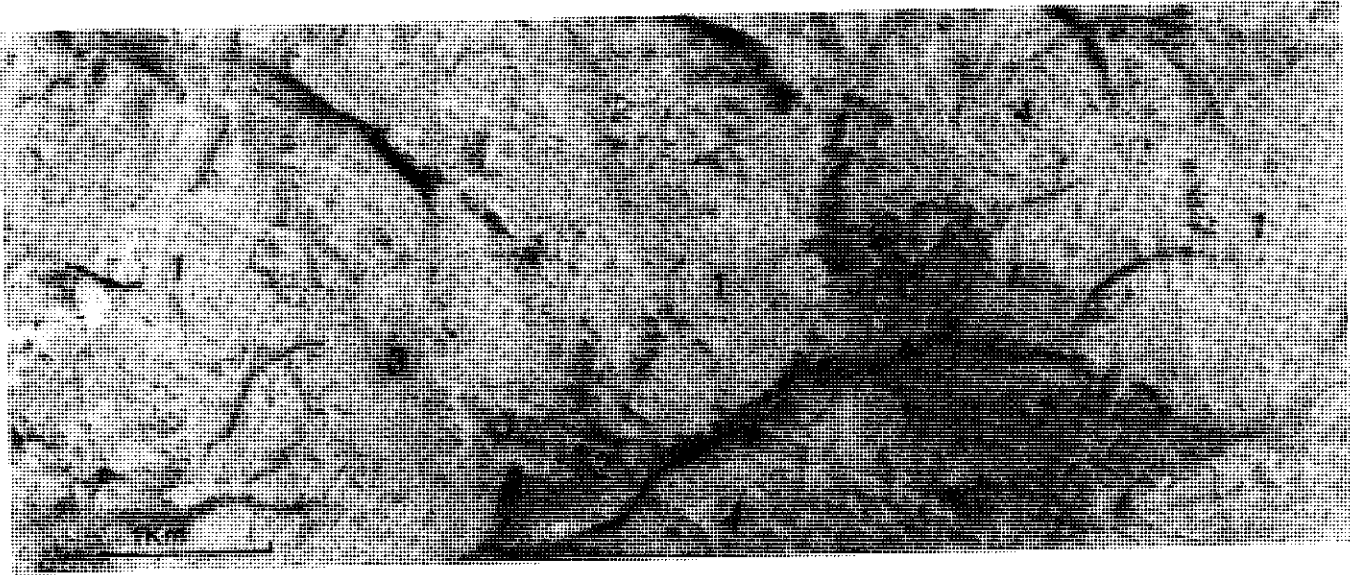
Estimated carrying capacity, good condition: 20 ha/dse.

Range condition summary (95 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
85	11	4	0	15	39	46



- Unit: 1. Stony plains.
2. Sandy banks.
3. Sandy surfaced plains on granite.
4. Hardpan plains.
5. Drainage tracts.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 1: Stony plains (40%)</p> <p>Gently sloping (< 1%) quartz interfluvial plains on granite, up to 1.5 km wide, with occasional granite outcrops and a moderately dense quartz pebbly mantle. Soils are shallow hardpan loams, red earths or hard-setting duplexes overlying granite or hardpan at < 35 cm; pH 4.5-7.5 with a mainly neutral reaction trend. Principal profile forms: Um5.51, Um5.31, Dr2.52.</p>	<p>Very scattered to scattered (PFC < 20%) mixed shrubland, <i>Acacia aneura</i>, <i>Eremophila</i> species and <i>Ptilotus obovatus</i>. Trees (2-4 m): <i>A. aneura</i>, <i>Canthium lineare</i>, <i>A. aff. citrinoviridis</i>. Tall shrubs (> 2 m): <i>A. aneura</i>. Mid shrubs (1-2 m): <i>A. aneura</i>, <i>E. freelingii</i>, <i>E. forrestii</i>. Low shrubs (< 1 m): <i>E. latrobei</i>, <i>Ptilotus obovatus</i>, <i>E. freelingii</i>.</p>	<p>3 inventory sites, 3 condition sites and traversed</p> <p>Vegetation type: Stony Mulga Mixed Shrubland. Palatable perennials include: <i>Eremophila forrestii</i>, <i>Ptilotus obovatus</i>, <i>P. schwartzii</i>, <i>Maireana</i> spp. Pastoral use limitations: None under controlled grazing. Vegetation condition %: VG/G 11, F 34, P/VP 55. Erosion incidence %: min 5. 38 obs.</p>
<p>Unit 2: Sandy banks (15%)</p> <p>Sandy banks up to 300 m wide and 1 km long, often overlying granitic material. Soils are probably red earthy sands.</p>	<p>Shrublands with prominent perennial grass layer of <i>Monachather paradoxa</i>, <i>Thyridolepis multiculmis</i> and <i>Eragrostis lanipes</i>. Trees and tall shrubs (> 2 m): <i>Acacia aneura</i>. Mid shrubs (1-2 m): <i>A. grasbyi</i>. Low shrubs (< 1 m): <i>Sida</i> sp., <i>Maireana triptera</i>.</p>	<p>1 condition site and traversed</p> <p>Vegetation type: Wanderrrie Bank Grassy Shrubland. Palatable perennials include: <i>Thyridolepis multiculmis</i>, <i>Monachather paradoxa</i>, <i>Eragrostis lanipes</i>, <i>Maireana triptera</i>, <i>Enchylaena tomentosa</i>. Pastoral use limitations: Mildly susceptible to erosion where degraded.</p>
<p>Unit 3: Sandy surfaced plains on granite (5%)</p> <p>Gently sloping (< 1.5%) sandy surfaced plains with frequent granite outcrops to > 5m high. Soils are shallow red or dark red granitic siliceous or earthy sands to 25 cm over granite; pH 6.0-6.5 with a neutral or acid reaction trend. Principal profile form: Uc5.21.</p>	<p>Scattered low woodland or tall shrubland (PFC 10-20%) dominated by low <i>Acacia aneura</i>, <i>A. cuthbertsonii</i> and <i>A. aff. quadrimarginea</i>. Trees (2-4 m): <i>A. aneura</i>. Tall shrubs (> 2 m): <i>A. cuthbertsonii</i>, <i>A. aff. quadrimarginea</i>. Mid shrubs (1-2 m): <i>Eremophila platycalyx</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>Solanum lasiophyllum</i>, <i>Eremophila punicea</i>, <i>E. latrobei</i>, <i>E. forrestii</i>, <i>E. fraseri</i>.</p>	<p>2 inventory sites and traversed</p> <p>Vegetation type: Granitic Mulga Shrubland. Palatable perennials include: <i>Sida calyxhymenia</i>, <i>Ptilotus obovatus</i>, <i>Rhagodia eremaea</i>, <i>Eremophila latrobei</i>, <i>Maireana convexa</i>, <i>M. planifolia</i>. Pastoral use limitations: None with controlled grazing.</p>
<p>Unit 4: Hardpan plains (35%)</p> <p>Flat hardpan plains with a sparse quartz mantle. Soils are shallow hardpan red sandy clay loams to 30 cm deep; pH 7.0 with a neutral reaction trend. Principal profile form: Um5.31.</p>	<p>Scattered (PFC 10-20%) shrublands, dominated by <i>Ptilotus obovatus</i>, <i>Eremophila forrestii</i> and <i>Solanum lasiophyllum</i>. Tall shrubs (> 2 m): <i>Acacia craspedocarpa</i>, <i>A. aneura</i>, <i>E. longifolia</i>. Mid shrubs (1-2 m): <i>A. kempeana</i>, <i>E. latrobei</i>, <i>E. forrestii</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>Solanum lasiophyllum</i>, <i>E. forrestii</i>.</p>	<p>1 inventory site, 3 condition sites and traversed</p> <p>Vegetation type: Hardpan Mulga Shrubland. Palatable perennials include: <i>Eremophila forrestii</i>, <i>Ptilotus obovatus</i>, <i>Maireana convexa</i>. Pastoral use limitations: Mildly susceptible to erosion where degraded. Vegetation condition %: VG/G 18, F 42, P/VP 40. Erosion incidence %: min 16, mod 3. 38 obs.</p>
<p>Unit 5: Narrow drainage tracts (5%)</p> <p>Flow zones up to 500 m wide with occasional small channels < 1 m. Soils are probably similar to unit 4.</p>	<p>Scattered (PFC 10-20%) mixed low woodland dominated by <i>Acacia aneura</i>. Trees (4-6 m): <i>A. aneura</i>. Tall shrubs (> 2 m): <i>A. tetragonophylla</i>. Mid shrubs (1-2 m): <i>Eremophila fraseri</i>, <i>A. cuthbertsonii</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>Solanum lasiophyllum</i>.</p>	<p>1 inventory site and traversed</p> <p>Vegetation type: Creekline Shrubland. Palatable perennials include: <i>Rhagodia eremaea</i>, <i>Ptilotus obovatus</i>. Pastoral use limitations: None under controlled grazing.</p>

Mindura land system (W) 3661 km² (4.26% of survey area)

Land type: 3; Pastoral potential: low.

Low hills, ridges and outcrops of granite, gneiss and quartz above convex, quartz-strewn interfluves and lower plains supporting sparse acacia shrublands.

Geology: Archaean gneiss and granitic rocks with some early Proterozoic inclusions and minor dykes and veins of quartz, dolerite and diorite; cemented Tertiary colluvium and Quaternary alluvium and colluvium, locally calcreted in north-east.

Geomorphology: Erosional surfaces; hills with crests to 30 m or more with much gneiss or granite exfoliation and benches with rock debris; short, discontinuous ridges above concave rocky slopes grading to broader, convex stony interfluves with low rounded rises < 20 m; some lower saline stony plains flanking incised dendritic drainage lines; overall relief (including hills) locally to 40 m but mostly < 30 m.

Vegetation and pastoral use: Rocky Hill Mixed Shrubland on hills and upper slopes; Stony Mulga Mixed Shrubland on interfluves and lower stony plains; mostly of low grazing productivity; patches of more productive Mulga Chenopod and Stony Snakewood Shrublands occur on more saline soils, with mixed bluebush species when in good condition but almost unrecognisable when degraded; vegetation on units 3, 4, 5 and 6 widely in poor condition; slight susceptibility to accelerated erosion of steam lines and major drainage tracts.

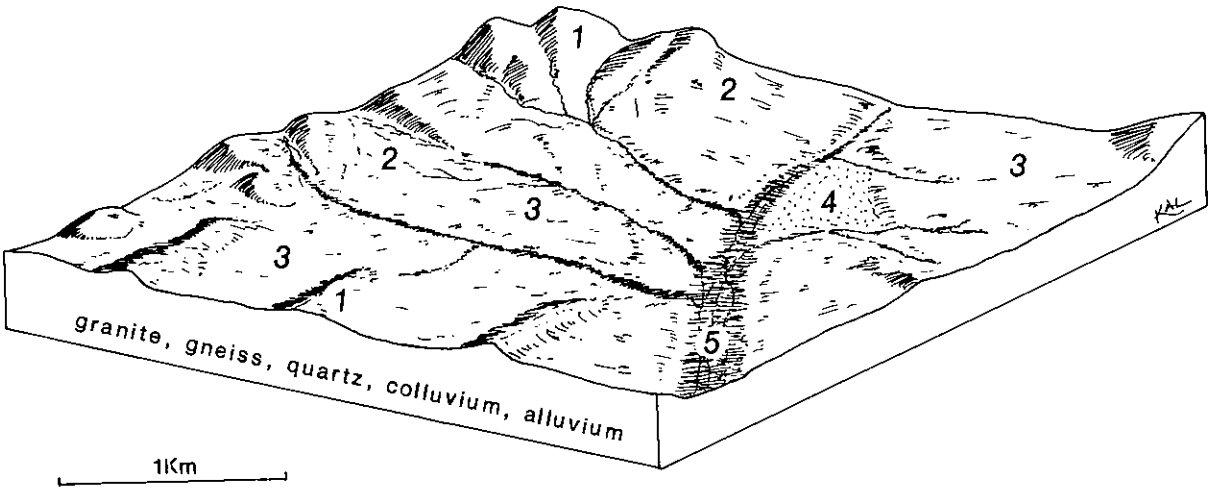
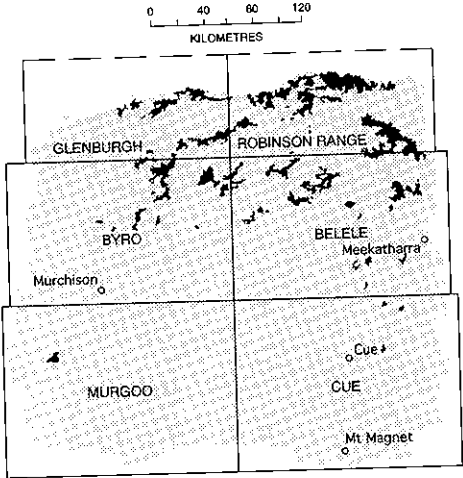
Estimated carrying capacity, good condition: 20 ha / dse.

Range condition summary (322 traverse observations):

(a) Erosion status (%)			
Nil	Min.	Mod.	Sev.
96	4	0	0

(b) Vegetation condition (%)		
Good	Fair	Poor
13	30	57

- Unit: 1. Low hills and ridges.
2. Hill slopes.
3. Stony plains and interfluves.
4. Saline stony plains.
5. Drainage floors.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Low hills and ridges (15%) Low hill crests and ridges to 30 m relief and steep upper slopes with extensive rock outcrops and moderately dense to very dense mantles of gneiss, granite, ironstone or quartz cobbles. Soils are lithosols or earthy shallow (< 35 cm) dark red coarse sands or clayey sands over granite or gneiss, stony throughout the profile and with a neutral reaction trend. Principal profile forms: Uc1., Uc5.51.	Very scattered to moderately close (PFC < 30%) low woodland dominated by <i>Acacia aneura</i> or <i>A. grasbyi</i> . Trees (2-6 m): <i>A. aneura</i> , <i>A. grasbyi</i> . Tall shrubs (> 2 m): <i>A. grasbyi</i> , <i>A. burkittii</i> . Mid shrubs (1-2 m): <i>A. aneura</i> , <i>A. tetragonophylla</i> , <i>Cassia sturtii</i> , <i>C. helmsii</i> , <i>Eremophila macmillaniana</i> . Low shrubs (< 1 m): <i>E. freelingii</i> , <i>Ptilotus obovatus</i> , <i>Solanum lasiophyllum</i> , <i>Scaevola spinescens</i> , <i>Cassia</i> spp. Perennial grass: <i>Eriachne</i> sp.	3 inventory sites, 1 condition site and traversed Vegetation type: Rocky Hill Mixed Shrubland. Palatable perennials include: <i>Eriachne</i> sp., <i>Tribulus platypterus</i> , <i>Eremophila latrobei</i> . Pastoral use limitations: Local inaccessibility to stock.
Unit 2: Hill slopes (15%) Concave slopes below unit 1, occasionally saline in parts; to 30 m above unit 5 with a moderately dense mantle of schist and quartz. Soils are shallow dark red or red-brown lithosols with acid or neutral reaction trend. Principal profile form: Uc1.43.	Moderately close (PFC 20-30%) low woodland or mixed shrublands dominated by <i>Acacia aneura</i> or <i>A. aff. grasbyi</i> . Trees (2-4 m): <i>A. aneura</i> , <i>A. aff. grasbyi</i> . Tall shrubs (> 2 m): <i>A. aff. quadrimarginea</i> , <i>A. xiphophylla</i> , <i>Eremophila fraseri</i> . Mid and low shrubs (1-2 m): <i>Solanum ashbyi</i> , <i>Cassia desolata</i> , <i>E. latrobei</i> , <i>E. cuneifolia</i> , <i>Ptilotus obovatus</i> , <i>Cassia helmsii</i> .	3 inventory sites, 1 condition site and traversed Vegetation type: Stony Acacia Hill Shrubland. Palatable perennials include: <i>Ptilotus obovatus</i> , <i>P. ashbyi</i> , <i>Eremophila latrobei</i> . Pastoral use limitations: None under controlled grazing.
Unit 3: Stony plains and interfluves (50%) Gently convex interfluves and plains with slopes < 1.5%, occasional quartz or gneiss outcrops, moderate to dense pebbly mantles of quartz and gneiss. Soils are dark red sandy clay loams or fine sandy loam over sandy clay loams mostly < 50 cm deep, over gneiss or granite; pH 5.5-7.0 with a strongly acidic or neutral trend. Principal profile forms: Um5.51, Gn2.12.	Scattered (PFC 10-20%) mixed shrublands dominated by <i>Acacia</i> , <i>Eremophila</i> and <i>Ptilotus</i> species. Trees: <i>A. pruinocarpa</i> . Tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. aff. quadrimarginea</i> , <i>A. victoriae</i> , <i>A. xiphophylla</i> . Mid shrubs (1-2 m): <i>Cassia helmsii</i> , <i>C. oligophylla</i> , <i>C. desolata</i> , <i>A. cuthbertsonii</i> , <i>A. grasbyi</i> , <i>A. tetragonophylla</i> , <i>Eremophila spathulata</i> , <i>E. fraseri</i> , <i>E. macmillaniana</i> , <i>E. freelingii</i> . Low shrubs (< 1 m): <i>E. spathulata</i> , <i>Ptilotus rotundifolius</i> , <i>P. schwartzii</i> , <i>P. obovatus</i> , <i>Solanum lasiophyllum</i> , <i>Grevillea deflexa</i> , <i>Maireana planifolia</i> , <i>M. triptera</i> , <i>Halosarcia</i> spp. Perennial grass: <i>Monachather paradoxa</i> .	5 inventory sites, 27 condition sites and traversed Vegetation type: Stony Mulga Mixed Shrubland. Palatable perennials include: <i>Ptilotus schwartzii</i> , <i>P. obovatus</i> , <i>P. rotundifolius</i> , <i>Maireana planifolia</i> , <i>M. georgei</i> , <i>M. melanocoma</i> , <i>M. thesioides</i> , <i>Grevillea deflexa</i> , <i>Rhagodia eremaea</i> . Pastoral use limitations: None under controlled grazing. Vegetation condition %: VG/G 14, F 31, VP/P 55. 190 obs.
Unit 4: Saline stony plains (10%) Plains with slopes generally < 1% and occasional outcrops of schist or other weathered rocks; sparse to moderately dense mantles of mixed composition. Soils are dark red loamy or duplex types, sandy loams over clayey loams or yellowish-red fine sandy loams, to 30 cm, pH 8.0 with an alkaline trend. Principal profile forms: Dr2.13, Um5.51.	Very scattered to scattered (PFC < 20%) mixed shrublands dominated by <i>Acacia cuspidifolia</i> and <i>A. xiphophylla</i> . Trees (4-6 m): <i>A. cuspidifolia</i> , <i>Eucalyptus</i> sp. Tall shrubs (> 2 m): <i>A. cuspidifolia</i> , <i>A. xiphophylla</i> , <i>A. sclerosperma</i> . Mid shrubs (1-2 m): <i>A. cuspidifolia</i> , <i>Eremophila youngii</i> . Low shrubs (< 1 m): <i>A. cuspidifolia</i> , <i>Cassia desolata</i> , <i>C. helmsii</i> , <i>Enchylaena tomentosa</i> , <i>Halosarcia</i> sp., <i>Scaevola tomentosa</i> , <i>Rhagodia eremaea</i> , <i>Frankenia magnifica</i> . Perennial grass: <i>Eriachne mucronata</i> .	3 inventory sites, 2 condition sites and traversed Vegetation type: Stony Snakewood Shrubland. Palatable perennials include: <i>Enchylaena tomentosa</i> , <i>Scaevola tomentosa</i> , <i>Rhagodia eremaea</i> , <i>Ptilotus beardii</i> , <i>Maireana georgei</i> , <i>M. thesioides</i> , <i>M. melanocoma</i> . Pastoral use limitations: None under controlled grazing.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 5: Drainage floors (10%) Drainage floors and valley bottoms 100-500 m wide with creeklines up to 100 m wide but more commonly < 50 m and incised < 2 m. Channel bedloads of sand and cobbles. Soils are deep brown earths, sands over sandy clay loam to > 1 m; pH 6.5-7.0 with a neutral trend. Principal profile form: Gn2.12.	Close or closed (PFC 30- > 50%) tall shrubland or low woodland dominated by <i>Acacia aneura</i> and <i>A. kempeana</i> . Trees (6-8 m): <i>A. aneura</i> , <i>A. aff. quadrimarginea</i> , <i>A. pruinocarpa</i> , <i>Hakea suberea</i> . Tall shrubs (> 2 m): <i>A. kempeana</i> , <i>A. cuthbertsonii</i> , <i>A. rhodophloia</i> , <i>A. tetragonophylla</i> . Mid shrubs (1-2 m): <i>A. kempeana</i> , <i>Eremophila forrestii</i> , <i>E. fraseri</i> . Low shrubs (< 1 m): <i>Solanum lasiophyllum</i> , <i>Cassia helmsii</i> , <i>C. desolata</i> .	2 inventory sites and traversed Vegetation type: Creekline Shrubland. Palatable perennials include: <i>Eremophila forrestii</i> , <i>Rhagodia eremaea</i> . Pastoral use limitations: Slightly susceptible to accelerated erosion where degraded and subject to preferential grazing. Vegetation condition %: VG/G 10, F 17, P/VP 73 Erosion incidence %: min 21. 42 obs.

Mongolia land system 456 km² (0.53% of survey area)

Land type: 7; Pastoral potential: moderate.

Very gently sloping to flat sandy-surfaced lateritic plains strewn with ironstone gravels, supporting acacia and minor halophytic shrublands.

Geology: Mainly Quaternary colluvium associated with late Proterozoic siltstones and sandstones of the Coomberarie formation (Badgeradda group); also Tertiary laterite.

Geomorphology: Erosional surfaces mostly adjacent to sandstone hill systems as pediment plains; low rounded rises and interfluvies above broad stony and lateritic plains with occasional sandplain remnants; lower alluvial plains flanking saline drainage floors; relief to 10 m.

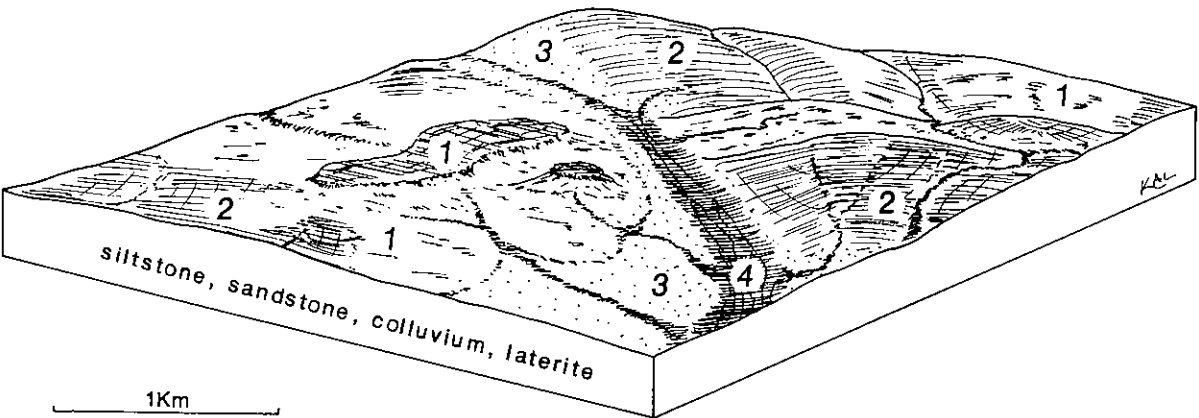
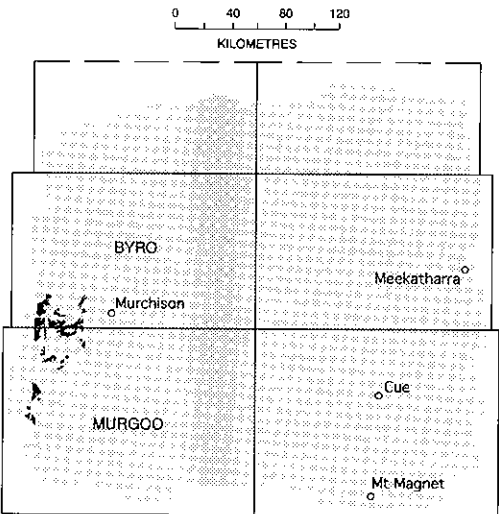
Vegetation and pastoral use: Mainly Lateritic Acacia Shrubland of low to moderate productivity with minor more productive Bluebush or Stony Snakewood Shrublands on deeper duplex soils; in good condition providing reasonable perennial reserves at low stocking rates as well as annual grazing in good seasons. Minor susceptibility to accelerated erosion on drainage floors with duplex soils.

Estimated carrying capacity, good condition: 12 ha/dse.

Range condition summary (72 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
96	3	1	0	39	39	22

- Unit: 1. Stony plains.
2. Gravelly plains.
3. Saline stony plains.
4. Drainage tracts.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Stony plains (40%) Very gently undulating plains with low stony rises and occasional breakaways to 10 m high and with slopes < 2% usually covered with moderately dense mantle of sandstone fragments. Occasional tracts of sand (usually < 500 m in extent) occur near higher margins of system. Soils are red or brown lithosols or hardpan loams, to 30 cm deep overlying hardpan or sandstone; pH 6.0-6.5 with a neutral reaction trend. Principal profile forms: Uc1.43, Um5.31.	Scattered (PFC 10-20%) tall shrublands dominated by <i>Acacia grasbyi</i> or <i>A. cuthbertsonii</i> . Trees (to 4 m): <i>A. aneura</i> . Tall shrubs (> 2 m): <i>A. grasbyi</i> , <i>A. tetragonophylla</i> , <i>A. cuthbertsonii</i> , <i>A. victoriae</i> . Mid shrubs (1-2 m): <i>A. grasbyi</i> , <i>Cassia nemophila</i> , <i>C. phyllodinea</i> , <i>E. platycalyx</i> . Low shrubs (< 1 m): <i>Ptilotus obovatus</i> , <i>P. schwartzii</i> , <i>Rhagodia eremaea</i> , <i>Sida calyxhymenia</i> , <i>Maireana thesioides</i> , <i>M. georgei</i> , <i>M. convexa</i> , <i>E. compacta</i> , <i>E. aff. compacta</i> .	2 inventory sites, 6 condition sites and traversed Vegetation type: Stony Mulga Mixed Shrubland. Palatable perennials include: <i>Ptilotus</i> spp., <i>Eremophila compacta</i> , <i>Rhagodia eremaea</i> , <i>Maireana</i> spp., <i>Sida calyxhymenia</i> . Pastoral use limitations: None with controlled grazing. Vegetation condition %: VG/G 39, F 33, P/VP 28. 40 obs.
Unit 2: Gravelly plains (30%) Almost flat plains (slopes < 1%) on parent rock and laterite; isolated patches of sand occur on higher parts; moderately dense to dense gravelly ironstone mantling. Soils are dark red gravelly sandy loams or reddish-brown gravelly sandy clay loams < 40 cm deep, overlying deeply weathered sandstone; pH 6.0-7.5 with a neutral to acidic reaction trend. Principal profile forms: Uc1.43, Um1.43.	Scattered to moderately close (PFC 10-30%) shrublands dominated by <i>Acacia grasbyi</i> or <i>Ptilotus obovatus</i> . Trees (to 4 m): <i>A. aneura</i> . Tall shrubs (> 2 m): <i>A. grasbyi</i> , <i>A. tetragonophylla</i> , <i>A. ramulosa</i> , <i>Exocarpus aphyllus</i> , <i>Hakea arida</i> . Mid shrubs (1-2 m): <i>Cassia helmsii</i> , <i>C. phyllodinea</i> , <i>Eremophila platycalyx</i> , <i>E. latrobei</i> . Low shrubs (< 1 m): <i>P. obovatus</i> , <i>Sida calyxhymenia</i> , <i>Maireana thesioides</i> , <i>M. georgei</i> , <i>M. triptera</i> , <i>E. compacta</i> .	2 inventory sites, 1 condition site and traversed Vegetation type: Lateritic Acacia Shrubland. Palatable perennials include: <i>Eremophila compacta</i> , <i>E. latrobei</i> , <i>Ptilotus obovatus</i> , <i>Sida calyxhymenia</i> , <i>Maireana</i> spp. Pastoral use limitations: None with controlled grazing.
Unit 3: Saline stony plains (20%) Almost flat plains often towards margins of system, with small scattered saline depressions and mantled with moderately dense siltstone, quartz and sandstone pebbles. Soils are shallow duplexes, dark red clayey sands over clay loams and light clays; pH 8.5 with an alkaline reaction trend.	Moderately close (PFC 20-30%) tall shrublands dominated by <i>Acacia xiphophylla</i> and <i>Maireana pyramidata</i> . Tall shrubs (> 2 m): <i>A. xiphophylla</i> , <i>A. tetragonophylla</i> , <i>Santalum spicatum</i> , <i>S. lanceolatum</i> . Mid shrubs (1-2 m): <i>A. tetragonophylla</i> . Low shrubs (< 1 m): <i>M. pyramidata</i> , <i>M. platycarpa</i> , <i>M. georgei</i> , <i>M. triptera</i> , <i>Atriplex bunburyana</i> , <i>Rhagodia eremaea</i> , <i>Lycium australe</i> , <i>Enchylaena tomentosa</i> , <i>Frankenia</i> spp., <i>Solanum lasiophyllum</i> , <i>S. orbiculatum</i> , <i>Halosarcia</i> sp.	1 inventory site, 1 condition site and traversed Vegetation type: Bluebush or Stony Snakewood Shrubland. Palatable perennials include: <i>Atriplex bunburyana</i> , <i>Maireana</i> spp., <i>Rhagodia eremaea</i> , <i>Enchylaena tomentosa</i> . Pastoral use limitations: None with controlled grazing.
Unit 4: Drainage tracts (10%) Flat drainage tracts on red-brown hardpan, to 300 m wide, with occasional shallow channels. Soils are probably duplex types overlying hardpan.	Very scattered to scattered (PFC < 20%) low or mixed shrublands dominated by <i>Eremophila pterocarpa</i> or <i>Maireana pyramidata</i> , with groves of non-halophytic shrubs. Trees (to 4 m): <i>Acacia aneura</i> . Tall shrubs (> 2 m): <i>A. tetragonophylla</i> , <i>A. victoriae</i> , <i>Hakea preissii</i> . Mid shrubs (1-2 m): <i>E. pterocarpa</i> , <i>E. fraseri</i> , <i>A. ramulosa</i> . Low shrubs (< 1 m): <i>M. pyramidata</i> , <i>M. platycarpa</i> , <i>Rhagodia eremaea</i> , <i>Atriplex amnicola</i> , <i>Ptilotus obovatus</i> , <i>P. divaricatus</i> , <i>Scaevola spinescens</i> , <i>Eremophila margarethae</i> . Perennial grass: <i>Stipa elegantissima</i> .	1 inventory site and traversed Vegetation type: Bluebush Shrubland. Palatable perennials include: <i>Maireana</i> spp., <i>Ptilotus</i> spp., <i>Rhagodia eremaea</i> , <i>Atriplex amnicola</i> , <i>Scaevola spinescens</i> . Pastoral use limitations: Mild to moderate susceptibility to accelerated water erosion where degraded.

Moogooloo land system (G) 20 km² (0.02% of survey area)

Land type: 1; Pastoral potential: low.

Intensely dissected plateaux, mesas and hills of sedimentary rocks with steep footslopes and dendritic drainage, supporting tall shrublands of mulga and other acacias; of only marginal occurrence in present area.

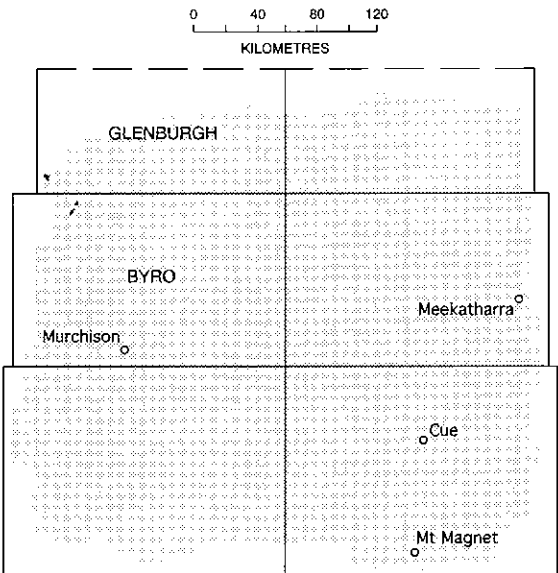
Geology: Permian quartz, sandstone, greywacke and siltstone of the Kennedy group.

Geomorphology: Erosional surfaces of residual flat topped hills with stony slopes, narrow valley floors and high density dendritic drainage lines with incised channels; relief to 60 m but mostly less.

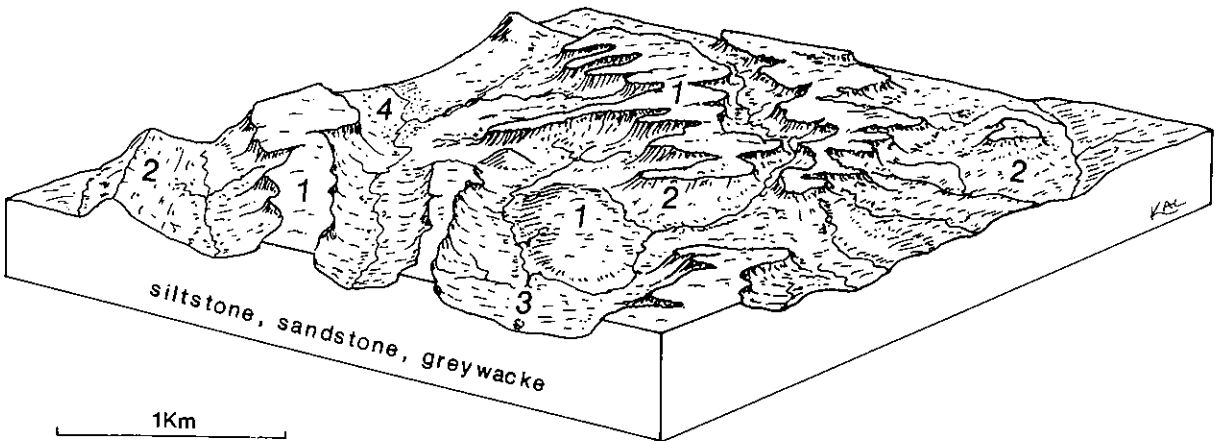
Vegetation and pastoral use: Unproductive hilly shrublands with some areas virtually inaccessible to stock. In favourable seasons, ephemerals and annuals provide some forage. Palatable perennial reserves generally low, even when in good condition.

Estimated carrying capacity, good condition: 20 ha/dse.

Range condition summary: Not traversed; Payne *et al.* (1987) report 58% in good condition, 37% fair and 5% was in poor condition.



- Unit: 1. Mesas and hills.
2. Stony slopes.
3. Drainage floors and incised creek lines.
4. Marginal alluvial plains.



Moogooloo I.s. (adapted from Payne *et al.* 1987)

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 1: Mesas and hills (40%)</p> <p>Mesas and low hills, relief up to 65 m, heavily strewn with sandstone cobbles and boulders. Soils are skeletal, very shallow red loamy sands, pH 6.0 with an acidic trend.</p>	<p>Scattered to moderately close tall shrublands dominated by <i>Acacia aneura</i>. Trees (4-6 m): <i>A. pruinocarpa</i>, <i>A. aneura</i>. Tall shrubs (2-4 m): <i>A. aneura</i>, <i>A. tetragonophylla</i>, <i>A. pruinocarpa</i>, <i>Heterodendrum oleaefolium</i>. Low shrubs (< 1 m): <i>Cassia helmsii</i>, <i>Eremophila forrestii</i>, <i>Rhagodia</i> spp., <i>Ptilotus obovatus</i>, <i>Solanum lasiophyllum</i>.</p>	<p>Vegetation type: Rocky Hill Mixed Shrubland. Perennials augmented by annual grasses and forbs in favourable season. Palatable perennials include: <i>Maireana</i> spp., <i>Ptilotus obovatus</i>. Pastoral use limitations: Inaccessibility to stock.</p>
<p>Unit 2: Stony slopes (40%)</p> <p>Even to convex slopes and hillsides sloping up to 20%, heavily strewn with sandstone pebbles and cobbles. Soils are dark red to brown sands or loams, loamy sand or fine sandy loam grading to light sandy clay loam, > 1 m deep, pH 6.0-8.0. Principal profile forms: Uc5.12, Um6.14.</p>	<p>Moderately close tall shrublands dominated by <i>Acacia</i> spp. Trees (2-6 m): <i>Acacia cuspidifolia</i>, <i>Grevillea</i> spp. Tall shrubs (2-4 m): <i>Acacia xiphophylla</i>, <i>Acacia</i> sp., <i>A. aneura</i>. Low shrubs (< 1 m): <i>Cassia desolata</i>, <i>C. helmsii</i>, <i>Solanum lasiophyllum</i>, <i>Enchylaena tomentosa</i>, <i>Frankenia</i> spp., <i>Eremophila cuneifolia</i>.</p>	<p>Vegetation type: Stony Snakewood Shrubland. Perennials augmented by annual grasses and forbs in favourable seasons. Palatable perennials include: <i>Maireana</i> spp., <i>Rhagodia eremaea</i>, <i>Enchylaena tomentosa</i>. Pastoral use limitations: Local inaccessibility to stock.</p>
<p>Unit 3: Drainage floors and incised creeklines (10%)</p> <p>Dendritic streams and drainage floors with sharply incised channels and creeklines. Soils are variable, locally duplex types immediately below scree slopes; channels with sandy or cobbly bedloads.</p>	<p>Tall shrublands dominated by <i>Acacia aneura</i> and <i>A. subtessaragona</i> with understorey shrubs mainly <i>Cassia</i> spp.</p>	<p>Vegetation type: Creekline Shrubland. Perennials augmented by annual grasses and forbs in favourable seasons. Pastoral use limitations: Local susceptibility to water erosion.</p>
<p>Unit 4: Marginal alluvial plains (10%)</p> <p>Flat to gently sloping plains, lightly to sparsely mantled by gravels or pebbles. Soils are sandy surfaced duplex types.</p>	<p>Very scattered to scattered tall shrublands dominated by <i>Acacia victoriae</i>, <i>A. cuspidifolia</i> or <i>A. xiphophylla</i>. Occasional <i>Atriplex bunburyana</i> and <i>Maireana</i> spp.</p>	<p>Vegetation type: Stony Snakewood Shrubland. Perennials augmented by annual grasses and forbs in favourable seasons. Palatable perennials include: <i>Atriplex bunburyana</i>. Pastoral use limitations: Mild susceptibility to erosion by wind and water.</p>

Naluthanna land system 26 km² (0.03% of survey area)

Land type: 2; Pastoral potential: low.

Rough hills, tor fields and slopes of gabbro above lower stony plains with gilgaied drainage floors supporting mixed acacia shrublands with sparse halophytes; a very minor system confined to the far south-east.

Geology: Archaean gabbro and minor basalt with dolerite intrusives.

Geomorphology: Erosional surfaces; rough gabbro strike ridges to 50 m high with unweathered gabbro outcrops above lower, rounded hills of more weathered rocks with dolerite dykes and sills; footslopes and lower stony plains covered with dense gabbro mantles flanking minor valleys of gilgaied alluvium with central meandering drainage channels; overall relief to 50 m.

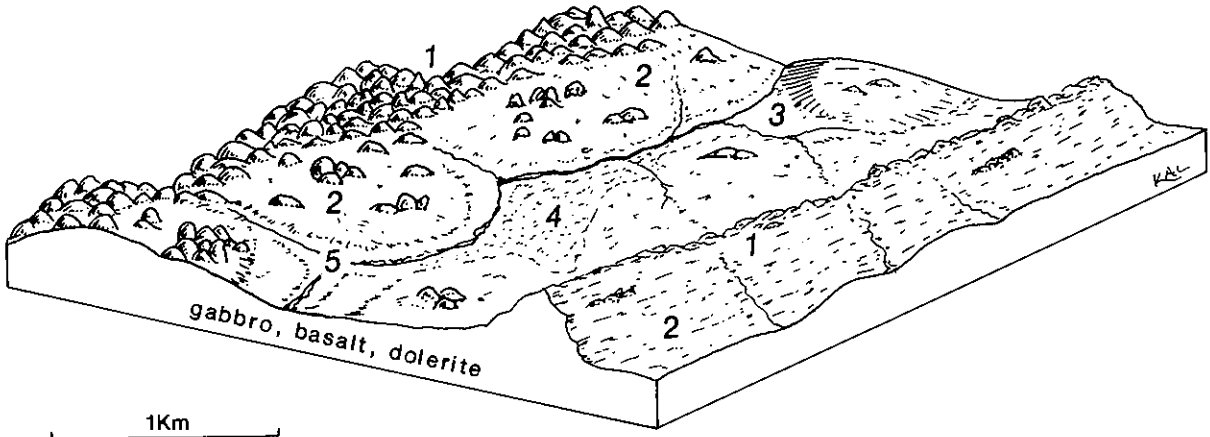
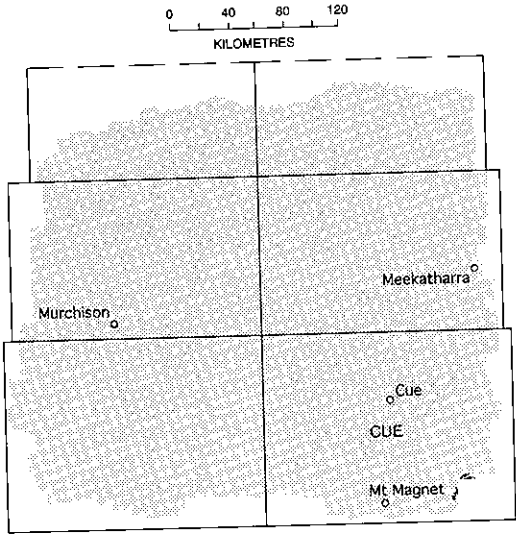
Vegetation and pastoral use: Hills and footslopes support Rocky Hill Mixed Shrubland and Granitic Mulga Shrubland of low to moderate productivity and upper parts inaccessible to stock; lower plains carry sparse Bluebush or Saltbush Shrubland, with pockets of Alluvial Tussock Grassland in gilgai depressions; unit 5 may be susceptible to erosion if degraded.

Estimated carrying capacity, good condition: 20 ha/dse.

Range condition summary (10 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
100	0	0	0	80	20	0

- Unit: 1. Hills, strike ridges and low rises.
2. Footslopes.
3. Saline stony plains.
4. Saline gilgai plains.
5. Narrow drainage floors.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Hills, strike ridges and low rises (45%) Gabbro hills, tor fields and rocky rises with crests to 50 m (mostly < 30 m) and steep upper slopes covered with dense gabbro mantles; also rough strike ridges with frequent outcrops of gabbro. Soils are probably skeletal lithosols, shallow sands or loamy sands over parent rock.	Mixed shrub communities with mainly scattered <i>Acacia</i> aff. <i>burkittii</i> (MRS No. 362), <i>A. ramulosa</i> , <i>Eremophila platycalyx</i> , <i>E. aff. mackinlayi</i> .	Traversed Vegetation type: Rocky Hill Mixed Shrubland. Pastoral use limitations: Poor accessibility to stock.
Unit 2: Footslopes (30%) Rough hillslopes with grades > 3% and extensive gabbro outcrops; lower slopes grading to lower stony plains with slopes < 3% with dense gabbro mantles. Soils are dark red shallow duplex types, loamy sands over clay loams to 40 cm deep over gabbro; pH 7.0-8.0 with a neutral trend. Principal profile form: Dr2.52.	Moderately close (PFC 20-30%) mixed shrublands dominated by <i>Acacia</i> aff. <i>burkittii</i> , <i>Eremophila platycalyx</i> or <i>E. aff. platycalyx</i> . Tall shrubs (> 2 m): <i>A. aff. burkittii</i> (MRS No. 362.), <i>A. ramulosa</i> , <i>A. sclerosperma</i> . Mid shrubs (1-2 m): <i>E. platycalyx</i> , <i>E. physocalyx</i> , <i>E. aff. mackinlayi</i> , <i>Dodonaea</i> aff. <i>inaequifolia</i> . Low shrubs (< 1 m): <i>E. aff. mackinlayi</i> , <i>Cassia helmsii</i> , <i>Maireana convexa</i> , <i>M. georgei</i> , <i>Ptilotus obovatus</i> , <i>Scaevola spinescens</i> , <i>Solanum lasiophyllum</i> .	1 inventory site and traversed Vegetation type: Rocky Hill Mixed Shrubland and Granitic Mulga Shrubland. Palatable perennials include: <i>Maireana</i> spp., <i>Ptilotus obovatus</i> , <i>Scaevola spinescens</i> . Pastoral use limitations: None with controlled grazing.
Unit 3: Saline stony plains (10%) Minor undulating clay plains (slopes to 1-5%) with moderately dense quartz and gabbro mantles; usually moderately saline, increasing downslope on margins of unit 2. Soils are dark red heavy clays < 50 cm deep overlying gabbro parent material; pH 7.0 with a neutral trend. Principal profile form: Uf6.21.	Very scattered to scattered (PFC < 20%) mixed shrublands with isolated <i>Hakea preissii</i> and <i>Maireana</i> spp. Tall shrubs (> 2 m): <i>H. preissii</i> , <i>Acacia aneura</i> , <i>A. sclerosperma</i> , <i>A. tetragonophylla</i> , <i>Pittosporum phylliraeoides</i> . Mid shrubs (1-2 m): <i>Eremophila</i> aff. <i>mackinlayi</i> . Low shrubs (< 1 m): <i>M. tomentosa</i> , <i>M. pyramidata</i> , <i>M. georgei</i> , <i>M. convexa</i> , <i>M. trichoptera</i> , <i>Rhagodia eremaea</i> , <i>Scaevola spinescens</i> , <i>Ptilotus obovatus</i> , <i>Solanum lasiophyllum</i> .	1 inventory site and traversed Vegetation type: Bluebush Shrubland. Palatable perennials include: <i>Maireana</i> spp., <i>Rhagodia eremaea</i> , <i>Ptilotus obovatus</i> , <i>Scaevola spinescens</i> . Pastoral use limitations: Little perennial forage for the vegetation type, but otherwise no limitations with controlled grazing.
Unit 4: Saline gilgai plains (10%) Restricted saline alluvial floors flanked by units 2 and 3; slopes < 1% with patches of gilgai depressions adjacent to sluggish drainage lines. Soils are probably dark red, light to heavy cracking clays > 1 m deep. Principal profile form: Ug5.36.	Scattered to very scattered (PFC < 20%) low shrublands dominated by <i>Atriplex amnicola</i> or <i>Maireana pyramidata</i> ; or scattered tussock grasslands dominated by <i>Eragrostis setifolia</i> .	Traversed Vegetation type: Bluebush or Saltbush Shrubland or Alluvial Tussock Grassland. Palatable perennials include: <i>Atriplex amnicola</i> , <i>Eragrostis setifolia</i> , <i>Eriachne flaccida</i> , <i>Eremophila maculata</i> , <i>Rhagodia</i> sp. Pastoral use limitations: None with controlled grazing.
Unit 5: Narrow drainage floors (5%) Dendritic drainage lines rising in upper parts of system and grading into broader alluvial floors usually with shallow incised channels < 20 m wide. Soils are hard-setting duplexes, dark red sandy loams over sandy clay loams < 1 m deep overlying gabbro parent material; pH 6.0-7.0 with a neutral trend. Principal profile form: Dr2.52.	Scattered woodland (PFC 10-20%) dominated by <i>Acacia aneura</i> . Trees (to 8 m): <i>A. aneura</i> , <i>Santalum spicatum</i> . Tall shrubs (> 2 m): <i>A. sp.</i> (MRS No. 362), <i>A. burkittii</i> . Mid shrubs (1-2 m): <i>Eremophila forrestii</i> , <i>E. platycalyx</i> . Low shrubs (< 1 m): <i>Ptilotus obovatus</i> , <i>Solanum lasiophyllum</i> , <i>Enchylaena tomentosa</i> , <i>Sida</i> sp.	1 inventory site and traversed Vegetation type: Creekline Shrubland. Palatable perennials include: <i>Eremophila forrestii</i> , <i>Ptilotus obovatus</i> , <i>Enchylaena tomentosa</i> , <i>Sida</i> sp. Pastoral use limitations: Mild susceptibility to erosion where degraded.

Narryer land system 2510 km² (2.92% of survey area)

Land type: 4; Pastoral potential: low.

Low hills and lateritised breakaways above very gently undulating stony slopes and plains on gneiss and granite with sparse acacia shrublands.

Geology: Massive Archaean banded gneiss, greenstone and quartzite wacke partly overlain by Tertiary laterite and patches of opaline silica; also Quaternary colluvium and alluvium.

Geomorphology: Erosional surfaces; remnant lateritic plateaux above breakaways to 15 m with scree slopes but limited development of pallid zones; rounded hills and occasional ridges to 20 m, mantled by dense ironstone gravel or laterite fragments; broad undulating stony plains and interfluvies with patches of exposed laterite capping and minor sandplain; narrow, channelled dendritic drainage tracts with occasional larger channels; overall relief to 20 m, occasionally greater.

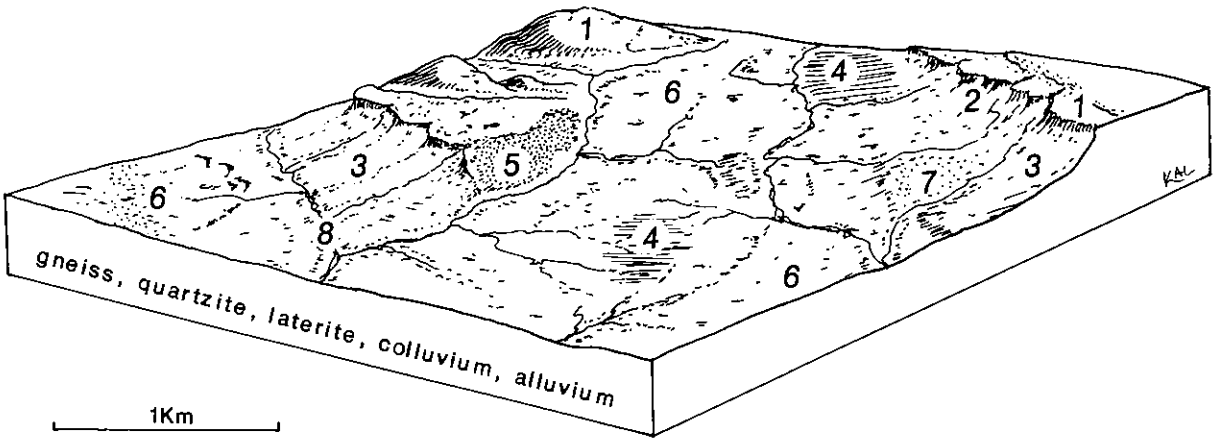
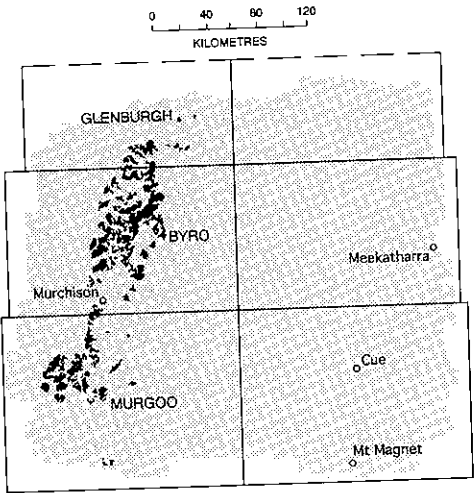
Vegetation and pastoral use: Mostly Granitic Mulga and Stony Mulga Mixed Shrubland with Rocky Hill Mixed Shrubland on plateaux and hills; saline parts of breakaway footslopes, stony plains and drainage tracts support patchy Stony Snakewood, Bluebush or Mulga Chenopod Shrubland which are often degraded and reduced to mainly annual understorey vegetation; major units not normally susceptible to erosion owing to protective mantles but units 3 and 7 are mildly susceptible when degraded.

Estimated carrying capacity, good condition: 20 ha/dse.

Range condition summary (300 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
88	9	3	0	11	35	54

- Unit: 1. Hill crests, ridges and low stony rises.
2. Breakaways and dissected plateaux.
3. Footslopes.
4. Lateritic plains.
5. Sandy banks and restricted sand sheets.
6. Stony plains.
7. Saline stony plains.
8. Drainage tracts and channels.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Hill crests, ridges and low stony rises (5%) Low stony hills and ridges to > 20 m with slopes generally < 2%; mostly covered with a dense mantle of mixed composition (mainly ironstone and quartz). Soils are shallow (< 30 cm) red or dark red earthy or granitic siliceous sands on gneiss or other metamorphic substrates; pH 4.5-6.5 with an acidic or strongly acidic reaction trend. Principal profile forms: Uc5.21, Um5.51, Uc5.11.	Very scattered to scattered (PFC < 20%) mixed shrublands dominated by <i>Acacia</i> aff. <i>coolgardiensis</i> , <i>A. craspedocarpa</i> or <i>A. aneura</i> . Trees (2-4 m): <i>A. aneura</i> , <i>Grevillea stenobotrya</i> . Tall shrubs (> 2 m): <i>A. craspedocarpa</i> , <i>A. aneura</i> , <i>A. ramulosa</i> . Mid shrubs (1-2 m): <i>A. cuthbertsonii</i> , <i>A. tetragonophylla</i> , <i>A. aff. coolgardiensis</i> , <i>Eremophila freelingii</i> , <i>E. spathulata</i> , <i>E. latrobei</i> , <i>Cassia desolata</i> . Low shrubs (< 1 m): <i>Maireana thesioides</i> , <i>M. planifolia</i> , <i>M. melanocoma</i> , <i>E. aff. compacta</i> , <i>Ptilotus schwartzii</i> , <i>P. obovatus</i> , <i>Solanum lasiophyllum</i> , <i>Hemigenia</i> sp., <i>Mirbelia spinosa</i> . Perennial grasses: <i>Monachather paradoxa</i> , <i>Eragrostis</i> sp.	4 inventory sites, 4 condition sites and traversed Vegetation type: Stony Mulga Mixed Shrubland. Palatable perennials include: <i>Maireana melanocoma</i> , <i>M. planifolia</i> , <i>M. thesioides</i> , <i>Ptilotus obovatus</i> , <i>P. schwartzii</i> , <i>Monachather paradoxa</i> , <i>Eragrostis</i> sp. Pastoral use limitations: None with controlled grazing.
Unit 2: Breakaways and dissected plateaux (3%) Low breakaways and lateritic scarps to 20 m high with slopes to 6%; covered with a dense quartz mantle. Soils are shallow skeletal lithosols overlying deeply weathered granite.	Scattered (PFC 10-20%) mixed height shrublands dominated by <i>Acacia aneura</i> . Trees (2-4 m): <i>A. aneura</i> . Tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. aff. citrinoviridis</i> , <i>A. grasbyi</i> . Mid shrubs (1-2 m): <i>A. cuthbertsonii</i> , <i>A. tetragonophylla</i> . Low shrubs (< 1 m): <i>Eremophila latrobei</i> , <i>Sida calyxhymenia</i> , <i>Ptilotus schwartzii</i> , <i>P. obovatus</i> , <i>Solanum lasiophyllum</i> .	1 inventory site and traversed Vegetation type: Lateritic Acacia Shrubland. Palatable perennials include: <i>Ptilotus obovatus</i> , <i>P. schwartzii</i> , <i>Sida calyxhymenia</i> . Pastoral use limitations: None with controlled grazing.
Unit 3: Footslopes (5%) Undulating and gently sloping stony footslopes below units 1 and 2, saline in lower parts. Soils are shallow crusted duplexes or granitic siliceous sands.	Scattered mixed shrublands dominated by <i>Acacia aneura</i> , <i>A. grasbyi</i> , <i>A. xiphophylla</i> with understorey of low halophytes, mainly <i>Frankenia</i> spp., or <i>Ptilotus beardii</i> and <i>Maireana</i> spp.	1 condition site and traversed Vegetation type: Stony Snakewood Shrubland or Mixed Halophyte Shrubland. Pastoral use limitations: None with controlled grazing.
Unit 4: Lateritic plains (10%) Gently undulating lateritic plains with slopes to 2% and relief to 15 m on higher parts of unit. Densely mantled with ironstone gravel. Soils are red or dark red gravelly loamy sands, fine sandy loams or clayey sands to 60 cm overlying gravel, ironstone or deeply weathered substrates; pH 4.5-6.0 with an acidic or neutral trend. Principal profile forms: Uc1.43, Uc5.11.	Scattered (PFC 10-20%) tall or mixed shrublands dominated by <i>Acacia ramulosa</i> or <i>A. aff. coolgardiensis</i> . Trees (6-8 m): <i>A. pruinocarpa</i> , <i>A. aneura</i> . Tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. aff. citrinoviridis</i> , <i>A. ramulosa</i> . Mid shrubs (1-2 m): <i>A. aff. coolgardiensis</i> , <i>Cassia desolata</i> , <i>Thryptomene decussata</i> , <i>A. tetragonophylla</i> , <i>Eremophila forrestii</i> . Low shrubs (< 1 m): <i>A. aff. coolgardiensis</i> , <i>Ptilotus obovatus</i> , <i>P. schwartzii</i> , <i>Solanum lasiophyllum</i> , <i>Thryptomene decussata</i> . Perennial grass: <i>Monachather paradoxa</i> .	3 inventory sites, 1 condition site and traversed Vegetation type: Sandplain Wanderrie Grassy Shrubland. Palatable perennials include: <i>Ptilotus obovatus</i> , <i>P. schwartzii</i> , <i>Monachather paradoxa</i> , <i>Eremophila forrestii</i> . Pastoral use limitations: None with controlled grazing. Vegetation condition %: VG/G 6, F 40, P/VP 54. Erosion incidence %: min 2. 48 obs.
Unit 5: Sandy banks and restricted sand sheets (2%) Isolated tracts of sand sheet or low sand banks extending to 1 km long and 0.5 km wide. Soils are probably earthy sands.	Scattered to moderately close (PFC 10-30%) tall or mid shrublands with <i>Acacia ramulosa</i> , <i>Eremophila forrestii</i> and a grassy understorey with <i>Monachather paradoxa</i> , <i>Eragrostis eriopoda</i> and <i>Thyridolepis</i> spp.	Traversed Vegetation type: Wanderrie Bank Grassy Shrublands. Pastoral use limitations: None with controlled grazing.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 6: Stony plains (60%)</p> <p>Extensive areas of gently undulating stony plains with slopes to 2%. Often moderately saline and with outcrops of granite or gneiss. Soils vary from lithosols and earthy sands to duplexes or isolated pockets of red clays to 35 cm, overlying granite, hardpan or metamorphic material; pH 5.5-8.0 with a mainly neutral trend (occasionally acidic). Principal profile forms: Uc5.21, Uc1.43, Um5.51, Uf6.31, Dr2.52.</p>	<p>Very scattered to scattered (PFC < 20%) shrublands, variably dominated by <i>Acacia</i> species or <i>Eremophila macmillaniana</i> or <i>E. freelingii</i>. Trees (2-4 m): <i>A. aneura</i>. Tall shrubs (> 2 m): <i>A. xiphophylla</i>, <i>A. aneura</i>, <i>A. ramulosa</i>, <i>A. grasbyi</i>. Mid shrubs (1-2 m): <i>A. tetragonophylla</i>, <i>Eremophila cuneifolia</i>, <i>E. freelingii</i>, <i>E. macmillaniana</i>, <i>E. spathulata</i>, <i>Maireana georgei</i>, <i>M. triptera</i>, <i>Rhagodia eremaea</i>, <i>Solanum lasiophyllum</i>, <i>Ptilotus obovatus</i>, <i>P. schwartzii</i>.</p>	<p>3 inventory sites, 31 condition sites and traversed</p> <p>Vegetation type: Stony Mulga Mixed Shrubland. Palatable perennials include: <i>Maireana georgei</i>, <i>M. pyramidata</i>, <i>M. triptera</i>, <i>Rhagodia eremaea</i>, <i>Ptilotus obovatus</i>, <i>P. schwartzii</i>. Pastoral use limitations: None under controlled grazing. Vegetation condition %: VG/G 15, F 41, P/VP 44. Erosion incidence %: min 3. 140 obs.</p>
<p>Unit 7: Saline stony plains (10%)</p> <p>Flat to gently sloping plains, mainly adjacent to outcrops of deeply weathered parent rocks, with moderately dense mantling of quartz pebbles. Soils are shallow dark red duplex or clay types, pH 6.0-7.5 with a neutral reaction trend. Principal profile forms: Dr2.52, Uf6.31.</p>	<p>Very scattered to scattered (PFC < 20%) mixed shrublands dominated by <i>Maireana</i> and <i>Acacia</i> species. Tall shrubs (2-4 m): <i>Acacia aneura</i>, <i>A. ramulosa</i>, <i>A. xiphophylla</i>. Medium shrubs (1-2 m): <i>Hakea arida</i>, <i>H. preissii</i>, <i>Scaevola spinescens</i>, <i>Cassia sturtii</i>, <i>C. nemophila</i>, <i>Maireana pyramidata</i>, <i>Rhagodia drummondii</i>. Low shrubs (< 1 m): <i>Maireana pyramidata</i>, <i>M. triptera</i>, <i>M. georgei</i>, <i>M. tomentosa</i>, <i>M. glomerifolia</i>, <i>Frankenia</i> spp., <i>Halosarcia</i> spp.</p>	<p>3 inventory sites, 1 condition site and traversed</p> <p>Vegetation type: Mulga Chenopod Shrubland or Bluebush Shrubland. Palatable perennials include: <i>M. georgei</i>, <i>M. glomerifolia</i>, <i>M. atkinsiana</i>, <i>Sida calyxhymenia</i>, <i>Ptilotus divaricatus</i>. Pastoral use limitations: None under controlled grazing.</p>
<p>Unit 8: Drainage tracts and channels (5%)</p> <p>Dendritic drainage tracts to 300 m wide, channels incised to 4 m deep. Soils of drainage floors are often sandy surfaced duplexes or shallow loamy sands overlying hardpan, pH 6.5 with a neutral trend. Principal profile forms: Dr1., Uc5.21.</p>	<p>Moderately close to closed (PFC 20- > 50%) woodland dominated by <i>Acacia ramulosa</i> in washlines; <i>A. rhodophloia</i> or <i>A. tetragonophylla</i> on channel margins. Trees (to 8 m): <i>A. aneura</i>, <i>A. pruinocarpa</i>, <i>Eucalyptus coolabah</i>, <i>Hakea suberea</i>. Tall shrubs (> 2 m): <i>A. ramulosa</i>, <i>A. rhodophloia</i>, <i>A. tetragonophylla</i>, <i>A. aneura</i>. Mid shrubs (1-2 m): <i>Cassia helmsii</i>, <i>A. ramulosa</i>, <i>A. palustris</i>, <i>Eremophila fraseri</i>, <i>E. forrestii</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>Solanum lasiophyllum</i>, <i>Grevillea deflexa</i>, <i>Cassia nemophila</i>. Perennial grasses: <i>Monachather paradoxa</i>, <i>Eragrostis lanipes</i>.</p>	<p>2 inventory sites, 1 condition site and traversed</p> <p>Vegetation type: Mulga Grove Woodland and Creekline Grassy Shrubland. Palatable perennials include: <i>Ptilotus obovatus</i>, <i>Eremophila forrestii</i>, <i>Monachather paradoxa</i>, <i>Eragrostis lanipes</i>. Pastoral use limitations: Moderately susceptible to accelerated water erosion where degraded. Vegetation condition %: VG/G 3, F 14, P/VP 83. Erosion incidence %: min 45, mod 10. 29 obs.</p>

Nerramyne land system 848 km² (0.99% of survey area)

Land type: 7; Pastoral potential: low.

Undulating plains of sandy-surfaced laterite and weathered granite with low remnant plateaux, breakaways and rises supporting acacia shrublands.

Geology: Massive Archaean granite partly overlain by Tertiary laterite and Quaternary aeolian sandplain and alluvium.

Geomorphology: Mostly erosional surfaces; remnant lateritised plateaux, associated breakaways and footslopes; low, rounded laterite and quartz covered rises and ridges; broad and gently undulating plains with colluvial and alluvial surface deposits of ironstone gravels below exposed weathered granite and laterite; minor sandplain remnants mask laterite plains; variable dendritic drainage below old plateaux remnants; overall relief to 10 m.

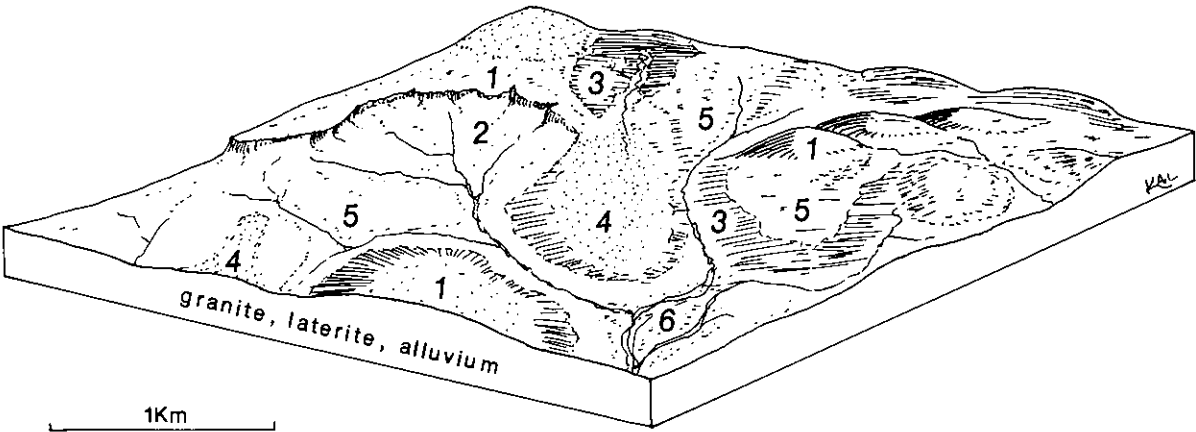
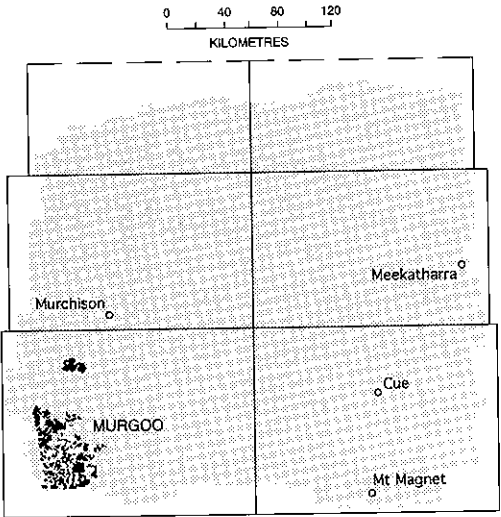
Vegetation and pastoral use: Lateritic Acacia Shrubland and Granitic Mulga Shrubland with minor areas of Bluebush and Mixed Halophytic Shrublands on saline footslopes and drainage plains, often degraded owing to their restricted distribution; slight susceptibility to accelerated erosion on units 3 and 5 when degraded.

Estimated carrying capacity, good condition: 20 ha/dse.

Range condition summary (146 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
87	6	5	2	16	40	44

- Unit: 1. Low hills and plateaux.
2. Footslopes below breakaways.
3. Gravelly plains.
4. Sand sheets and low banks.
5. Stony plains.
6. Drainage zones.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 1: Low hills and plateaux (8%)</p> <p>Weathered hills and plateaux above low breakaways with minor areas of exposed pallid zone slopes to 4% and to 10 m high. Also gently sloping low ridges and rises of deeply weathered granite, often densely mantled with weathered, platy ironstone and quartz pebbles. Soils are shallow, brown or reddish-brown coarse skeletal lithosols over granite < 20 cm deep; pH 6.0-7.0 with a neutral reaction trend. Principal profile form: Uc1.43.</p>	<p>Scattered or very scattered (PFC < 20%) mixed or low shrublands dominated by <i>Acacia ramulosa</i>. Tall shrubs (> 2 m): <i>A. ramulosa</i>, <i>A. burkittii</i>, <i>A. aneura</i>, <i>A. palustris</i>, <i>A. grasbyi</i>. Mid shrubs (1-2 m): <i>A. ramulosa</i>, <i>Eremophila glutinosa</i>, <i>Hakea recurva</i>, <i>A. tetragonophylla</i>, <i>E. latrobei</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>Solanum lasiophyllum</i>, <i>S. orbiculatum</i>, <i>Borja nitida</i>, <i>Dodonaea boroniifolia</i>, <i>Calytrix</i> sp., <i>Eriostemon brucei</i>, <i>Micromyrtus racemosa</i>.</p>	<p>1 inventory sites and traversed</p> <p>Vegetation type: Lateritic Acacia Shrubland. Palatable perennial shrubs include: <i>Eremophila latrobei</i>, <i>Ptilotus obovatus</i>, <i>Maireana</i> spp., <i>Scaevola spinescens</i>. Pastoral use limitations: None under controlled grazing.</p>
<p>Unit 2: Footslopes below breakaways (2%)</p> <p>Quartz strewn slopes, some lying below minor pallid zone development, < 300 m long. Soils are granitic siliceous sands or shallow crusted duplexes over decomposing granite.</p>	<p>Very scattered low shrublands (PFC < 10%). Mid shrubs (1-2 m): <i>Acacia</i> aff. <i>coolgardiensis</i>, <i>A. burkittii</i>, <i>Hakea arida</i>, <i>Acacia tetragonophylla</i>, <i>A. grasbyi</i>, <i>Frankenia</i> sp., <i>Maireana glomerifolia</i>, <i>Ptilotus obovatus</i>. Low shrubs (< 1 m): <i>Rhagodia drummondii</i>, <i>Cassia phyllodinea</i>.</p>	<p>1 inventory site and traversed</p> <p>Vegetation type: Mixed Halophyte Shrubland or Bluebush Shrubland. Palatable perennials include: <i>Maireana glomerifolia</i>, <i>Frankenia</i> spp. Pastoral use limitations: Preferentially grazed and locally susceptible to microterracing and rilling where degraded.</p>
<p>Unit 3: Gravelly plains (30%)</p> <p>Gently sloping plains on weathered granite foundation with undulations to 5 m high occurring at 2-3 km intervals; usually covered with dense mantle of fine ironstone fragments. Soils are gravelly brown or yellowish-red loamy sands < 1 m deep over gravels; pH 6.0 with an acidic trend. Principal profile form: Uc1.43.</p>	<p>Scattered or moderately close (PFC 10-30%) tall or mixed shrublands dominated by <i>Acacia</i> aff. <i>acuminata</i> or <i>A. ramulosa</i>. Tall shrubs (> 2 m): <i>A. aff. acuminata</i>, <i>A. ramulosa</i>, <i>A. tetragonophylla</i>, <i>Thryptomene decussata</i>, <i>Eremophila forrestii</i>. Low shrubs (< 1 m): <i>T. decussata</i>, <i>E. aff. malacoides</i>, <i>Ptilotus obovatus</i>. Perennial grasses: <i>Monachather paradoxa</i>, <i>Stipa elegantissima</i>.</p>	<p>2 inventory sites, 1 condition site and traversed</p> <p>Vegetation type: Lateritic Acacia Shrubland. Palatable perennials include: <i>Eremophila forrestii</i>, <i>Ptilotus obovatus</i>, <i>Monachather paradoxa</i>. Pastoral use limitations: None with controlled grazing.</p>
<p>Unit 4: Sand sheets and low banks (5%)</p> <p>Isolated areas of remnant sandplain, usually < 1 km in extent with slopes < 1% and relief occasionally to 2 m. Soils are red or reddish-brown earthy or siliceous sands > 1 m deep; pH 5.5-7.0 with a neutral or acidic trend. Principal profile form: Uc5.21.</p>	<p>Scattered to moderately close (PFC 10-30%) tall shrublands with prominent hummock grasses (up to 25% cover) dominated by <i>Triodia</i> sp. Trees (to 8 m): <i>Eucalyptus</i> sp., <i>E. hypochlamydea</i>. Tall shrubs (> 2 m): <i>Acacia ligulata</i>, <i>T. decussata</i>, <i>A. ramulosa</i>, <i>A. rhodophloia</i>. Mid shrubs (1-2 m): <i>Eremophila forrestii</i>, <i>E. granitica</i>, <i>Grevillea</i> sp., <i>T. decussata</i>. Low shrubs (< 1 m): <i>Keraudrinia hermanniifolia</i>, <i>Sida cardiophylla</i>, <i>Ptilotus obovatus</i>, <i>P. schwartzii</i>. Perennial grasses: <i>Triodia</i> sp., <i>Monachather paradoxa</i>, <i>Stipa elegantissima</i>, <i>Thyridolepis multiculmis</i>.</p>	<p>2 inventory sites and traversed</p> <p>Vegetation type: Sandplain Wanderrie Grassy Shrubland or Sandplain Mallee-Acacia-Spinifex Shrubland. Palatable perennials include: <i>Sida</i> spp., <i>Ptilotus</i> spp., <i>Monachather paradoxa</i>, <i>Thyridolepis multiculmis</i>. Pastoral use limitations: None with controlled grazing.</p>

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 5: Stony plains (40%)</p> <p>Gently sloping and undulating plains lower than units 1, 2 and 4, with moderately dense mantles of quartz and ironstone gravel with extensive very low granite outcrops. Soils are shallow yellowish-red, red or dark red granitic siliceous sands or sandy clay loams over granite at < 50 cm deep; pH 6.0-7.0 with a neutral or acidic reaction trend. Principal profile forms: Gn2.11, Uc1.43, Uc5.21, Um5.51.</p>	<p>Scattered to moderately close (PFC 10-30%) tall or mixed shrublands dominated by <i>Acacia grasbyi</i>, <i>Hakea arida</i>, <i>Cassia phyllodinea</i>, <i>Eremophila punicea</i> or <i>Ptilotus obovatus</i>. Tall shrubs (> 2 m): <i>A. burkittii</i>, <i>A. grasbyi</i>, <i>A. tetragonophylla</i>, <i>A. ramulosa</i>, <i>H. arida</i>. Mid shrubs (< 2 m): <i>C. phyllodinea</i>, <i>H. arida</i>, <i>Thryptomene mucronata</i>, <i>E. latrobei</i>, <i>E. platycalyx</i>, <i>E. aff. mackinlayi</i>, <i>E. glandulifera</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>P. schwartzii</i>, <i>Thryptomene decussata</i>, <i>E. punicea</i>, <i>Maireana convexa</i>, <i>M. villosa</i>, <i>M. thesioides</i>, <i>Sida calyxhymeria</i>, <i>Scaevola spinescens</i>.</p>	<p>4 inventory sites, 9 condition sites and traversed</p> <p>Vegetation type: Granitic Mulga Shrubland or Stony Mulga Mixed Shrubland. Palatable perennials include: <i>Eremophila latrobei</i>, <i>Ptilotus obovatus</i>, <i>P. schwartzii</i>, <i>Maireana</i> spp., <i>Sida</i> spp., <i>Scaevola spinescens</i>. Pastoral use limitations: None with controlled grazing.</p>
<p>Unit 6: Drainage zones (15%)</p> <p>Narrow drainage zones from catchments in the higher units and adjacent elevated systems (e.g. Kalli and Challenge); creeklines locally flooding onto broad, saline alluvial fans, otherwise continuing as zones with channels, locally incised, over hardpan. Soils are duplex types dark red clayey sand or loamy sands over red or reddish-brown light clays to 90 cm deep; pH 6.0-8.0 with a neutral trend. Principal profile forms: Gn.2.12, Dr1.55.</p>	<p>a) Very scattered (PFC < 10%) low shrublands dominated by <i>Frankenia</i> spp. Tall shrubs (> 2 m): <i>Acacia tetragonophylla</i>, <i>A. sclerosperma</i>, <i>A. grasbyi</i>. Mid shrubs (1-2 m): <i>Eremophila platycalyx</i>. Low shrubs (< 1 m): <i>F. magnifica</i>, <i>Ptilotus obovatus</i>, <i>P. divaricatus</i>, <i>Rhagodia drummondii</i>, <i>R. eremaea</i>, <i>Chenopodium gaudichaudanum</i>, <i>Scaevola spinescens</i>. b) Moderately close to close (PFC 20-50%) tall and mixed height shrublands dominated by <i>Acacia aneura</i> or <i>A. tetragonophylla</i>. Trees (to 6 m): <i>A. aneura</i>. Tall shrubs (> 2 m): <i>A. tetragonophylla</i>, <i>A. burkittii</i>, <i>A. aneura</i>, <i>Hakea arida</i>. Mid shrubs (1-2 m): <i>A. aneura</i>, <i>Eremophila forrestii</i>, <i>E. latrobei</i>, <i>E. platycalyx</i>. Low shrubs (< 1 m): <i>Abutilon</i> sp., <i>Sida calyxhymeria</i>, <i>S. sp.</i>, <i>Enchylaena tomentosa</i>, <i>Chenopodium gaudichaudanum</i>, <i>Scaevola spinescens</i>, <i>Maireana thesioides</i>, <i>M. villosa</i>, <i>Ptilotus schwartzii</i>.</p>	<p>2 inventory sites and traversed</p> <p>Vegetation type: a) Mixed Halophyte Shrubland. b) Creekline Shrubland. Palatable perennials include: <i>Ptilotus</i> spp., <i>Frankenia</i> spp., <i>Rhagodia</i> spp., <i>Maireana</i> spp., <i>Enchylaena tomentosa</i>, <i>Scaevola spinescens</i>, <i>Chenopodium gaudichaudanum</i>, <i>Sida</i> spp., <i>Eremophila forrestii</i>, <i>E. latrobei</i>. Pastoral use limitations: Moderate susceptibility to accelerated erosion if vegetation is degraded.</p>

Nerren land system (CB) 110 km² (0.13% of survey area)

Land type: 11; Pastoral potential: low.

Very gently undulating red sandplain with tall wanyu shrubland and patchy mallee shrubland virtually identical to Sandplain land system (further north), but with more *Eucalyptus* and some understorey species from South-Western Botanical Province vegetation.

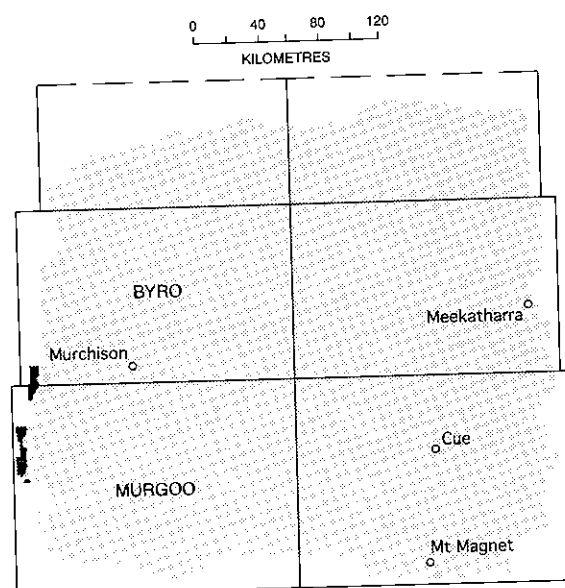
Geology: Quaternary sand.

Geomorphology: Depositional surfaces; extensive red or reddish yellow sandplains with deep soils; relief up to 10 m, though usually much less; no drainage features.

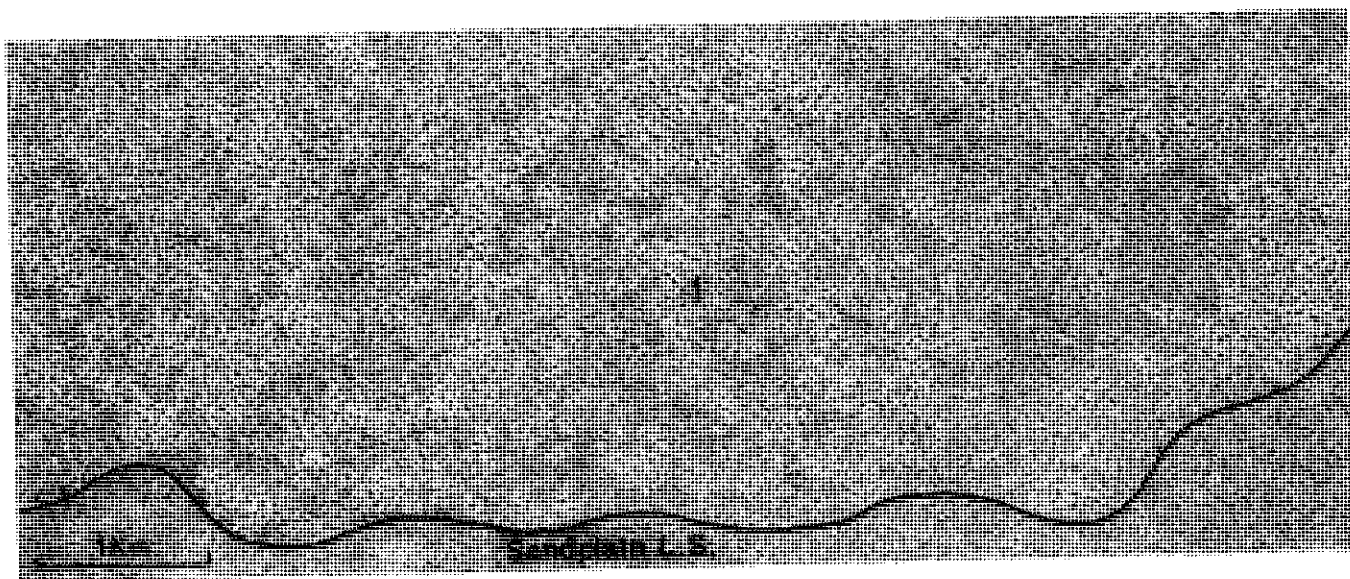
Vegetation and pastoral use: Sandplain Acacia Shrubland of low to very low pastoral potential; very sparse palatable perennial shrubs and wanderie grasses; minor areas of mallee thickets with palatable understorey shrubs; most areas useful only from seasonal grazing of forbs and grasses; surfaces stable and not normally susceptible to erosion; effects of fire probably profound but no data available.

Estimated carrying capacity, good condition: 20 ha/dse.

Range condition summary: One site record and poorly traversed; condition probably mainly good.



Unit: 1. Sand plains.



Nerren I.s.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 1: Sand plains (100%)</p> <p>Extensive flat to very gently undulating plains of red sand with slopes < 1%. Soils are red or dark red siliceous sands or earthy sands > 1 m deep. Principal profile form: Uc5.21.</p>	<p>Moderately close (PFC 20-30%) tall shrublands dominated by <i>Acacia ramulosa</i> with <i>Eucalyptus</i> spp. Trees and mallees (to 10 m): <i>Eucalyptus</i> sp. (MRS No 488), <i>E. aff. foecunda</i>, <i>E. oldfieldii</i>, <i>Callitris collumellaris</i>, <i>Brachychiton gregorii</i>. Tall shrubs (to 6 m): <i>A. ramulosa</i>, <i>A. roycei</i>, <i>Stylobasium spathulatum</i>. Mid shrubs (1-2 m): <i>A. ramulosa</i>, <i>A. wiseana</i>, <i>Eremophila forrestii</i>, <i>E. latrobei</i>, <i>Pimelea microcephala</i>, <i>S. spathulatum</i>. Low shrubs (< 1 m): <i>E. aff. forrestii</i>, <i>Dianella revoluta</i>, <i>Ptilotus schwartzii</i>, <i>P. obovatus</i>. Perennial grasses (infrequent): <i>Monachather paradoxa</i>, <i>Stipa elegantissima</i>.</p>	<p>3 inventory sites and traversed</p> <p>Vegetation type: Sandplain Acacia Shrubland. Palatable perennials include: <i>Eremophila forrestii</i>, <i>E. latrobei</i>, <i>Ptilotus</i> spp., <i>Monachather paradoxa</i>, <i>Stipa elegantissima</i>. Pastoral use limitations: None under controlled grazing.</p>

Norie land system (W) 1321 km² (1.54% of survey area)

Land type: 1; Pastoral potential: low.

Granite hills with exfoliating domes and extensive tor fields, supporting acacia shrublands.

Geology: Massive Archaean biotitic and porphyritic granite and banded gneiss, minor Tertiary laterite and shallow Quaternary alluvium and colluvium.

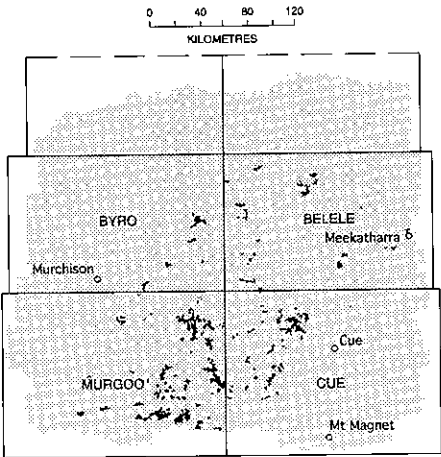
Geomorphology: Erosional surfaces; mainly low hills of unweathered granite with actively eroding slopes and extensive outcrops; clusters of exfoliating granite tors with large batholiths to 30 m high; sandy surfaced footslopes and plains below hills and tor fields, with narrow alluvial fans tributary to minor drainage tracts; overall relief usually 20 to 100 m.

Vegetation and pastoral use: Rocky Hill Mixed Shrubland on hills and tor fields, mostly inaccessible to stock and of low pastoral value; sandy lower plains support moderately productive Granitic Mulga Shrubland in mostly fair condition; drainage fringes and foci at bases of large granites carry dense Mulga Grove Woodland associations, in which kite leaf poison (*Gastrolobium laytonii*) is locally common, particularly in the south-east of the survey area; saline footslopes locally support patchy but useful Bluebush Shrubland but the unit is preferentially grazed and mostly degraded; drainage tracts and alluvial fans are slightly susceptible to accelerated erosion. Presence of poison, especially in areas where it grows away from the confines of thickets in the drainage foci, has restricted use for livestock, especially in poor seasons when risk of losses is high.

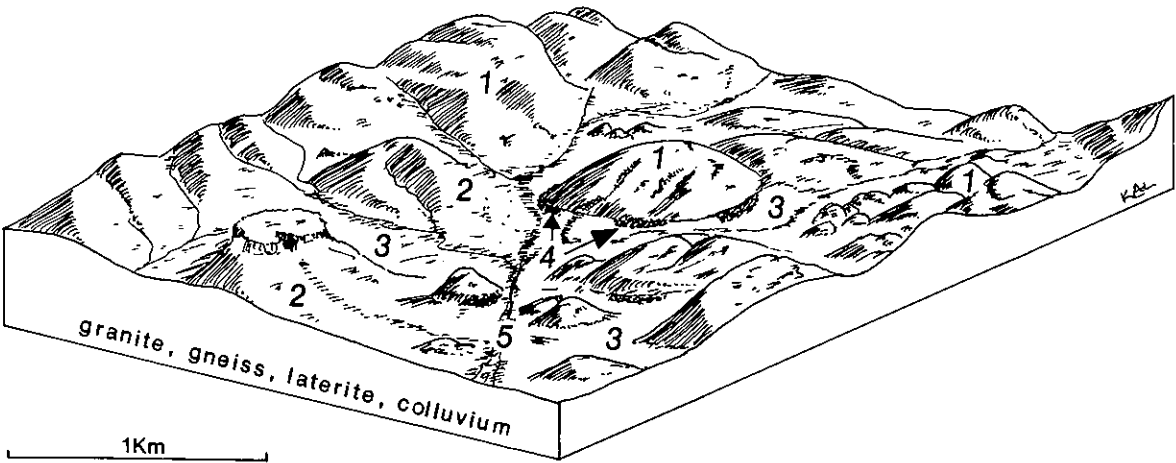
Estimated carrying capacity, good condition: 20 ha/dse.

Range condition summary (146 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
96	4	0	0	31	54	15



- Unit: 1. Granite hills, domes and tor fields.
2. Footslopes.
3. Sandy surfaced plains.
4. Drainage foci.
5. Drainage tracts and channels.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Granite hills, domes and tor fields (50%) Hills, domes and tor fields of granite to 50 m high; much rock outcrop with exfoliating platy fragments and dense surface mantles. Soils (in occasional pockets) are reddish-brown or brown coarse loamy granitic siliceous sands over granite (up to 70 cm deep); pH 6.0 with a neutral trend. Principal profile form: Uc5.21.	Patches and thickets of mixed height shrublands dominated by <i>Acacia aneura</i> , <i>A. rhodophloia</i> , <i>A. quadrimarginea</i> or <i>Thryptomene decussata</i> . Tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. grasbyi</i> , <i>A. quadrimarginea</i> , <i>A. rhodophloia</i> , <i>A. tetragonophylla</i> . Mid shrubs (1-2 m): <i>A. exocarpoides</i> , <i>A. quadrimarginea</i> , <i>Dodonaea</i> sp., <i>Pimelea microcephala</i> , <i>Eremophila exilifolia</i> , <i>E. forrestii</i> , <i>E. platycalyx</i> , <i>E. latrobei</i> , <i>Cassia sturtii</i> . Low shrubs (< 1 m): <i>Solanum ashbyi</i> , <i>S. lasiophyllum</i> , <i>P. microcephala</i> , <i>Ptilotus obovatus</i> , <i>Thryptomene decussata</i> . Perennial grasses: <i>Cymbopogon ambiguus</i> , <i>C. sp.</i> , <i>Monachather paradoxa</i> .	3 inventory sites and traversed Vegetation type: Rocky Hill Mixed Shrubland. Palatable perennials include: <i>Eremophila forrestii</i> , <i>E. latrobei</i> , <i>Ptilotus obovatus</i> , <i>Monachather paradoxa</i> . Pastoral use limitations: Poorly accessible to stock.
Unit 2: Footslopes (20%) Slopes below unit 1 with gradients to 6%, rock outcrops in upper sectors and mantles of quartz grits and granite fragments in lower parts. Soils are granitic siliceous sands or duplex types, < 50 cm deep over granite; pH 6.0 with an acidic or neutral trend. Principal profile forms: Dr1.52, Uc5.21.	Scattered (PFC 10-20%) tall shrublands dominated by <i>Acacia aneura</i> on sandy soils or <i>Maireana georgei</i> on heavier saline soils. Trees (2-4 m): <i>A. aneura</i> . Tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. cuthbertsonii</i> . Mid shrubs (1-2 m): <i>A. craspedocarpa</i> , <i>A. xiphophylla</i> , <i>Eremophila platycalyx</i> , <i>E. pterocarpa</i> , <i>E. forrestii</i> , <i>Cassia helmsii</i> , <i>C. nemophila</i> , <i>C. phyllodinea</i> , <i>C. sturtii</i> . Low shrubs (< 1 m): <i>M. georgei</i> , <i>M. glomerifolia</i> , <i>M. triptera</i> , <i>E. aff. margarethae</i> , <i>Ptilotus obovatus</i> , <i>Rhagodia eremaea</i> , <i>Solanum lasiophyllum</i> .	2 inventory sites and traversed Vegetation type: Granitic Mulga Shrubland, rarely Bluebush Shrubland. Palatable perennials include: <i>Eremophila forrestii</i> , <i>Maireana</i> spp., <i>Ptilotus obovatus</i> , <i>Rhagodia eremaea</i> . Pastoral use limitations: Exposed soils on steeper slopes are mildly susceptible to accelerated erosion where perennial vegetation is degraded.
Unit 3: Sandy surfaced plains (20%) Gently sloping plains and alluvial fans on system margins and between hills or rises. Characterised by shallow sandy loam soils with variable mantles over granite.	Scattered to moderately close (PFC 10-30%) tall shrublands dominated by <i>Acacia burkittii</i> , <i>A. quadrimarginea</i> . Trees (to 4 m): <i>A. rhodophloia</i> . Tall shrubs (> 2 m): <i>A. burkittii</i> , <i>A. quadrimarginea</i> , <i>A. aneura</i> , <i>A. xiphophylla</i> , <i>A. tetragonophylla</i> . Mid shrubs (1-2 m): <i>A. daviesoides</i> , <i>A. exocarpoides</i> , <i>Cassia phyllodinea</i> , <i>C. sturtii</i> , <i>Eremophila</i> sp., <i>E. latrobei</i> , <i>Thryptomene mucronulata</i> . Low shrubs (< 1 m): <i>Ptilotus obovatus</i> , <i>P. schwartzii</i> , <i>Solanum lasiophyllum</i> , <i>Sida</i> sp., <i>Maireana planifolia</i> . Perennial grass: <i>Cymbopogon</i> sp.	4 condition sites and traversed Vegetation type: Granitic Mulga Shrubland. Palatable perennials include: <i>Ptilotus</i> spp., <i>Sida rohlenae</i> , <i>Maireana</i> spp., <i>Enchylaena tomentosa</i> . Pastoral use limitations: None with controlled grazing. Vegetation condition %: VG/G 25, F 65, P/NP 10. Erosion incidence %: min 5. 20 obs.
Unit 4: Drainage foci (< 1%) Densely vegetated fringing depressions receiving concentrated run-off from adjacent granite domes. Soils vary from granitic siliceous sands to deep red earths overlying granite; pH 6.0-7.5 with an acidic or neutral reaction trend. Principal profile forms: Dr3., Uc5.21, Gn1.12.	Closed (PFC > 50%) low woodland dominated by <i>Acacia rhodophloia</i> and <i>A. sp.</i> (aff. <i>rhodophloia</i>). Trees (to 8 m) <i>A. rhodophloia</i> . Tall shrubs (> 2 m): <i>A. rhodophloia</i> , <i>A. sclerosperma</i> , <i>A. tetragonophylla</i> , <i>A. sp.</i> , <i>A. quadrimarginea</i> , <i>Calycopeplus ephedroides</i> , <i>Santalum spicatum</i> , <i>Gastrolobium laytonii</i> . Mid shrubs (1-2 m): <i>Dodonaea viscosa</i> , <i>Rulingia kempeana</i> . Low shrubs (< 1 m): <i>Ptilotus obovatus</i> , <i>Solanum lasiophyllum</i> , <i>Rhagodia eremaea</i> . Perennial grass: <i>Eriachne pulchella</i> .	4 inventory sites and traversed Vegetation type: Mulga Grove Woodland. Palatable perennials include: <i>Ptilotus obovatus</i> , <i>Rhagodia eremaea</i> , <i>Santalum spicatum</i> , <i>Eriachne pulchella</i> . Pastoral use limitations: Presence of <i>Gastrolobium laytonii</i> poison in some parts.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 5: Drainage tracts and channels (9%)</p> <p>Narrow (< 0.5 km wide) valley floors and drainage tracts flanked by units 1, 3 and 4, often with central shallowly incised channels mostly < 20 m wide. Soils are dark red clayey sands or loamy sands < 1 m deep overlying granite; pH 6.5-7.0 with a neutral reaction trend. Principal profile forms: Uc5.21, Uc5.51.</p>	<p>Scattered (PFC 10-20%) tall shrublands dominated by <i>Acacia aneura</i> or <i>A. aff. quadrimarginea</i>. Trees and tall shrubs (to 6m): <i>A. aneura</i>, <i>A. aff. quadrimarginea</i>, <i>A. tetragonophylla</i>, <i>Eremophila fraseri</i>, <i>E. macmillaniana</i>, <i>Santalum spicatum</i>. Mid shrubs (1-2 m): <i>A. craspedocarpa</i>, <i>E. macmillaniana</i>, <i>Cassia helmsii</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>C. helmsii</i>, <i>Solanum lasiophyllum</i>, <i>E. compacta</i>.</p>	<p>2 inventory sites and traversed</p> <p>Vegetation type: Creekline Shrubland. Palatable perennials include: <i>Santalum spicatum</i>, <i>Ptilotus obovatus</i>, <i>Eremophila compacta</i>, <i>Rhagodia</i> spp. Pastoral use limitations: Local occurrence of poisonous <i>Gastrolobium laytonii</i>.</p>

Outcamp land system 44 km² (0.05% of survey area)

Land type: 16; Pastoral potential: moderate.

Flat tributary alluvial plains with saline clayey soils, supporting degraded bluebush shrublands and mulga; a very minor system confined to far south-west.

Geology: Quaternary alluvium.

Geomorphology: Depositional flat surfaces; marginal alluvial plains underlain by hardpan flanking central flood plains carrying disorganised concentrated flow, subject to recent widespread sheet erosion and active movement of lag gravels; relief is < 2 m.

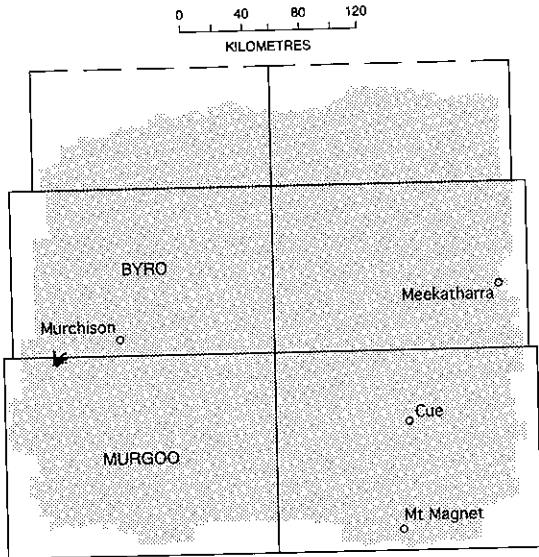
Vegetation and pastoral use: Moderately productive Hardpan Mulga Shrubland with some sparse chenopods remaining; perennial vegetation mainly degraded resulting in extensive surface stripping and subsequent sealing of deflated clayey top soils; Bluebush Shrubland remnants on denuded saline alluvial plains (unit 2) which was probably originally Bluebush and Saltbush on duplex soil with a thin sandy topsoil highly susceptible to accelerated erosion.

Estimated carrying capacity, good condition: 12 ha/dse.

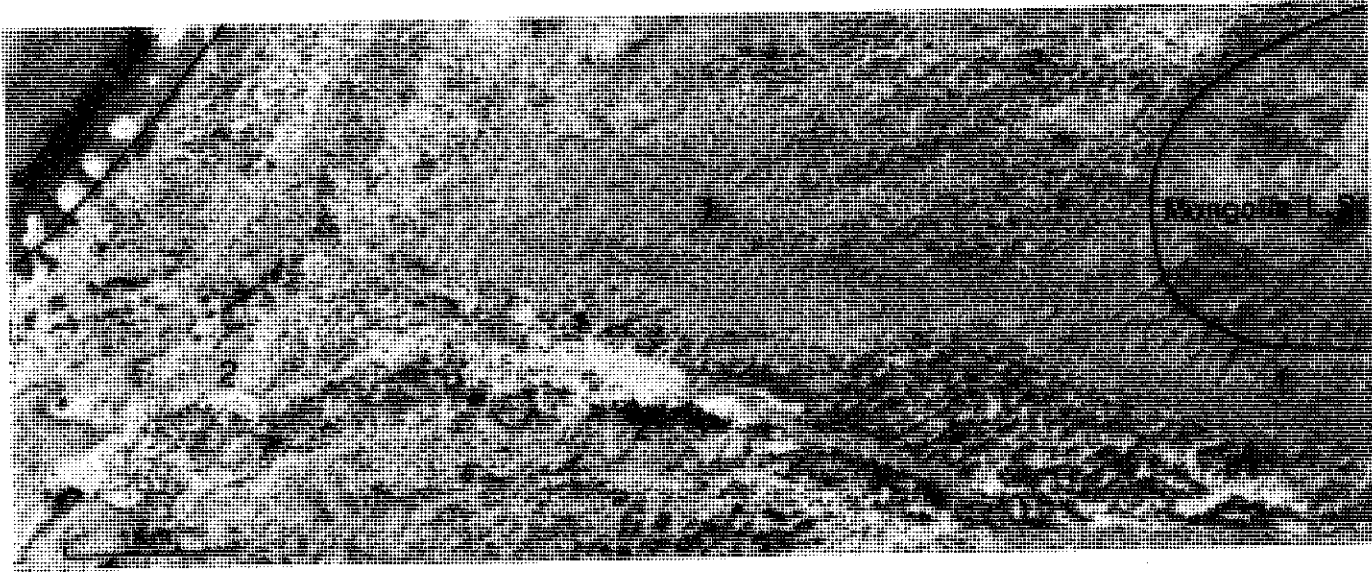
Range condition summary (12 traverse observations):

(a) Erosion status (%)			
Nil	Min.	Mod.	Sev.
8	42	22	8

(b) Vegetation condition (%)		
Good	Fair	Poor
0	25	75



- Unit: 1. Hardpan plains.
2. Flood plains.



Outcamp I.s.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Hardpan plains (40%) Almost flat plains subject to sheet flow below Mongolia and Bunny land systems, often with light ironstone mantles. Soils are yellowish-red light clays to 90 cm deep, frequently over hardpan; pH 7.0 with a neutral trend. Principal profile form: Uf6.71.	Scattered (PFC 10-20%) mixed shrublands dominated by <i>Acacia tetragonophylla</i> . Trees (2-4 m): <i>A. aneura</i> . Tall shrubs (> 2 m): <i>A. tetragonophylla</i> , <i>A. cuthbertsonii</i> , <i>A. grasbyi</i> . Mid shrubs (1-2m): <i>A. tetragonophylla</i> , <i>Eremophila forrestii</i> . Low shrubs (< 1 m): <i>Ptilotus obovatus</i> , <i>P. divaricatus</i> , <i>Atriplex bunburyana</i> , <i>Rhagodia eremaea</i> , <i>E. maculata</i> , <i>E. aff. margarethae</i> , <i>Scaevola spinescens</i> , <i>Maireana convexa</i> , <i>M. pyramidata</i> . Perennial grass: <i>Stipa elegantissima</i> .	1 inventory site, 1 condition site and traversed Vegetation type: Riverine Mixed Shrubland. Palatable perennials include: <i>Eremophila forrestii</i> , <i>E. maculata</i> , <i>Ptilotus</i> spp., <i>Maireana</i> spp., <i>Atriplex bunburyana</i> , <i>Rhagodia eremaea</i> , <i>Scaevola spinescens</i> . Pastoral use limitations: Moderately susceptible to accelerated erosion where degraded.
Unit 2: Flood plains (60%) Very gently sloping, unchannelled and partly saline flood plains with sparse mantles of ironstone gravel, tributary to concentrated drainage systems such as Cunyu. Often badly eroded. Soils are probably stripped duplex types, now reddish-brown light clays < 1 m deep over hardpan; pH 6.5-7.5 with a neutral reaction trend. Principal profile form: Uf1.43.	Very scattered (PFC < 10%) low shrublands dominated by <i>Maireana pyramidata</i> . Tall shrubs (> 2 m): <i>Acacia aneura</i> , <i>A. victoriae</i> , <i>A. tetragonophylla</i> , <i>Hakea preissii</i> . Mid shrubs (1-2 m): <i>A. tetragonophylla</i> , <i>A. victoriae</i> . Low shrubs (< 1 m): <i>M. pyramidata</i> , <i>M. platycarpa</i> , <i>Atriplex bunburyana</i> . Perennial grass: <i>Stipa elegantissima</i> .	1 inventory site, 2 condition sites and traversed Vegetation type: Bluebush Shrubland. Palatable perennials include: <i>Maireana platycarpa</i> , <i>Atriplex bunburyana</i> , <i>Stipa</i> spp. Pastoral use limitations: Highly susceptible to scalding, sheet erosion and rilling where vegetation is degraded.

Peak Hill land system (G) 503 km² (0.59% of survey area)

Land type: 1; Pastoral potential: very low.

Rugged, sinuous ranges and rounded hills of Proterozoic banded ironstone and hematitic shale, supporting stunted mulga and cottonbush shrublands.

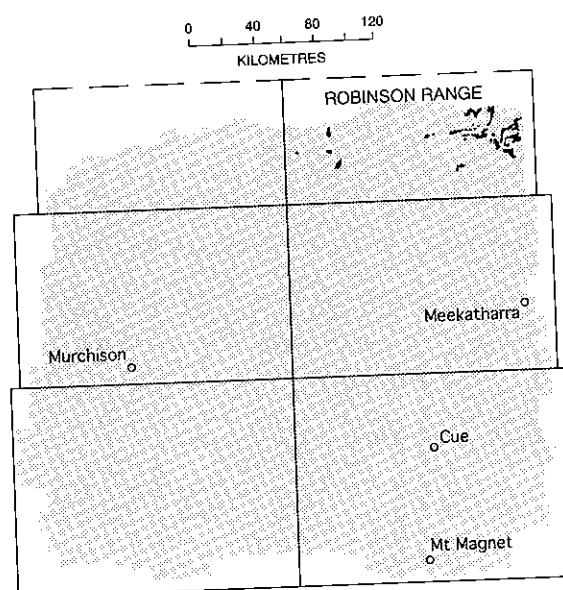
Geology: Lower Proterozoic hematitic shale, banded ironstone, quartzite wacke and assorted minor conglomerates of the Padbury Group; Archaean gneiss, hematite and banded iron; Quaternary colluvium on slopes.

Geomorphology: Erosional surfaces; sinuate ranges, often elongated and extending to 30 km long; scattered or isolated rounded hills flanking ranges; short footslopes and interfluvies with narrow, dendritic drainage lines; relief to 100 m, or locally much higher (e.g. Mt Gould).

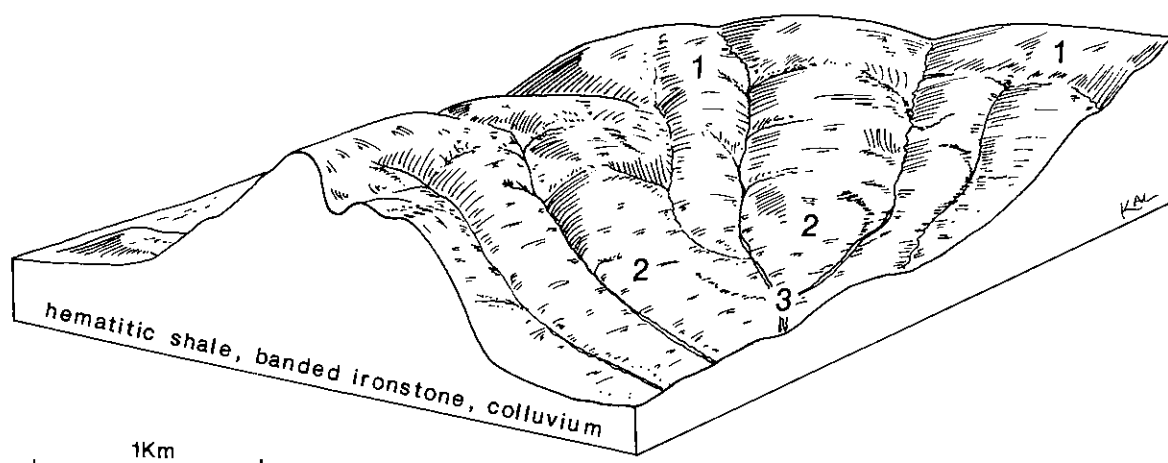
Vegetation and pastoral use: Mainly Rocky Hill Mixed Shrubland of low productivity and poorly accessible to stock; lower footslopes and drainage lines support Creekline Shrubland of slightly higher pastoral value; little or no accelerated erosion owing to dense stony mantles and skeletal soils.

Estimated carrying capacity, good condition: 30 ha/dse.

Range condition summary: Not sufficiently traversed, some lower footslopes and more productive lower drainage lines degraded but vegetation otherwise probably in good condition.



- Unit: 1. Hills and ridges.
 2. Lower slopes and interfluvies.
 3. Drainage floors and minor channels.



Peak Hill I.s. (adapted from Wilcox and McKinnon 1972)

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 1: Hills and ridges (50%)</p> <p>Rough hills and ridges with peaks to 120 m; also sinuous ranges, < 1 km wide, extending to > 30 km long, tending NE-SW, occasional examples occurring as unbroken ridges. Generally covered with dense ironstone mantles; outcropping also frequent. Soils are mostly skeletal, confined to pockets of shallow loamy sands.</p>	<p>Very scattered (PFC < 10%) mixed shrublands with <i>Acacia</i> spp. co-dominant. Shrubs: <i>Acacia aneura</i>, <i>A. tetragonophylla</i>, <i>Eremophila latrobei</i>, <i>E. exilifolia</i>, <i>Cassia desolata</i>, <i>Solanum</i> spp. Perennial grasses (infrequent): <i>Eriachne</i> spp., <i>Eragrostis</i> spp.</p>	<p>Vegetation type: Rocky Hill Mixed Shrubland. Pastoral use limitations: Poor accessibility for stock and very low grazing potential.</p>
<p>Unit 2: Lower slopes and interfluves (40%)</p> <p>Gently sloping footslopes or rounded interfluves flanking unit 1; grades usually < 2%; covered with moderately dense ironstone mantles. Soils are dark red loamy sands < 50 cm deep overlying ironstone; pH 5.5-6.0 with an acidic reaction trend. Principal profile form: Uc5.21.</p>	<p>Very scattered (PFC < 10%) mixed shrublands dominated by <i>Acacia grasbyi</i>. Trees (to 6 m): <i>A. pruinocarpa</i>, <i>A. aneura</i>, <i>A. aff. citrinoviridis</i>. Mid shrubs (1-2 m): <i>A. grasbyi</i>, <i>Cassia desolata</i>, <i>Eremophila latrobei</i>, <i>E. exilifolia</i>. Low shrubs (< 1 m): <i>C. helmsii</i>, <i>Ptilotus obovatus</i>, <i>P. rotundifolius</i>, <i>P. schwartzii</i>, <i>Euphorbia boophthona</i>, <i>C. chatelainiana</i>.</p>	<p>1 inventory site and traversed</p> <p>Vegetation type: Rocky Hill Mixed Shrubland. Palatable perennials include: <i>Eremophila latrobei</i>, <i>Cassia chatelainiana</i>, <i>Ptilotus</i> spp. Pastoral use limitations: None with controlled grazing.</p>
<p>Unit 3: Drainage floors and minor channels (10%)</p> <p>Narrow dendritic channels to 10 m wide from higher parts of system and grading into broader saline alluvial fans and minor valley floors with little or no channel formation. Soils on narrow channel margins are probably similar to unit 2; alluvial fans and drainage floors may have areas of shallow duplex types with light mantling and gritty ironstone fragments throughout.</p>	<p>Scattered mixed shrublands dominated by <i>Acacia aneura</i>, <i>A. tetragonophylla</i> or <i>A. victoriae</i>. Trees and tall shrubs (> 2 m): <i>A. aneura</i>, <i>A. tetragonophylla</i>, <i>A. victoriae</i>, <i>A. cuspidifolia</i>, <i>A. xiphophylla</i>. Mid shrubs (1-2 m): <i>Eremophila</i> spp. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>Cassia</i> spp., <i>Scaevola spinescens</i>, <i>Solanum lasiophyllum</i>, <i>Maireana</i> spp.</p>	<p>Vegetation type: Creekline Shrubland. Palatable perennials include: <i>Ptilotus obovatus</i>, <i>Scaevola spinescens</i>, <i>Maireana</i> spp. Pastoral use limitations: None with controlled grazing.</p>

Pells land system (G) 4 km² (< 0.01% of survey area)

Land type: 1; Pastoral potential: low.

Low hills, ridges and mesas of sandstone and siltstone, supporting acacia shrubland and minor halophytes; of only marginal occurrence in this area.

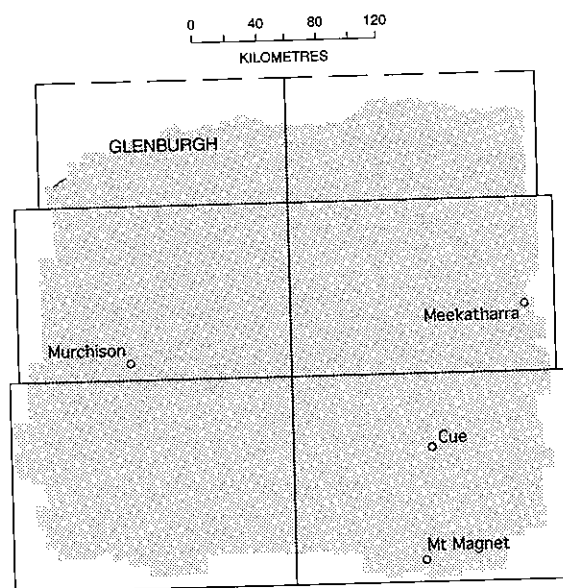
Geology: Permian sandstone, greywacke and siltstone of the Wooramel Group with fossiliferous sediments of the Callytharra Formation; also minor Quaternary alluvial deposits.

Geomorphology: Erosional surfaces; remnant mesas capped with laterite above cuesta-like ridges and low irregular hills with rough talus slopes; small valley floors dissected by narrow, trellised drainage and flanked by low sandy banks; overall relief to about 30 m.

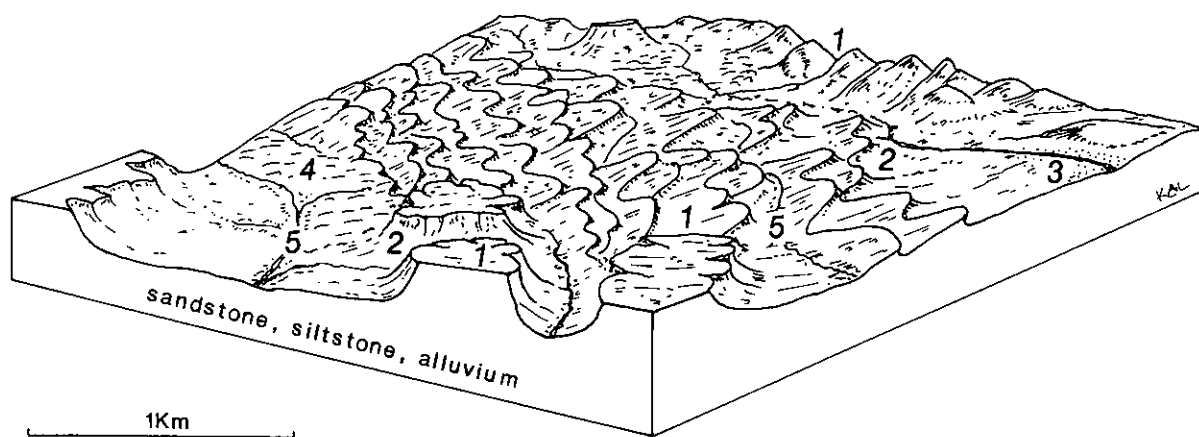
Vegetation and pastoral use: Mostly unproductive Rocky Hill Mixed Shrubland, poorly accessible to stock; slopes carry sparse Bluebush Shrubland although these areas are restricted; alluvial floors susceptible to erosion.

Estimated carrying capacity, good condition: 20 ha/dse.

Range condition summary: Not traversed; Payne *et al.* (1987) report that 22% was in good condition, 56% was fair and 22% was in poor condition in the adjacent Carnarvon Basin survey area.



- Unit: 1. Mesas, hills and ridges.
2. Stony slopes.
3. Alluvial fans.
4. Sandy banks.
5. Drainage channels and incised creeklines.



Pells I.s. (adapted from Payne *et al.* 1987)

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 1: Mesas, hills and ridges (50%)</p> <p>Isolated mesas with mantles of sandstone fragments or laterite, ridges and rocky hills with NNW-SSE strike lines and steeply dipping bedding planes. Soils are shallow skeletal sands.</p>	<p>Very scattered to scattered (PFC < 20%) shrublands dominated by <i>Acacia aneura</i>. Tall shrubs (2-3 m): <i>A. aneura</i>, <i>A. tetragonophylla</i>. Low shrubs (< 1 m): <i>Solanum lasiophyllum</i>, <i>Cassia helmsii</i>, <i>Ptilotus polakii</i>, <i>Eremophila</i> spp.</p>	<p>Vegetation type: Rocky Hill Mixed Shrubland. Pastoral use limitations: Frequently inaccessible to stock.</p>
<p>Unit 2: Stony slopes (25%)</p> <p>Rocky slopes to 4%, heavily strewn with limestone or sandstone cobbles. Soils are shallow reddish-brown fine sandy loams or sands, pH 8.0 with a neutral reaction trend. Principal profile form: Uc1.13.</p>	<p>Scattered shrublands (PFC 10-20%) dominated by <i>Acacia aneura</i>. Tall shrubs (2-3 m): <i>A. aneura</i>, <i>A. victoriae</i>. Low shrubs (< 1.5 m): <i>Ptilotus obovatus</i>, <i>Maireana tomentosa</i>, <i>Cassia desolata</i>, <i>C. sturtii</i>, <i>Acacia cuthbertsonii</i>, <i>Solanum lasiophyllum</i>, <i>Eremophila forrestii</i>.</p>	<p>Vegetation type: Rocky Hill Mixed Shrubland. Palatable perennials include: <i>Maireana tomentosa</i>, <i>Enchylaena tomentosa</i>, <i>Eremophila forrestii</i>. Pastoral use limitations: Locally inaccessible to stock.</p>
<p>Unit 3: Alluvial fans (15%)</p> <p>Small alluvial fans, with some channelling, below stony slopes. Soils are probably reddish-brown duplex types, sand over clayey sands to sandy clays, 50 cm to 1 m deep, pH 6.5 with a neutral reaction trend.</p>	<p>Scattered shrublands (PFC 10-20%) dominated by <i>Acacia victoriae</i> and low chenopod shrubs when in good condition. Tall shrubs: <i>A. victoriae</i>, <i>A. tetragonophylla</i>, <i>A. aneura</i>, <i>Hakea preissii</i>. Low shrubs: <i>Maireana polypterygia</i>, <i>Ptilotus polakii</i>, <i>Eremophila pterocarpa</i>, <i>Cassia helmsii</i>, <i>Solanum lasiophyllum</i>, <i>E. cuneifolia</i>, <i>Frankenia</i> spp.</p>	<p>Vegetation type: Bluebush Shrubland. Perennials augmented by annual grasses and forbs in favourable seasons. Indicators of good condition: <i>Maireana polypterygia</i>, <i>Ptilotus polakii</i>. Pastoral use limitations: Moderate susceptibility to erosion where degraded.</p>
<p>Unit 4: Sandy banks (5%)</p> <p>Restricted sandy banks between units 2 or 3 and 5. Soils are probably shallow sands, lightly strewn with pebbles, clay content increasing down profile, pH 7.0 with a neutral trend.</p>	<p>Scattered to moderately close (PFC 10-30%) tall shrublands dominated by <i>Acacia aneura</i>. Tall shrubs: <i>A. aneura</i>, <i>A. tetragonophylla</i>. Low shrubs: <i>Eremophila forrestii</i>, <i>E. exilifolia</i>, <i>Rhagodia</i> spp., <i>Cassia helmsii</i>. Perennial grass: <i>Monachather paradoxa</i>.</p>	<p>Vegetation type: Sandplain Acacia Shrubland. Palatable perennials include: <i>Eremophila forrestii</i>, <i>Monachather paradoxa</i>. Pastoral use limitations: Moderately susceptible to erosion where degraded.</p>
<p>Unit 5: Drainage channels and incised creeklines (5%)</p> <p>Incised trellised drainage lines with sandy bedloads.</p>	<p>Scattered to close tall shrublands dominated by <i>Acacia aneura</i>.</p>	<p>Vegetation type: Creekline Shrubland.</p>

Roderick land system 407 km² (0.47% of survey area)

Land type: 16; Pastoral potential: high.

Broad, saline riverine plains, with numerous grassy drainage foci and claypans adjacent to central alluvial plains and major channels; also non-saline marginal hardpan wash plains; mainly supports halophytic shrublands with minor perennial grasslands, but widely degraded and eroded.

Geology: Quaternary alluvium with aeolian deposits.

Geomorphology: Depositional surfaces; flat saline alluvial plains up to 7 km wide, floodplains with numerous rounded claypans and discrete drainage foci, minor sandy banks and; river channels, incised and carrying bedloads of coarse materials, often saline; minor peripheral hardpan plains. Overall relief mostly < 5 m.

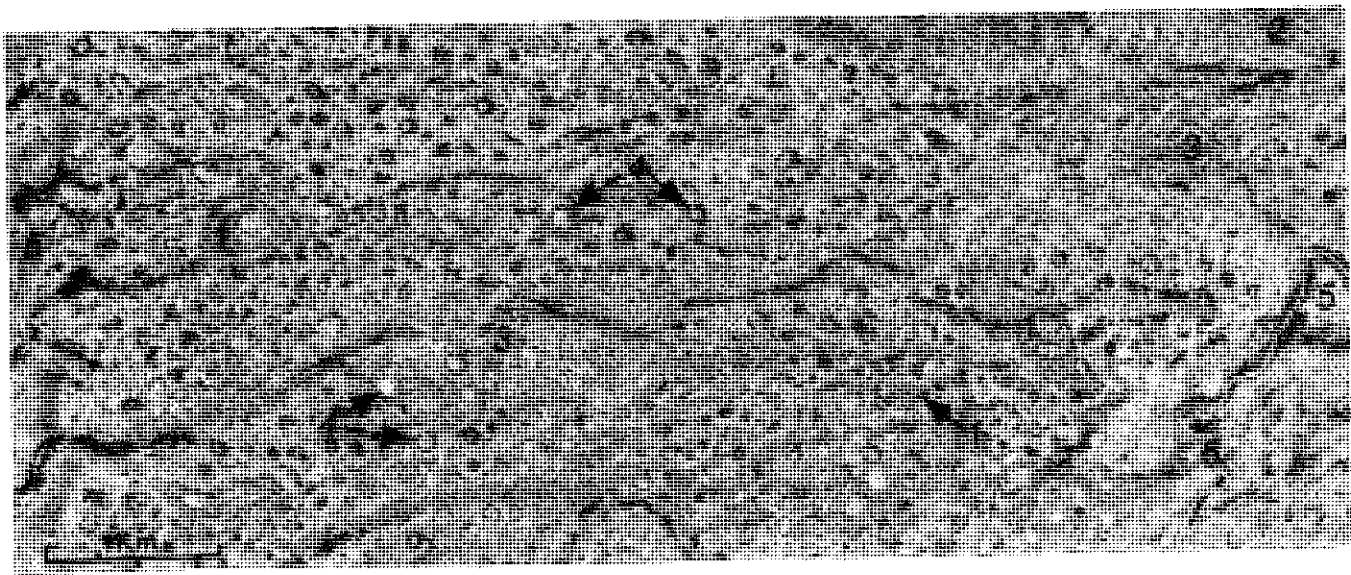
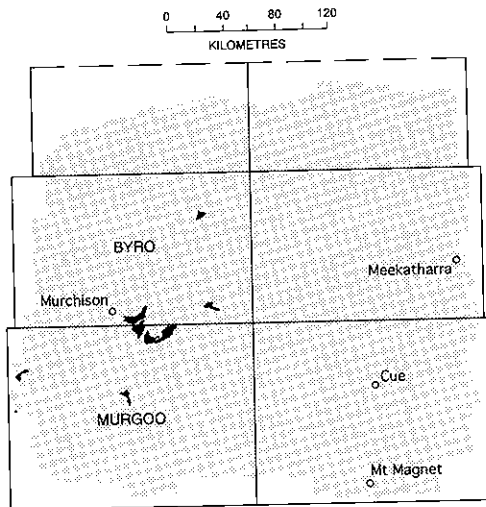
Vegetation and pastoral use: Highly productive Bluebush, Alluvial Tussock Grassland and Riverine Mixed Shrubland, Saltbush and Mixed Halophyte Shrublands, now widely degraded and in many areas succeeded by unpalatable *Acacia*, *Cassia*, *Eremophila* and *Hakea* species; few areas remaining in good condition (mainly those adjacent to saline water points); formerly provided excellent and diverse annual and perennial shrub and grass forage; major unit (4) is highly susceptible to accelerated erosion when degraded. Erosion in various forms is widespread on the duplex plains, hardpan plains and sandy banks.

Estimated carrying capacity, good condition: 7 ha/dse.

Range condition summary (74 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
30	37	32	1	10	27	63

- Unit: 1. Sandy banks.
2. Hardpan plains.
3. Alluvial plains.
4. Pans and drainage depressions.
5. Saline plains.
6. Major channels and drainage tracts.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 1: Sandy banks (5%)</p> <p>Isolated and widely degraded sand banks, perhaps recently accreted, on units 2 and 3 with slopes to 2% and relief to 2 m above surrounding plains. Soils are dark red earthy sands > 1 m deep, often overlying calcrete; pH 6.5 with a neutral or alkaline trend. Principal profile form: Uc5.21.</p>	<p>Scattered (PFC 10-20%) tall shrublands dominated by <i>Hakea preissii</i> or <i>Cassia</i> spp. on degraded sites. Tall shrubs (> 2 m): <i>H. preissii</i>, <i>Acacia victoriae</i>, <i>A. grasbyi</i>, <i>A. tetragonophylla</i>. Mid shrubs (1-2 m): <i>A. victoriae</i>, <i>Stylobasium spathulatum</i>, <i>C. desolata</i>, <i>Eremophila margarethae</i>. Low shrubs (< 1 m): <i>C. desolata</i>, <i>Ptilotus obovatus</i>, <i>Enchylaena tomentosa</i>.</p>	<p>1 inventory site and traversed</p> <p>Vegetation type: (?)</p> <p>Palatable perennials include: <i>Ptilotus obovatus</i>, <i>Enchylaena tomentosa</i>.</p> <p>Pastoral use limitations: Exposed, sandy soils are susceptible to wind erosion. Increasing unpalatable shrubs such as <i>Hakea preissii</i>, <i>Cassia desolata</i> and <i>Acacia victoriae</i>.</p>
<p>Unit 2: Hardpan plains (5%)</p> <p>Loamy plains with often partly stripped surfaces and underlain by hardpan, marginal to system boundaries or occurring in isolation flanking drainage tracts. Soils are dark red hardpan loams or earthy sands < 60 cm deep, locally overlying decomposing granite; pH 7.0-7.5 with a neutral reaction trend. Principal profile forms: Um5.31, Uc5.21.</p>	<p>Scattered to moderately close (PFC 10-30%) mixed shrublands dominated by <i>Acacia tetragonophylla</i>. Tall shrubs (> 2 m): <i>A. victoriae</i>, <i>A. tetragonophylla</i>. Mid shrubs (1-2 m): <i>A. tetragonophylla</i>, <i>Cassia desolata</i>, <i>C. helmsii</i>. Low shrubs (< 1 m): <i>C. desolata</i>, <i>C. helmsii</i>, <i>Ptilotus obovatus</i>, <i>Maireana planifolia</i>, <i>Eremophila</i> aff. <i>compacta</i>, <i>E. maculata</i>, <i>Rhagodia eremaea</i>, <i>Scaevola spinescens</i>, <i>Chenopodium gaudichaudianum</i>, <i>Solanum lasiophyllum</i>.</p>	<p>1 inventory site and traversed</p> <p>Vegetation type: Hardpan Mulga Shrubland/Bluebush Shrubland.</p> <p>Palatable perennials include: <i>Ptilotus obovatus</i>, <i>Eremophila</i> aff. <i>compacta</i>, <i>E. maculata</i>, <i>Rhagodia eremaea</i>, <i>Maireana</i> spp.</p> <p>Pastoral use limitations: Moderately susceptible to accelerated erosion where degraded.</p>
<p>Unit 3: Alluvial plains (60%)</p> <p>Extensive, almost flat river frontage plains adjacent to major channels of the Murchison and Roderick Rivers; more or less saline with local areas of hummocking and mounding. Soils are red or reddish-brown duplex types, clayey sands over light clays to 1 m deep, occasionally over calcrete; pH 7.5-9.0 with an alkaline trend. Principal profile form: Dr1.53.</p>	<p>Very scattered to scattered (PFC < 20%) low or mixed shrublands dominated by <i>Atriplex</i> and <i>Maireana</i> spp., where in good condition but widely degraded and succeeded by <i>Acacia victoriae</i>, <i>Cassia</i> spp., <i>Eremophila pterocarpa</i> and <i>Hakea preissii</i>. Trees (to 8 m): <i>Grevillea striata</i>. Tall shrubs (> 2 m): <i>A. victoriae</i>, <i>Hakea preissii</i>, <i>A. tetragonophylla</i>. Mid shrubs (1-2 m): <i>A. tetragonophylla</i>, <i>Cassia helmsii</i>, <i>C. sturtii</i>, <i>C. nemophila</i>, <i>Eremophila pterocarpa</i>. Low shrubs (< 1 m): <i>Maireana pyramidata</i>, <i>M. platycarpa</i>, <i>Atriplex vesicaria</i>, <i>A. amnicola</i>, <i>C. phyllodinea</i>, <i>Scaevola spinescens</i>, <i>Rhagodia eremaea</i>, <i>Enchylaena tomentosa</i>, <i>Frankenia</i> spp., <i>Eremophila laanii</i>, <i>Ptilotus</i> spp. Perennial grass: <i>Stipa elegantissima</i>.</p>	<p>2 inventory sites, 6 condition sites and traversed</p> <p>Vegetation type: Bluebush and Saltbush Shrubland.</p> <p>Palatable perennials include: <i>Maireana atkinsiana</i>, <i>M. platycarpa</i>, <i>Atriplex</i> spp., <i>Rhagodia eremaea</i>, <i>Enchylaena tomentosa</i>, <i>Frankenia</i> spp., <i>Ptilotus</i> spp.</p> <p>Increaser species include: <i>Hakea preissii</i>, <i>Cassia</i> spp., <i>Acacia victoriae</i>.</p> <p>Pastoral use limitations: Highly susceptible to accelerated erosion and subsequent invasion by unpalatable shrubs.</p> <p>Vegetation condition %: VG/G 14, F 26, P/VP 60.</p> <p>Erosion incidence %: min 41, mod 38, sev 2. 58 obs.</p>

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 4: Pans and drainage depressions (15%)	<p>a) Open or shrubby tussock grassland dominated by <i>Eriachne flaccida</i>. Trees (to 10 m tall on margins; infrequent in centre): <i>Eucalyptus coolabah</i>, <i>Grevillea striata</i>, <i>Acacia aneura</i>. Tall shrubs (> 2 m): <i>Hakea preissii</i>, <i>A. tetragonophylla</i>, <i>Eremophila longifolia</i>. Perennial grasses: <i>Eriachne flaccida</i>, <i>Eragrostis setifolia</i>.</p> <p>b) Moderately close to close (PFC 20-50%) low woodlands or tall shrublands dominated by <i>Acacia distans</i>, <i>A. tetragonophylla</i>, <i>A. victoriae</i> and <i>Cassia desolata</i>. Trees (to 8 m): <i>A. distans</i>, <i>A. aneura</i>. Tall shrubs (> 2 m): <i>A. tetragonophylla</i>, <i>A. victoriae</i>, <i>Hakea preissii</i>. Mid shrubs (1-2 m): <i>Cassia desolata</i>, <i>Eremophila pterocarpa</i>. Low shrubs (< 1 m): <i>C. desolata</i>, <i>Rhagodia eremaea</i>, <i>Chenopodium gaudichaudanum</i>, <i>Enchylaena tomentosa</i>, <i>Solanum lasiophyllum</i>, <i>Scaevola spinescens</i>. Perennial grasses: <i>Eragrostis setifolia</i>, <i>Eriachne flaccida</i>.</p>	<p>4 inventory sites and traversed</p> <p>Vegetation type: (a) Alluvial Tussock Grassland. b) Mulga Grove Woodland. Palatable perennials include: <i>Eriachne flaccida</i>, <i>Eragrostis setifolia</i>, <i>Rhagodia eremaea</i>, <i>Chenopodium</i> spp., <i>Enchylaena tomentosa</i>. Increaser species include: <i>Hakea preissii</i>, <i>Eremophila pterocarpa</i>, <i>Acacia victoriae</i>, <i>Cassia desolata</i>. Pastoral use limitations: Highly productive and attractive to stock but susceptible to shrub invasion where grasses are overgrazed; internally drained units not normally susceptible to erosion.</p>
Unit 5: Saline plains (10%)	<p>Very scattered to scattered (PFC < 20%) low shrublands dominated by <i>Halosarcia</i> spp. Mid shrubs (1-2 m): <i>A. victoriae</i>, <i>Cratystylis subspinescens</i>, <i>Atriplex amnicola</i>. Low shrubs (< 1m): <i>Halosarcia</i> spp., <i>Frankenia</i> spp.</p>	<p>Traversed</p> <p>Vegetation type: Samphire Shrubland. Pastoral use limitations: High salt content of pasture plants; subject to inundation and waterlogging.</p>
Unit 6: Major channels and drainage tracts (5%)	<p>Scattered trees (to 12 m) and variable shrubs, rushes and grasses. Beds are generally bare of vegetation; banks and terraces commonly dominated by <i>Casuarina obesa</i> or <i>Eucalyptus coolabah</i> with <i>E. camaldulensis</i>, <i>Melaleuca</i> spp., <i>Acacia sclerosperma</i>, <i>Juncus</i> spp., <i>Atriplex amnicola</i>, <i>Frankenia</i> spp.</p>	<p>Traversed</p> <p>Vegetation type: Riverine Mixed Shrubland. Pastoral use limitations: Bank and channel margins are prone to accelerated erosion where degraded.</p>

Sandiman land system (G) 347 km² (0.40% of survey area)

Land type: 2; **Pastoral potential:** moderate.

Plateau remnants and breakaway slopes on sedimentary rocks, with ridge spurs above saline stony footslopes and interfluvial plains, supporting mulga and snakewood shrublands with Gascoyne bluebush and other halophytes.

Geology: Permian greywacke, sandstone and fossiliferous siltstone of the Keogh and Lyons Formations, mainly of the Sakmarian series; minor Quaternary alluvium and colluvium with shallow aeolian deposits.

Geomorphology: Predominantly erosional surfaces; residual low plateaux and ridges, with footslopes extensively mantled by sandstone and siltstone fragments, locally highly fossiliferous; trellised drainage through narrow floors with incised channels and, locally, to narrow clay plains with occasional gilgaied surfaces; relief to 30 m.

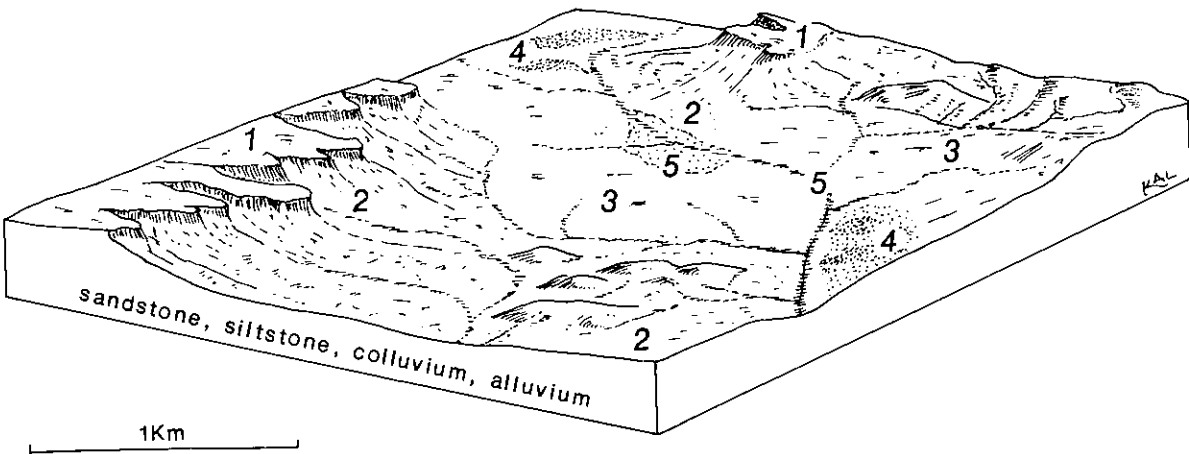
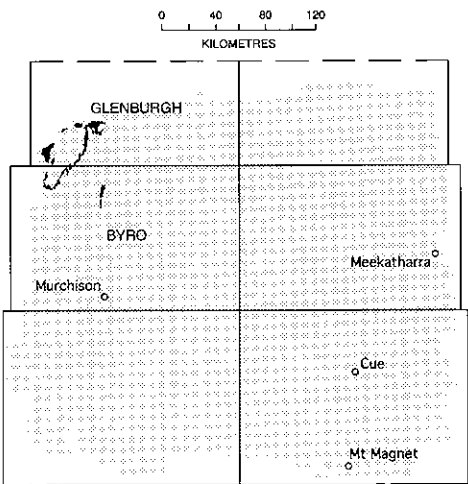
Vegetation and pastoral use: Higher plateaux, ridges and breakaways support shrublands of mostly acacia species with very sparse halophytes; footslopes and plateau edges carry moderately productive Bluebush and Stony Snakewood Shrubland, with Mulga Chenopod Shrubland on the lower units which, in good condition can provide useful perennial grazing. Where degraded the sparse shrublands provide little other than annual forage. Slopes, plains and drainage tracts which are not protected by a stony mantle are highly susceptible to accelerated erosion owing to the inherently unstable nature of soils derived from soft Permian sedimentary rocks. It therefore requires unusually responsive and exacting management if degradation is to be avoided.

Estimated carrying capacity, good condition: 12 ha/dse.

Range condition summary (33 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
46	27	24	3	18	49	33

- Unit: 1. Plateaux and breakaways.
2. Stony footslopes.
3. Stony plains.
4. Sandy sheets and banks.
5. Drainage tracts and channels.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Plateaux and breakaways (20%) Rough and densely mantled siltstone plateaux with breakaway scarps and talus slopes to 30 m high and sloping up to 100%. Soils are shallow red stony or skeletal lithosols overlying weathered sedimentary substrates; pH 6.5 with a mainly neutral trend. Principal profile form: Um1.41.	Very scattered to scattered (PFC < 20%) mid or low shrublands dominated by <i>Cassia phyllodinea</i> or <i>Acacia</i> spp., <i>Maireana polypterygia</i> . Trees (2-4 m): <i>Acacia aneura</i> . Tall shrubs (> 2 m): <i>A. xiphophylla</i> , <i>A. cuthbertsonii</i> . Mid shrubs (1-2 m): <i>A. aneura</i> , <i>A. xiphophylla</i> , <i>A. tetragonophylla</i> , <i>A. cuspidifolia</i> , <i>Eremophila</i> aff. <i>forrestii</i> . Low shrubs (< 1 m): <i>M. polypterygia</i> , <i>M. thesioides</i> , <i>C. phyllodinea</i> , <i>Ptilotus obovatus</i> , <i>P. polakii</i> , <i>Enchylaena tomentosa</i> , <i>Scaevola spinescens</i> , <i>Rhagodia eremaea</i> , <i>Frankenia</i> sp., <i>Sida</i> sp., <i>Solanum ashbyi</i> . Perennial grass: <i>Stipa</i> sp.	2 inventory sites and traversed Vegetation type: Bluebush and Stony Snakewood Shrubland. Palatable perennials include: <i>Maireana polypterygia</i> , <i>M. thesioides</i> , <i>Ptilotus obovatus</i> , <i>P. polakii</i> , <i>Enchylaena tomentosa</i> , <i>Scaevola spinescens</i> , <i>Rhagodia eremaea</i> , <i>Sida</i> sp. Pastoral use limitations: None under controlled grazing.
Unit 2: Stony footslopes (40%) Densely mantled and steeply graded upper slopes becoming more gently inclined (to 2%) and less mantled downslope; also more saline. Soils are red clayey fine sands overlying sedimentary rocks to 1 m deep; pH is 8.0 with an alkaline trend. Principal profile form: Uc5.21.	Scattered low shrublands (PFC 10-20%) dominated by <i>Maireana pyramidata</i> . Tall shrubs (2-4 m): <i>Acacia cuspidifolia</i> , <i>A. xiphophylla</i> . Mid shrubs (1-2 m): <i>A. cuspidifolia</i> , <i>A. ligulata</i> , <i>Cassia desolata</i> , <i>Eremophila platycalyx</i> . Low shrubs (< 1 m): <i>M. polypterygia</i> , <i>M. pyramidata</i> , <i>C. helmsii</i> , <i>Chenopodium gaudichaudianum</i> , <i>Rhagodia eremaea</i> , <i>Enchylaena tomentosa</i> , <i>Atriplex</i> sp., <i>Solanum lasiophyllum</i> .	1 inventory site, 3 condition sites and traversed Vegetation type: Bluebush Shrubland. Palatable perennials include: <i>Maireana polypterygia</i> , <i>M. pyramidata</i> , <i>Rhagodia eremaea</i> , <i>Enchylaena tomentosa</i> , <i>Chenopodium gaudichaudianum</i> , <i>Atriplex</i> sp. Pastoral use limitations: Parts of unit are highly susceptible to gully erosion where overgrazed or trampled and disturbed.
Unit 3: Stony plains (30%) Restricted areas of gently sloping (< 1%) or undulating plains with quartz or granitic mantles of various density; generally occurring immediately below unit 1. Soils are red earths to > 1 m deep overlying sedimentary substrates; pH 7.0-8.5 with a neutral trend. Principal profile form: Uc5.21.	Scattered or moderately close (PFC 10-30%) mixed shrublands dominated by <i>Cassia desolata</i> or <i>Acacia grasbyi</i> and low <i>A. aneura</i> on more stony parts. Trees (2-4 m): <i>A. aneura</i> . Tall shrubs (> 2 m): <i>A. ramulosa</i> , <i>A. grasbyi</i> , <i>A. ligulata</i> . Mid shrubs (1-2 m): <i>C. desolata</i> , <i>A. kempeana</i> , <i>A. tetragonophylla</i> . <i>Stylobasium spathulatum</i> . Low shrubs (< 1 m): <i>C. desolata</i> , <i>Ptilotus obovatus</i> , <i>Rhagodia eremaea</i> , <i>Maireana integra</i> , <i>M. planifolia</i> , <i>Chenopodium gaudichaudianum</i> , <i>Scaevola tomentosa</i> , <i>Solanum lasiophyllum</i> .	2 inventory sites and traversed Vegetation type: Mulga Chenopod Shrubland. Palatable perennials include: <i>Ptilotus obovatus</i> , <i>Rhagodia eremaea</i> , <i>Maireana integra</i> , <i>M. planifolia</i> , <i>Chenopodium gaudichaudianum</i> , <i>Scaevola tomentosa</i> . Pastoral use limitations: Locally susceptible to accelerated erosion where vegetation is degraded.
Unit 4: Sandy sheets and banks (5%) Isolated small tracts of wanderrie banks or sandplain, usually less than 1 km in extent with little slope and relief to < 2 m. Soils are probably deep earthy sands.	Scattered shrublands dominated by <i>Acacia ramulosa</i> , <i>A. kempeana</i> , <i>A. ligulata</i> and <i>Monachather paradoxa</i> .	Traversed Vegetation type: Wanderrie Bank Grassy Shrubland. Pastoral use limitations: None.
Unit 5: Drainage tracts and channels (< 5%) Dendritic drainage tracts grading into wider flow zones with channels to 200 m wide (more commonly < 100 m wide) and incised to 3 m deep into Permian rocks. Soils are probably shallow clay loams overlying sedimentary rocks; clayey types prevalent on channel margins.	Shrublands with a patchy lower storey, mainly of <i>Maireana platycarpa</i> , <i>M. aphylla</i> , <i>Ptilotus obovatus</i> , <i>P. polakii</i> and <i>Solanum lasiophyllum</i> on drainage floors. Channel banks probably support moderately close (PFC 30-50%) woodlands with <i>Melaleuca</i> sp. and <i>Eucalyptus coolabah</i> .	1 condition site and traversed Vegetation type: Bluebush Shrubland and Creekline Shrubland. Palatable perennials include: <i>Maireana aphylla</i> , <i>M. platycarpa</i> , <i>Ptilotus obovatus</i> , <i>P. polakii</i> . Pastoral use limitations: None under controlled grazing.

Sandplain land system (CB) 2884 km² (3.36% of survey area)

Land type: 10; Pastoral potential: low.

Extensive, gently undulating red sandplain with occasional dunes, supporting tall wanyu shrublands with mainly shrub (but locally grassy) understorey; mainly in far west.

Geology: Quaternary sand, partly aeolian.

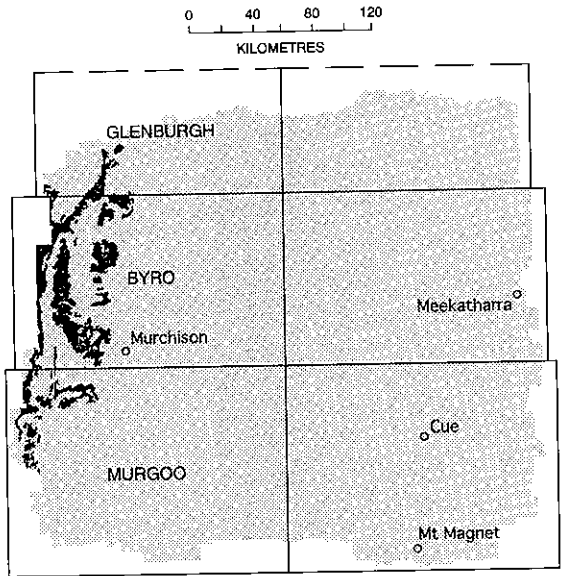
Geomorphology: Depositional surfaces; flat to gently undulating extensive sand sheets with infrequent minor dunes; mainly lacks any features of drainage development but occasional diffuse drainage foci; overall relief to 20 m.

Vegetation and pastoral use: Poorly to moderately productive Sandplain Wanderrie Grassy Shrubland and Sandplain Acacia Shrubland; forage value can increase following fire (Curry 1986); the system is generally stable and not susceptible to erosion.

Estimated carrying capacity, good condition: 20 ha/dse.

Range condition summary (209 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
99	0	1	0	65	29	6



- Unit: 1. Dunes.
2. Sand plains.
3. Drainage foci.



Sandplain I.s.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 1: Dunes (2%)</p> <p>Linear dunes to 12 m high and with slopes to 14% extending up to 2 km long aligned approximately NE-SW. Soils are dark red siliceous sands > 1 m deep with a neutral trend. Principal profile form: Uc1.23.</p>	<p>Scattered (PFC 10-20%) tall shrublands dominated by <i>Acacia ramulosa</i>. Tall shrubs (> 2 m): <i>A. ramulosa</i>, <i>A. murrayana</i>, <i>Grevillea stenobotrya</i>. Mid shrubs (1-2 m): <i>Pityrodia paniculata</i>, <i>Thryptomene</i> spp., <i>Eremophila forrestii</i>, <i>Calytrix muricata</i>. Low shrubs (< 1 m): <i>P. paniculata</i>, <i>Pimelea microcephala</i>, <i>Rhagodia eremaea</i>, <i>Solanum orbiculatum</i>. Perennial grass: <i>Eragrostis lanipes</i>.</p>	<p>1 inventory site and traversed</p> <p>Vegetation type: Sand Dune Shrubland. Palatable perennials include: <i>Eremophila forrestii</i>, <i>Eragrostis lanipes</i>, <i>Rhagodia eremaea</i>. Pastoral use limitations: None with controlled grazing.</p>
<p>Unit 2: Sand plains (97%)</p> <p>Extensive very gently undulating expanses of sandplain with slopes to 4% and relief to adjacent sand dunes of up to 12 m; occasionally lightly mantled with ironstone pebbles; also isolated occurrences of exposed hardpan or bedrock. Soils are red earthy sands, mostly > 1 m deep but occasionally underlain by hardpan; pH 5.0-6.5 with an acidic trend. Principal profile form: Uc5.21.</p>	<p>Scattered to moderately close (PFC 10-30%) tall shrublands dominated by <i>Acacia ramulosa</i>, <i>A. aff. coolgardiensis</i> or <i>Eremophila forrestii</i>. Trees (to 8 m): <i>A. pruinocarpa</i>, <i>Eucalyptus dicromophloia</i>, <i>E. lucasii</i>. Tall shrubs (> 2 m): <i>A. ramulosa</i>, <i>A. murrayana</i>, <i>A. aff. coolgardiensis</i>. Other shrubs (< 2 m): <i>A. aff. coolgardiensis</i>, <i>E. forrestii</i>, <i>E. georgei</i>, <i>Ptilotus schwartzii</i>, <i>P. obovatus</i>, <i>Solanum lasiophyllum</i>, <i>S. orbiculatum</i>, <i>Sida</i> sp., <i>S. cardiophylla</i>, <i>Rhagodia eremaea</i>, <i>Enchylaena tomentosa</i>, <i>Mirbelia spinosa</i>, <i>Pimelea microcephala</i>. Perennial grasses: <i>Eragrostis lanipes</i>, <i>E. eriopoda</i>, <i>Monachather paradoxa</i>, <i>Thyridolepis multiculmis</i>, <i>Eriachne helmsii</i>.</p>	<p>5 inventory sites, 16 condition sites and traversed</p> <p>Vegetation type: Sandplain Wanderrie Grassy Shrubland or Sandplain Acacia Shrubland. Palatable perennials include: <i>Eremophila forrestii</i>, <i>E. latrobei</i>, <i>Ptilotus</i> spp., <i>Maireana planifolia</i>, <i>Rhagodia eremaea</i>, <i>Enchylaena tomentosa</i>, <i>Eragrostis</i> spp., <i>Monachather paradoxa</i>, <i>Thyridolepis multiculmis</i>. Pastoral use limitations: None under controlled grazing; dense mature <i>Acacia ramulosa</i> can be succeeded by more productive shrubland after fire. Vegetation condition %: VG/G 69, F 28, P/VP 3. 187 obs.</p>
<p>Unit 3: Drainage foci (< 1%)</p> <p>Isolated claypans and swamps up to 1.5 km in diameter, occasionally with gilgaied micro-relief; claypans are frequently saline with bare centres; soils are shallow brown light clays over decomposing sandstone to deep clays; pH 7.5 with a neutral trend. Principal profile form: Uf6.31.</p>	<p>Very scattered (PFC < 10%) mixed shrublands characterised by <i>Chenopodium auricomum</i> (to 2 m), <i>Eucalyptus coolabah</i> (to 8 m) with <i>Meuhlenbeckia cunninghamii</i> (to 2 m). <i>Melaleuca uncinata</i> (> 2 m) forms dense fringes with <i>Atriplex amnicola</i> (< 2 m).</p>	<p>1 inventory site and traversed</p> <p>Palatable perennials include: <i>Atriplex amnicola</i>, <i>Chenopodium auricomum</i>. Pastoral use limitations: Seasonally inaccessible owing to waterlogging but otherwise none under controlled grazing.</p>

Sherwood land system (W) 4839 km² (5.63% of survey area)

Land type: 4; Pastoral potential: moderate.

Extensive, gently sloping stony and sandy plains on granite and gneiss below saline footslopes of lateritised breakaways and outcrops of weathered rock; mainly supports scattered mulga shrublands with understorey non-halophytic and halophytic shrubs

Geology: Massive Archaean gneiss and granite; Tertiary laterite and silcrete duricrusts on edges of old plateau; Quaternary colluvium on slopes with alluvium in drainage floors.

Geomorphology: Erosional surfaces; stripped edges of the old plateau and slopes of stripped lateritic surfaces with exposures of weathered granite, mesas and kaolinised breakaways above short pallid upper slopes, draining sheet flow to alluvial footslopes and duplex plains; also low stony rises and granite outcrops above broad interfluvial loamy plains based on granite and mantled with fragments of granite and quartz; sandy-surfaced plains with quartz grits below outcrops of unweathered rocks; narrow dendritic drainage in upper parts grading to broad sandy drainage floors downslope; overall system relief to 25 m or more.

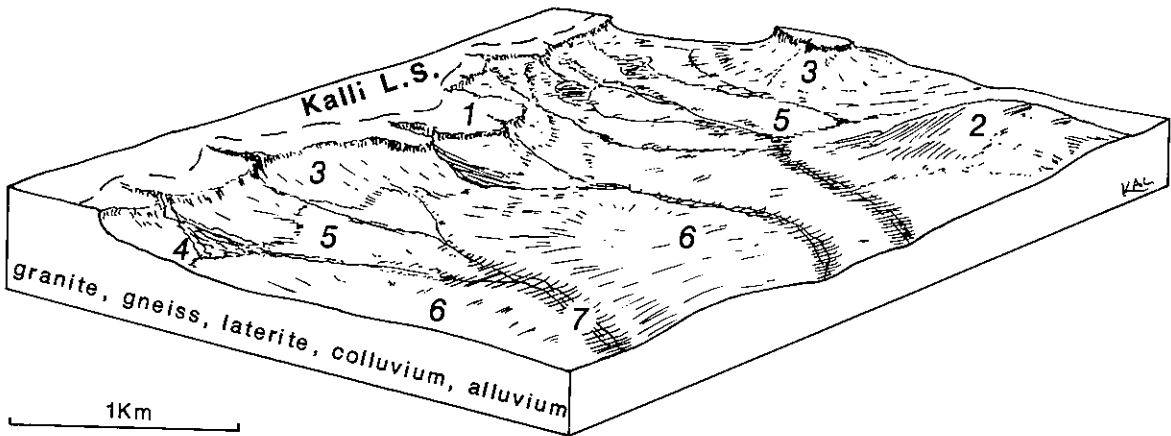
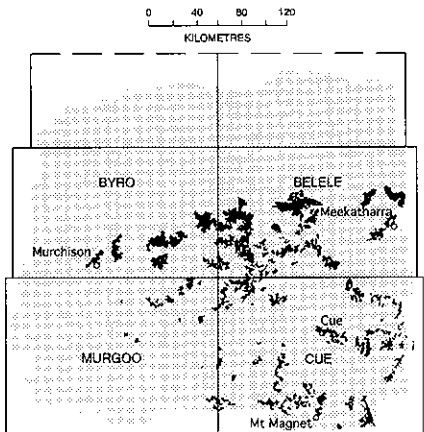
Vegetation and pastoral use: Mainly Granitic Mulga Shrubland of moderate productivity providing perennial shrub reserves when in good condition; where condition is poor, production is reduced to mainly ephemerals. Saline footslopes, sandy floors and drainage tracts support Bluebush, Saltbush or Mixed Halophytic Shrublands which are prone to selective overgrazing by stock, kangaroos, euros, feral goats and donkeys; duplex soils of units 3, 4 and 7 are highly susceptible to accelerated erosion when shrub cover is degraded, as it is in most areas. Major units are not generally susceptible to accelerated erosion and are in better condition.

Estimated carrying capacity, good condition: 12 ha / dse.

Range condition summary (762 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
70	19	9	2	25	39	36

- Unit: 1. Plateaux edges, residuals and breakaways.
2. Low hills, rises and tor fields.
3. Footslope plains.
4. Sandy alluvial fans.
5. Gritty surfaced plains on granite.
6. Stony plains and interfluves.
7. Drainage tracts and channels.



Sherwood I.s.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Plateaux edges, residuals and breakaways (10%) Erosional edges of plateaux with buttes and residuals with stripped lateritic surfaces sloping 0.7-1.5%, up to 5 km long and 1 km wide; or occurring as isolated mesas to 25 m high. Eroding ferricrete or deeply weathered granite slopes (grades to 40%) are generally mantled with quartz and silcrete pebbles and lateritic gravels. Lower slopes truncated, with cliffs, bluffs and embayments capped by laterite, undermined by shallow caves. Soils are shallow red skeletal lithosols or occasional very shallow duplexes; pH 7.0 with a neutral trend. Principal profile forms: Uc5., Um5., Dr1.12.	Very scattered to scattered (PFC < 20%) low or mixed shrubland dominated by <i>Acacia aneura</i> , <i>Calytrix</i> sp. or <i>Eremophila</i> spp. Trees (to 6 m): <i>Callitris huegelii</i> , <i>A. aneura</i> . Tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. tetragonophylla</i> , <i>A. aff. coolgardiensis</i> , <i>Canthium</i> sp., <i>A. cuthbertsonii</i> . Mid shrubs (1-2 m): <i>A. craspedocarpa</i> , <i>Cassia phyllodinea</i> , <i>Dodonaea</i> sp., <i>Eremophila</i> sp., <i>E. latrobei</i> , <i>E. wilsii</i> . Low shrubs (< 1 m): <i>Calytrix</i> sp., <i>Stylidium</i> sp., <i>P. obovatus</i> , <i>Eriostemon brucei</i> , <i>Mirbelia spinosa</i> , <i>Sida</i> spp., <i>Solanum lasiophyllum</i> . Perennial grasses: <i>Eriachne mucronata</i> , <i>Eragrostis lanipes</i> .	4 inventory sites and traversed Vegetation type: Lateritic Acacia Shrubland. Pastoral use limitations: Partly inaccessible to stock; some local occurrences of poisonous <i>Gastrolobium laytonii</i> .
Unit 2: Low hills, rises and tor fields (5%) Irregular low stony rises (slopes to 2%), granite hills with granite outcrops and tors to 10 m high with sparse quartz and granite mantles. Soils are dark red granitic siliceous sands to 30 cm overlying granite bedrock; pH 6.0-7.0 with an acidic to neutral trend. Principal profile form: Uc5.21.	Scattered (PFC 10-20%) mixed shrublands dominated by <i>Acacia ramulosa</i> or <i>Eremophila forrestii</i> . Trees (to 4 m): <i>A. quadrimarginea</i> , <i>A. aneura</i> . Tall shrubs (> 2 m): <i>A. ramulosa</i> , <i>A. quadrimarginea</i> , <i>A. kempeana</i> , <i>A. victoriae</i> . Mid shrubs (1-2 m): <i>A. aneura</i> , <i>Cassia helmsii</i> , <i>C. sturtii</i> , <i>Eremophila forrestii</i> , <i>E. fraseri</i> , <i>E. latrobei</i> . Low shrubs (< 1 m): <i>E. forrestii</i> , <i>E. fraseri</i> , <i>Maireana planifolia</i> , <i>Ptilotus obovatus</i> , <i>Sida</i> sp., <i>Solanum lasiophyllum</i> , <i>Grevillea deflexa</i> .	2 inventory sites, 2 condition sites and traversed Vegetation type: Granitic Mulga Shrubland. Palatable perennials include: <i>Eremophila forrestii</i> , <i>E. latrobei</i> , <i>Maireana planifolia</i> , <i>Ptilotus obovatus</i> , <i>Sida</i> sp., <i>Eragrostis lanipes</i> , <i>Monachather paradoxa</i> . Pastoral use limitations: None with controlled grazing.
Unit 3: Footslope plains (10%) Slopes and plains below breakaways; upper slopes developed from deeply weathered and partly pallid zone material, often with boulders, slopes to 5%; lower slopes are broader, slightly concave, up to 1 km long, slopes 0.3-2%. Generally saline throughout with sparse quartz, ironstone and granite mantles. Soils are mainly red or dark red duplex types, clayey sands or crusted loamy sands over light clays overlying gneiss or granite at < 50 cm; pH 6.0-7.5 with neutral or alkaline reaction trends. Principal profile forms: Dr1.12, Dr1.52, Dr2.52, Dr2.53, Uc5.21, Uc5.23.	Very scattered to scattered (PFC < 20%) mainly low or mixed height shrublands now mostly dominated by <i>Acacia</i> and <i>Cassia</i> spp., but originally dominated by <i>Atriplex vesicaria</i> , <i>Maireana</i> , <i>Frankenia</i> and <i>Ptilotus</i> species. Trees (to 4 m): <i>A. aneura</i> . Tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. grasbyi</i> , <i>A. sclerosperma</i> , <i>A. tetragonophylla</i> , <i>A. xiphophylla</i> , <i>Eremophila pterocarpa</i> , <i>Hakea preissii</i> . Mid shrubs (1-2 m): <i>A. cuthbertsonii</i> , <i>A. craspedocarpa</i> , <i>A. grasbyi</i> , <i>Cassia nemophila</i> , <i>C. phyllodinea</i> , <i>C. sturtii</i> , <i>E. pterocarpa</i> , <i>Hakea preissii</i> . Low shrubs (< 1 m): <i>Atriplex vesicaria</i> , <i>A. quinii</i> , <i>C. desolata</i> , <i>E. compacta</i> , <i>Frankenia</i> sp., <i>Maireana georgei</i> , <i>M. glomerifolia</i> , <i>M. triptera</i> , <i>M. pyramidata</i> , <i>M. platycarpa</i> , <i>Ptilotus beardii</i> , <i>P. obovatus</i> , <i>Rhagodia eremaea</i> , <i>Solanum lasiophyllum</i> . Perennial grass: <i>Eragrostis dielsii</i> (locally abundant).	13 inventory sites, 15 condition sites and traversed Vegetation type: Saltbush or Mixed Halophyte Shrubland. Palatable perennials include: <i>Atriplex</i> spp., <i>Maireana</i> spp., <i>Ptilotus</i> spp., <i>Rhagodia eremaea</i> , <i>Eragrostis dielsii</i> . Pastoral use limitations: Duplex soils are highly susceptible to accelerated erosion, developing microterracing, rilling and gullyng; also susceptible to invasion by <i>Hakea preissii</i> , <i>Eremophila pterocarpa</i> , or <i>Acacia</i> spp. where degraded. Vegetation condition %: VG/G 27, F 31, P/NP 42. Erosion incidence %: min 46, mod 21, sev 3. 140 obs.

Landform and soils	Vegetation: formations and major species	Comments and condition indicators
<p>Unit 4: Sandy alluvial fans (5%)</p> <p>Sandy, mainly non-saline alluvial fans with shallow distributary channels, on unit 3 or as short valley tracts, slopes < 2%. Soils are duplex types, red or dark red loamy sands or sandy loams over sandy clay loams or light clays overlying granite at < 1 m; pH 6.5-8.0 with a neutral trend. Principal profile forms: Dr1.52, Dr2.52.</p>	<p>Very scattered (PFC < 10%) mixed or low shrublands dominated by <i>Ptilotus</i> spp. and <i>Eremophila</i> spp. Trees (to 4 m): <i>Acacia aneura</i>. Tall shrubs (> 2 m): <i>A. aneura</i>, <i>A. cuthbertsonii</i>, <i>A. tetragonophylla</i>, <i>A. victoriae</i>, <i>Hakea preissii</i>. Mid shrubs (1-2 m): <i>A. palustris</i>, <i>A. tetragonophylla</i>, <i>A. victoriae</i>, <i>Eremophila platycalyx</i>, <i>E. forrestii</i>, <i>E. pterocarpa</i>, <i>E. macmillaniana</i>. Low shrubs (< 1 m): <i>E. compacta</i>, <i>E. foecunda</i>, <i>Ptilotus beardii</i>, <i>P. obovatus</i>, <i>Maireana triptera</i>, <i>M. melanocoma</i>, <i>M. convexa</i>, <i>Rhagodia eremaea</i>, <i>Solanum lasiophyllum</i>. Perennial grasses: <i>Enteropogon acicularis</i>, <i>Monachather paradoxa</i>, <i>Eriachne helmsii</i>.</p>	<p>2 inventory sites, 1 condition site and traversed</p> <p>Vegetation type: Mostly Granitic Mulga Shrubland, occasionally Mixed Halophytic Shrubland. Palatable perennials include: <i>Eremophila forrestii</i>, <i>Ptilotus</i> spp., <i>Maireana</i> spp., <i>Rhagodia eremaea</i>, <i>Enteropogon acicularis</i>, <i>Monachather paradoxa</i>. Pastoral use limitations: Sandy duplex soils are highly susceptible to erosion where degraded. Vegetation condition %: VG/G 0, F 21, P/VP 79. Erosion incidence %: min 31, mod 38, sev 17. 29 obs.</p>
<p>Unit 5: Gritty surfaced plains on granite (15%)</p> <p>Plains mostly flat or very gently undulating with slopes < 1.5% and relief to 5 m; generally mantled with quartz grits. Soils are shallow dark red, granitic siliceous sands or loams overlying granite at < 40 cm; pH 6.0-7.0 with a neutral reaction trend. Principal profile forms: Uc5.21, Uc5.51, Uc6.13, Um5.12, Um5.51. This unit increasingly replaces unit 6 in the south-west of the area.</p>	<p>Very scattered to scattered (PFC < 20%) mixed shrublands dominated by <i>Acacia aneura</i> and <i>Ptilotus obovatus</i>. Trees (to 4 m): <i>A. aneura</i>. Tall shrubs (> 2 m): <i>A. aneura</i>, <i>A. burkittii</i>, <i>A. grasbyi</i>, <i>A. craspedocarpa</i>, <i>A. tetragonophylla</i>, <i>A. quadrimarginea</i>. Mid shrubs (1-2 m): <i>A. sp.</i> (P41), <i>A. tetragonophylla</i>, <i>Cassia nemophila</i>, <i>C. desolata</i>, <i>C. phyllodinea</i>, <i>E. forrestii</i>, <i>E. latrobei</i>. Low shrubs (< 1 m): <i>E. compacta</i>, <i>M. convexa</i>, <i>M. villosa</i>, <i>M. triptera</i>, <i>Rhagodia eremaea</i>, <i>Solanum lasiophyllum</i>.</p>	<p>4 inventory sites, 18 condition sites and traversed</p> <p>Vegetation type: Granitic Mulga Shrubland or Mulga Chenopod Shrubland. Palatable perennials include: <i>E. latrobei</i>, <i>E. compacta</i>, <i>Maireana</i> spp., <i>Ptilotus obovatus</i>, <i>Rhagodia eremaea</i>. Pastoral use limitations: Slightly susceptible to accelerated erosion when perennials are degraded. Vegetation condition %: VG/G 24, F 41, P/VP 35. Erosion incidence %: min 15, mod 2. 170 obs.</p>
<p>Unit 6: Stony plains and interfluvies (45%)</p> <p>Flat to gently undulating plains and interfluvies with sparse to moderate mantling of quartz or mixed pebbles and gravels; minor outcrops of quartz and granite; mainly 0.5-2 km between drainage lines and 2-8 km down slope. Slopes mostly < 1% and relief of whole unit mainly < 5 m. Soils are shallow loamy duplex or sandy types over granite or gneiss, mainly dark red sandy clay loams, pH 5.0-7.0 with acidic or neutral reaction trends. Principal profile forms: Um5.12, Dr2.52, Uc5.21.</p>	<p>Very scattered to scattered (PFC < 20%) tall shrublands dominated by <i>Acacia</i> and <i>Eremophila</i> species. Trees and tall shrubs (> 2 m): <i>A. aneura</i>, <i>A. grasbyi</i>, <i>A. tetragonophylla</i>, <i>A. victoriae</i>, <i>A. xiphophylla</i>, <i>A. burkittii</i>, <i>Canthium lineare</i>. Mid shrubs (1-2 m): <i>Eremophila spathulata</i>, <i>E. fraseri</i>, <i>E. forrestii</i>, <i>E. latrobei</i>, <i>E. platycalyx</i>, <i>E. oppositifolia</i>, <i>A. quadrimarginea</i>, <i>A. aff. quadrimarginea</i> (MRS 111), <i>Cassia desolata</i>. Low shrubs (< 1 m): <i>C. helmsii</i>, <i>Ptilotus obovatus</i>, <i>P. schwartzii</i>, <i>Solanum lasiophyllum</i>, <i>E. freelingii</i>, <i>Maireana planifolia</i>, <i>M. convexa</i>, <i>M. melanocoma</i>, <i>M. triptera</i>.</p>	<p>8 inventory sites, 20 condition sites and traversed</p> <p>Vegetation type: Stony Mulga Mixed Shrubland (in north of area) or Mulga Chenopod or Granitic Mulga Shrublands (in south). Palatable perennials include: <i>Maireana planifolia</i>, <i>M. convexa</i>, <i>M. georgei</i>, <i>Eremophila latrobei</i>, <i>E. compacta/muelleriana</i>, <i>Ptilotus schwartzii</i>, <i>P. obovatus</i>. Increaser species include: <i>Eremophila spathulata</i>, <i>E. fraseri</i>, <i>Cassia desolata</i>. Pastoral use limitations: None under controlled grazing. Vegetation condition %: VG/G30, F 46, P/VP 24. Erosion incidence %: min 6. 223 obs.</p>

Sherwood I.s.—continued

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 7: Drainage tracts and channels (10%)</p> <p>Dendritic drainage lines in upper parts of the system draining into broad flow zones downslope. Larger tracts are often channelled and widely degraded unless protected by quartz mantles or vegetation. Soils are hard-setting duplex types, red or brown sandy loams or loamy sands over light clays or sandy clays; pH 6.0-9.0 with a neutral to alkaline trend. Principal profile forms: Dr2.52, Dr2.53.</p>	<p>Very scattered to scattered (PFC < 20%) low shrublands dominated by <i>Maireana triptera</i> or <i>Eremophila punicea</i> or close tall shrublands dominated by <i>Acacia burkittii</i>. Trees (to 6 m): <i>A. aneura</i>, <i>A. burkittii</i>. Tall shrubs (2-4 m): <i>A. burkittii</i>, <i>A. aneura</i>, <i>A. tetragonophylla</i>, <i>A. grasbyi</i>, <i>A. craspedocarpa</i>, <i>Hakea preissii</i>. Mid shrubs (1-2 m): <i>A. tetragonophylla</i>, <i>H. preissii</i>, <i>A. craspedocarpa</i>, <i>E. latrobei</i>, <i>E. platycalyx</i>. Low shrubs (< 1 m): <i>E. punicea</i>, <i>E. compacta</i>, <i>M. triptera</i>, <i>M. pyramidata</i>, <i>M. thesioides</i>, <i>M. villosa</i>, <i>Ptilotus obovatus</i>, <i>Rhagodia eremaea</i>.</p>	<p>5 inventory sites, 7 condition sites and traversed</p> <p>Vegetation type: Bluebush Shrubland and Creekline Shrubland. Palatable perennials include: <i>Eremophila compacta</i> ssp. <i>compacta</i>, <i>E. latrobei</i>, <i>Maireana</i> spp., <i>Ptilotus obovatus</i>, <i>Rhagodia eremaea</i>. Pastoral use limitations: Moderately susceptible to accelerated erosion where degraded. Increaser species include: <i>Hakea preissii</i>, <i>Eremophila punicea</i>, <i>E. compacta</i>, ssp. <i>foecunda</i>. Vegetation condition %: VG/G 18, F 23, P/VP 59. Erosion incidence %: min 44, mod 24, sev 3. 62 obs.</p>

Siberia land system 43 km² (0.05% of survey area)

Land type: 16; Pastoral potential: high.

Saline alluvial plains fringed with low dunes and peripheral stony plains; supports mostly halophytic shrublands with sparse tall acacias.

Geology: Predominantly Quaternary alluvium with minor Tertiary laterite.

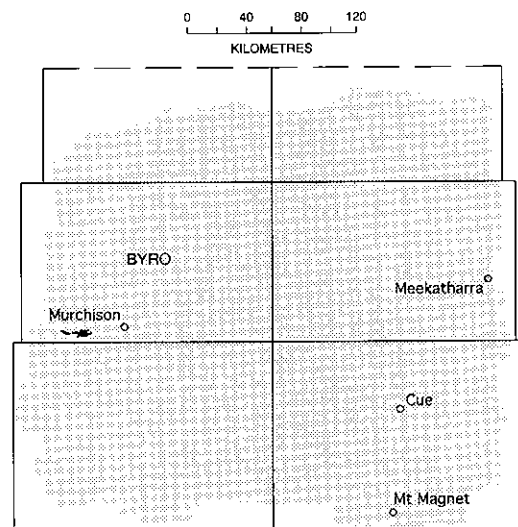
Geomorphology: Mostly depositional surfaces; alluvial plains receiving concentrated drainage from sandstone escarpments, forming perched flood plains distant from major tributary drainages; higher stony plains with sandstone mantle fringing broad almost flat saline plains with short, linear sand dunes and scattered sandplain residuals; drainage disorganised but through to Outwash land system; overall relief to 5 m.

Vegetation and pastoral use: Mostly bluebush shrublands or other halophytic shrublands of moderate to high value when in fair to good condition; halophyte-dominated saline plains provide good quality dry season reserves but value is diminished if fresh water is not available to stock, units 3 and 4 are moderately to susceptible to accelerated erosion when degraded.

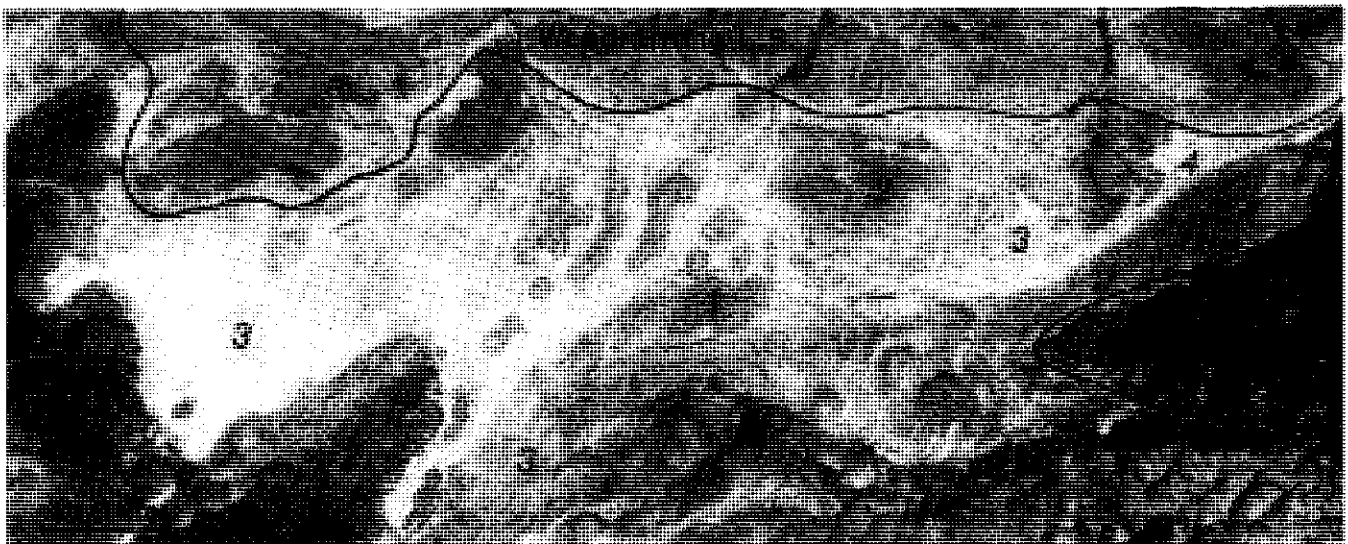
Estimated carrying capacity, good condition: 7 ha/dse.

Range condition summary (19 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
68	21	11	0	42	32	26



- Unit: 1. Sand dunes.
 2. Stony plains.
 3. Saline alluvial plains.
 4. Drainage tracts.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Sand dunes (3%) Isolated irregular shaped dunes up to 500 m long to 8 m high, on margins of unit 3. Soils are dark red siliceous sands > 1 m deep; pH 6.0 with an acidic reaction trend. Principal profile form: Uc1.23.	Moderately dense (PFC 20-30%) tall shrublands dominated by <i>Acacia ramulosa</i> . Tall shrubs (> 2 m): <i>A. ramulosa</i> , <i>A. tetragonophylla</i> , <i>A. sclerosperma</i> . Mid shrubs (1-2 m): <i>A. microcalyx</i> . Low shrubs (< 1 m): <i>Corynotheca</i> sp., <i>Pityrodia</i> sp., <i>Rhagodia eremaea</i> , <i>Chenopodium gaudichaudianum</i> , <i>Solanum lasiophyllum</i> , <i>Cassia phyllodinea</i> , <i>Maireana pyramidata</i> .	1 inventory site and traversed Vegetation type: Sand Dune Shrubland. Palatable perennials include: <i>Rhagodia eremaea</i> , <i>Chenopodium gaudichaudianum</i> , <i>Maireana pyramidata</i> . Pastoral use limitations: None with controlled grazing.
Unit 2: Stony plains (35%) Gently sloping expanses of stony plains below adjacent systems Woodrarrung and Mongolia; usually covered with dense platy sandstone mantles. Soils are duplexes, red loamy sands over red clayey loams to 20 cm deep; often overlying hardpan; pH 7.0 with a neutral trend. Principal profile form: Dr2.52.	Very scattered (PFC < 10%) mixed shrublands dominated by <i>Acacia grasbyi</i> . Trees (to 4 m): <i>A. aneura</i> . Tall shrubs (> 2 m): <i>A. grasbyi</i> , <i>A. cuthbertsonii</i> , <i>A. tetragonophylla</i> . Mid shrubs (1-2m): <i>Eremophila platycalyx</i> , <i>E. sp.</i> Low shrubs (< 1 m): <i>Maireana triptera</i> , <i>M. georgei</i> , <i>Ptilotus obovatus</i> , <i>Atriplex bunburyana</i> .	1 inventory site and traversed Vegetation type: Mulga Chenopod Shrubland. Palatable perennials include: <i>Atriplex bunburyana</i> , <i>Ptilotus obovatus</i> , <i>Maireana georgei</i> , <i>M. triptera</i> . Pastoral use limitations: None with controlled grazing.
Unit 3: Saline alluvial plains (50%) Mostly flat low lying plains; usually strongly saline with light sandstone mantles; subject to regular inundation. Soils are yellowish red light clays over heavy clays to 50 cm deep; pH 7.0 with a neutral trend. Principal profile form: Uf6.12.	Very scattered (PFC < 10%) low shrublands dominated by <i>Halosarcia</i> spp. and <i>Maireana glomerifolia</i> . Low shrubs (< 1 m): <i>Carpobrotus</i> sp., <i>Halosarcia</i> sp., <i>M. glomerifolia</i> .	1 inventory site and traversed Vegetation type: Samphire and Bluebush Shrublands. Palatable perennials include: <i>Maireana glomerifolia</i> . Pastoral use limitations: Seasonal flooding and high salt content of major species.
Unit 4: Drainage tracts (12%) Gently sloping, unchannelled saline drainage tracts up to 500 m wide; frequent areas of minor erosion with hummocking and rilling evident. Soils are probably clays similar to unit 3.	Variable low and mid height shrubland characterised by shrub layer (1-2 m) of <i>Acacia victoriae</i> , <i>Eremophila platycalyx</i> , <i>E. aff. forrestii</i> , <i>E. strongylophylla</i> and low shrubs (< 1 m): <i>Atriplex bunburyana</i> , <i>Maireana pyramidata</i> , <i>M. villosa</i> , <i>M. convexa</i> , <i>M. thesioides</i> , <i>Ptilotus obovatus</i> , <i>P. divaricatus</i> , <i>Rhagodia eremaea</i> , <i>Scaevola spinescens</i> .	Traversed Vegetation type: Saltbush/Bluebush Shrubland. Palatable perennials include: <i>Atriplex bunburyana</i> , <i>Maireana</i> spp., <i>Ptilotus</i> spp., <i>Rhagodia eremaea</i> , <i>Scaevola spinescens</i> . Pastoral use limitations: Moderately susceptible to accelerated erosion where perennial vegetation is degraded.

Thomas land system (G) 458 km² (0.53% of survey area)

Land type: 1; Pastoral potential: low.

Lateritised mesas among hills of granite and gneiss, with stony footslopes above short, gently sloping interfluvial plains, supporting sparse acacia-dominated shrublands.

Geology: Archaean and Lower Proterozoic quartzite, granite and gneiss with some Tertiary silcrete and laterite capping.

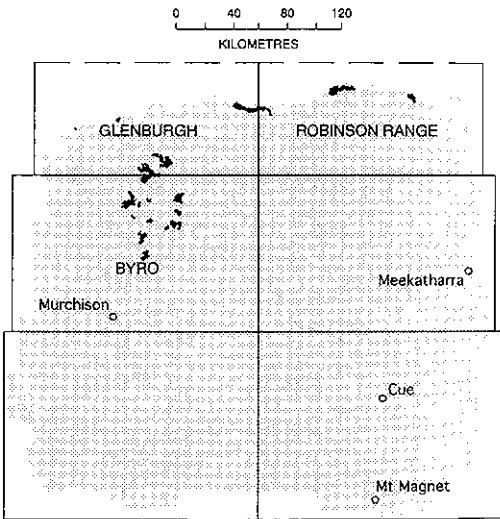
Geomorphology: Mainly erosional surfaces; lateritised breakaways, mesas and plateaux residuals above rounded hills and unweathered summits flanked by stony colluvial plains and small alluvial fans; drainage dendritic, mostly incised and of moderate intensity; relief to 50 m, locally higher.

Vegetation and pastoral use: Mostly Rocky Hill Mixed Shrubland and Stony Mulga Mixed Shrubland of low to very low pastoral value and partly inaccessible to stock; minor units of Stony Snakewood and Mulga Chenopod shrubland are grazed preferentially; a moderately productive system in good seasons when annual forbs and grasses provide useful forage; in poor seasons, provides little perennial reserves. Unit 4 is susceptible to erosion when degraded; the other major units are not normally susceptible to accelerated erosion.

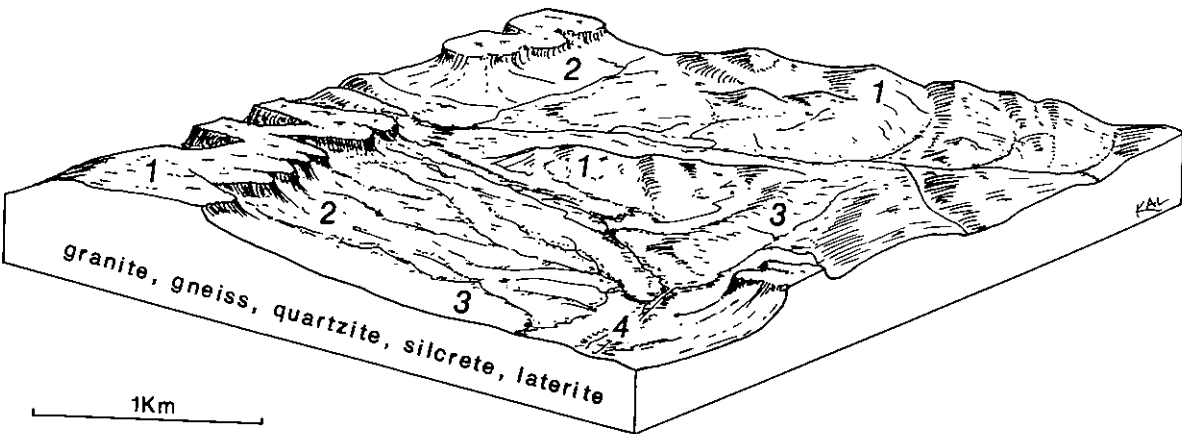
Estimated carrying capacity, good condition: 20 ha/dse.

Range condition summary (31 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
97	0	3	0	29	39	32



- Unit: 1. Low hills and breakaways.
2. Footslopes.
3. Stony plains and interfluves.
4. Drainage tracts and creeklines.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Low hills and breakaways (25%) Rough hills and breakaways with occasional mesas and laterite plateaux to 30 m high; usually covered with dense quartz or lateritic mantles; outcrops of dolerite and ironstone common. Soils are mostly confined to pockets of very shallow dark red skeletal lithosols with weakly acidic to neutral reaction trends. Principal profile form: Um1.43.	Scattered (PFC 10-20%) tall or mixed shrublands dominated by <i>Acacia aneura</i> , <i>A. pruinocarpa</i> or <i>Calytrix</i> spp. Trees (2-4 m): <i>A. aneura</i> , <i>A. aff. citrinoviridis</i> , <i>A. pruinocarpa</i> . Tall shrubs (> 2m): <i>A. aneura</i> , <i>A. pruinocarpa</i> , <i>A. tetragonophylla</i> . Mid shrubs (1-2 m): <i>A. aneura</i> , <i>Dodonaea</i> sp., <i>Thryptomene baeckeacea</i> , <i>Calytrix</i> sp., <i>Cassia liverssenii</i> , <i>Eremophila granitica</i> . Low shrubs (< 1 m): <i>Calytrix</i> sp., <i>C. muricata</i> , <i>Sida calyxhymenia</i> , <i>E. exilifolia</i> , <i>Mirbelia spinosa</i> , <i>Solanum ashbyi</i> , <i>S. lasiophyllum</i> , <i>Ptilotus obovatus</i> , <i>Tribulus platypterus</i> . Perennial grass: <i>Eriachne mucronata</i> .	3 inventory sites and traversed Vegetation type: Rocky Hill Mixed Shrubland. Palatable perennials include: <i>Sida calyxhymenia</i> , <i>Ptilotus obovatus</i> , <i>Tribulus platypterus</i> , <i>Eriachne mucronata</i> . Pastoral use limitations: Partly inaccessible to stock.
Unit 2: Footslopes (15%) Slopes below unit 1 with grades to 5%; with gneiss or quartz outcrops and dense quartz mantles; often saline in lower parts. Soils are duplexes, red to reddish-brown loamy to clayey sands over light clays overlying gneiss at < 20 cm; pH 6.5-7.0 with a neutral trend. Principal profile form: Dr2.52.	Scattered (PFC 10-20%) mixed shrublands dominated by <i>Acacia aneura</i> or <i>A. xiphophylla</i> . Trees (2-4 m): <i>A. aneura</i> , <i>A. burkittii</i> . Tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. xiphophylla</i> , <i>A. cuthbertsonii</i> , <i>Santalum spicatum</i> . Mid shrubs (1-2 m): <i>A. cuthbertsonii</i> , <i>A. victoriae</i> , <i>Cassia nemophila</i> , <i>C. phyllodinea</i> , <i>Eremophila freelingii</i> , <i>E. exilifolia</i> . Low shrubs (< 1 m): <i>E. freelingii</i> , <i>Ptilotus beardii</i> , <i>Scaevola spinescens</i> , <i>Frankenia magnifica</i> , <i>Maireana suaedifolia</i> , <i>M. glomerifolia</i> , <i>Solanum lasiophyllum</i> , <i>Rhagodia eremaea</i> .	2 inventory sites, 1 condition site and traversed Vegetation type: Stony Snakewood or Mulga Chenopod Shrublands. Palatable perennials include: <i>Ptilotus beardii</i> , <i>Scaevola spinescens</i> , <i>Maireana</i> spp., <i>Rhagodia eremaea</i> . Pastoral use limitations: None with controlled grazing.
Unit 3: Stony plains and interfluvies (50%) Gently sloping (< 2%) stony plains and broad interfluvies frequently dissected by narrow dendritic drainage lines; also areas of ironstone-based plains; usually with dense quartz or ironstone mantles and occasional low sandy banks. Soils are duplexes, dark red clayey sands over sandy clay loams < 50 cm deep overlying granite, gneiss or gravel; pH 7.0-8.5 with an alkaline reaction trend. Principal profile form: Dr2.13.	Scattered (PFC 10-20%) mixed shrublands dominated by <i>Acacia aneura</i> , <i>Eremophila exilifolia</i> or <i>E. cuneifolia</i> . Trees (2-4 m): <i>A. aneura</i> . Tall shrubs (> 2 m): <i>A. victoriae</i> , <i>A. tetragonophylla</i> , <i>A. cuspidifolia</i> . Mid shrubs (1-2 m): <i>A. tetragonophylla</i> , <i>Cassia desolata</i> . Low shrubs (< 1 m): <i>E. cuneifolia</i> , <i>E. exilifolia</i> , <i>Solanum lasiophyllum</i> , <i>Rhagodia eremaea</i> , <i>Maireana melanocoma</i> , <i>M. triptera</i> , <i>M. suaedifolia</i> , <i>Frankenia</i> sp.	1 inventory site, 1 condition site and traversed Vegetation type: Stony Mulga Mixed Shrubland. Palatable perennials include: <i>Rhagodia eremaea</i> , <i>Maireana</i> spp. Pastoral use limitations: None with controlled grazing.
Unit 4: Drainage tracts and creeklines (10%) Dendritic creeklines on narrow drainage floors and alluvial fans grading into wider, often eroded, broader tracts with larger channels. Soils are reddish-brown duplex types on margins and fans; channel beds usually carry bedloads of coarse sand and cobbles.	Scattered or very scattered (PFC < 20%) tall shrublands on alluvial fans and broader tracts with <i>Acacia xiphophylla</i> , <i>Hakea preissii</i> (on degraded sites), <i>Cassia helmsii</i> , <i>Eremophila cuneifolia</i> , <i>Maireana polypterygia</i> , <i>Halosarcia</i> spp. Dense tall shrublands of <i>A. aneura</i> , <i>A. tetragonophylla</i> or <i>A. holosericea</i> fringing creeklines and channels.	Traversed Vegetation type: Mulga Chenopod Shrubland or Creekline Shrubland. Palatable perennials include: <i>Maireana polypterygia</i> . Pastoral use limitations: Alluvial fans and broader tracts mildly susceptible to erosion and invasion by <i>Hakea preissii</i> where degraded.

Tindalarra land system 3091 km² (3.60% of survey area)

Land type: 14; Pastoral potential: moderate.

Very gently inclined hardpan wash plains with narrow drainage lines and fairly saline narrow tributary drainage floors; supports tall mixed acacia shrublands with patchy wanderrie banks and narrow tracts of snakewood and bluebush; a major wash system in the Greenough River catchment.

Geology: Quaternary alluvium with minor colluvium and aeolian deposits.

Geomorphology: Depositional surfaces; restricted stony higher plains, gently sloping and often lightly mantled and with minor granite outcrop; broad plains with slopes 0.3 to 0.75% on red-brown hardpan, carrying sheet flow between occasional low wanderrie banks or sandplain remnants; narrow flood plains flanking saline drainage tracts with incised channels; relief mostly < 5 m.

Vegetation and pastoral use: Predominantly Hardpan Mulga Shrubland relatively densely covered and co-dominated by several acacias; moderate productivity but generally in poor condition with many areas showing loss of desirable perennial understorey species; various shrublands on saline plains are highly productive but are often degraded through preferential overuse; unit 4 is moderately to highly susceptible to accelerated erosion and liable to increases in unpalatable *Cassia* and *Eremophila* species.

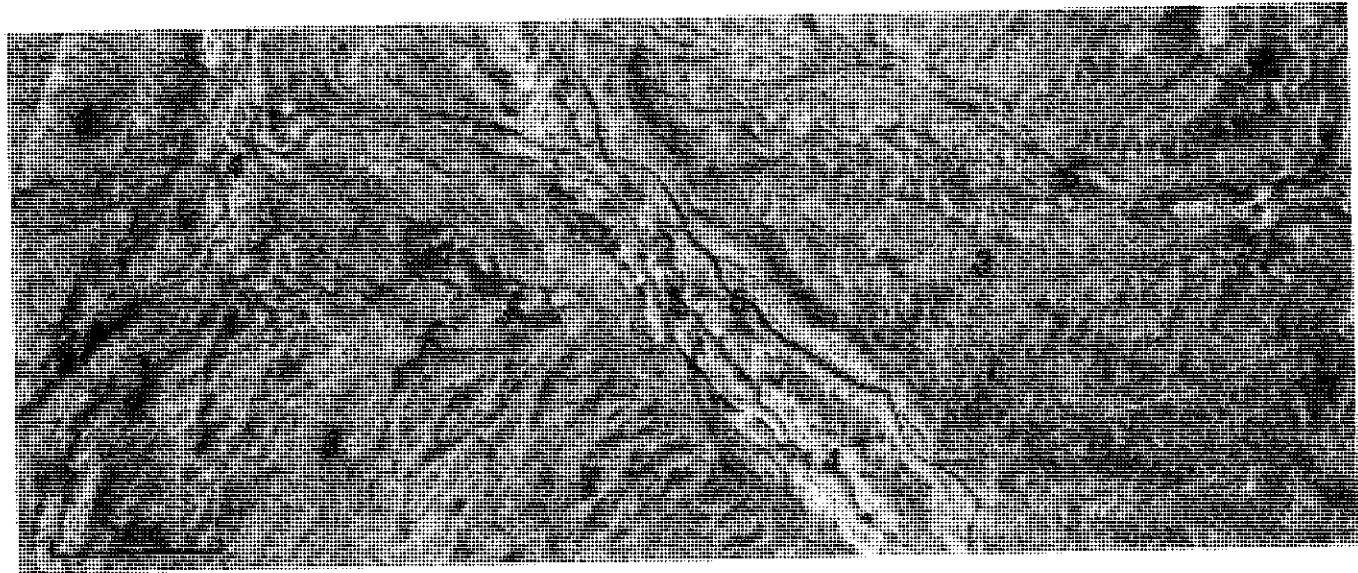
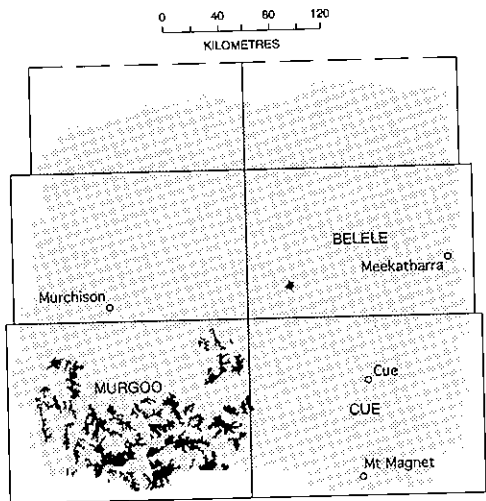
Estimated carrying capacity, good condition: 12 ha / dse.

Range condition summary (741 traverse observations):

(a) Erosion status (%)			
Nil	Min.	Mod.	Sev.
80	16	4	0

(b) Vegetation condition (%)		
Good	Fair	Poor
10	46	44

- Unit: 1. Sandy banks and minor sand sheets.
2. Sandy surfaced plains with outcrops.
3. Hardpan plains.
4. Alluvial plains and drainage tracts.
5. Creeklines.



Tindalarra I.s.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Sandy banks and minor sand sheets (7%) Isolated sandy banks and sandplain remnants to 1 km in extent and 1 m or more above surrounding plains. Soils are dark red earthy sands < 1 m deep over hardpan; pH 7.0 with a neutral trend. Principal profile form: Uc5.21.	Very scattered to scattered (PFC < 20%) tall shrublands dominated by <i>Acacia ramulosa</i> . Trees (2-4 m): <i>A. aneura</i> . Tall shrubs (> 2 m): <i>A. ramulosa</i> , <i>A. burkittii</i> , <i>A. grasbyi</i> , <i>A. xiphophylla</i> , <i>A. tetragonophylla</i> , <i>Hakea preissii</i> , <i>Exocarpus aphyllus</i> . Mid shrubs (1-2 m): <i>A. ramulosa</i> , <i>A. burkittii</i> , <i>Cassia nemophila</i> , <i>C. phyllodinea</i> , <i>Eremophila forrestii</i> . Low shrubs (< 1 m): <i>E. forrestii</i> , <i>Mirbelia</i> sp., <i>Solanum lasiophyllum</i> , <i>S. orbiculatum</i> , <i>Rhagodia eremaea</i> , <i>Ptilotus obovatus</i> , <i>Pimelea microcephala</i> . Perennial grasses: <i>Eriachne helmsii</i> , <i>Monachather paradoxa</i> .	2 inventory sites, 3 condition sites and traversed Vegetation type: Sandplain Wanderrie Grassy Shrubland. Palatable perennials include: <i>Eremophila forrestii</i> , <i>Rhagodia eremaea</i> , <i>Ptilotus obovatus</i> , <i>Monachather paradoxa</i> . Pastoral use limitations: None with controlled grazing.
Unit 2: Sandy surfaced plains with outcrops (1%) Gently sloping or slightly undulating plains with minor granite outcrops and light gritty or gravelly quartz mantles. Soils are shallow dark red hardpan loams over granite or hardpan; pH 6.5 with a neutral trend. Principal profile form: Um5.31.	Scattered to moderately close (PFC 10-30%) tall shrublands dominated by <i>Acacia burkittii</i> , <i>A. grasbyi</i> , <i>A. tetragonophylla</i> , <i>A. xiphophylla</i> , <i>Santalum spicatum</i> . Mid shrubs (1-2 m): <i>Cassia helmsii</i> , <i>Eremophila forrestii</i> , <i>E. platycalyx</i> , <i>E. latrobei</i> . Low shrubs (< 1 m): <i>Maireana convexa</i> , <i>M. thesioides</i> , <i>M. villosa</i> , <i>M. pyramidata</i> , <i>M. planifolia</i> , <i>M. triptera</i> , <i>Sida calyxhymenia</i> , <i>S. sp.</i> , <i>Ptilotus obovatus</i> , <i>P. schwartzii</i> , <i>E. compacta</i> , <i>Rhagodia eremaea</i> , <i>Scaevola spinescens</i> , <i>Enchylaena tomentosa</i> , <i>Solanum lasiophyllum</i> .	1 inventory site and traversed Vegetation type: Granitic Mulga Shrubland. Palatable perennials include: <i>E. latrobei</i> , <i>E. compacta</i> , <i>Maireana</i> spp., <i>Sida calyxhymenia</i> , <i>Enchylaena tomentosa</i> . Pastoral use limitations: None with controlled grazing.
Unit 3: Hardpan plains (80%) Gently inclined plains with more slope (0.3-0.75%) than other wash plains in region, on red-brown hardpan; occasionally strewn with light quartz mantles. Soils are mainly hardpan dark red sandy clay loams, red earths and occasional earthy sands 20-70 cm; pH 6.0-6.5 with a mostly neutral trend. Principal profile forms: Um5.31, Gn2.12, Uc5.21.	Scattered to moderately close (PFC 10-30%) tall shrublands dominated by <i>Acacia grasbyi</i> , <i>A. xiphophylla</i> , <i>A. ramulosa</i> , <i>A. burkittii</i> and <i>A. tetragonophylla</i> . Tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. burkittii</i> , <i>A. grasbyi</i> , <i>A. ramulosa</i> , <i>A. xiphophylla</i> , <i>A. tetragonophylla</i> , <i>Hakea recurva</i> , <i>A. victoriae</i> . Mid shrubs (1-2 m): <i>A. grasbyi</i> , <i>Hakea arida</i> , <i>Cassia helmsii</i> , <i>Cassia phyllodinea</i> , <i>E. forrestii</i> , <i>E. physocalyx</i> . Low shrubs (< 1 m): <i>E. forrestii</i> , <i>Maireana convexa</i> , <i>M. villosa</i> , <i>Ptilotus obovatus</i> , <i>P. schwartzii</i> , <i>Rhagodia eremaea</i> , <i>R. drummondii</i> , <i>Sida calyxhymenia</i> , <i>Solanum lasiophyllum</i> . Perennial grasses: <i>Monachather paradoxa</i> , <i>Eragrostis lanipes</i> , <i>Eriachne helmsii</i> .	7 inventory sites, 50 condition sites and traversed Vegetation type: Hardpan Mulga Shrubland. Palatable perennials include: <i>Eremophila forrestii</i> , <i>Maireana</i> spp., <i>Ptilotus obovatus</i> , <i>P. schwartzii</i> , <i>Rhagodia eremaea</i> , <i>R. drummondii</i> , <i>Sida calyxhymenia</i> . Pastoral use limitations: None under controlled grazing. Vegetation condition %: VG/G 9, F 51, P/VP 40. Erosion incidence %: min 8. 523 obs.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 4: Alluvial plains and drainage tracts (10%)	Very scattered to scattered (PFC < 20%) low shrublands dominated by <i>Acacia xiphophylla</i> and <i>Atriplex bunburyana</i> , <i>Eremophila platycalyx</i> , <i>Frankenia</i> spp. or <i>Maireana pyramidata</i> . Tall shrubs (> 2 m): <i>Acacia tetragonophylla</i> , <i>A. xiphophylla</i> , <i>A. victoriae</i> , <i>Hakea arida</i> . Mid shrubs (1-2 m): <i>E. platycalyx</i> , <i>E. pterocarpa</i> , <i>Cratystylis subspinescens</i> . Low shrubs (< 1 m): <i>Atriplex bunburyana</i> , <i>A. vesicaria</i> , <i>F. spp.</i> , <i>M. pyramidata</i> , <i>M. platycarpa</i> , <i>M. tomentosa</i> , <i>M. villosa</i> , <i>Solanum lasiophyllum</i> , <i>Rhagodia eremaea</i> , <i>Scaevola spinescens</i> , <i>Ptilotus obovatus</i> , <i>P. divaricatus</i> , <i>Gunniopsis quadrifida</i> . Perennial grass: <i>Stipa elegantissima</i> .	5 inventory sites, 8 condition sites and traversed Vegetation type: Bluebush or Saltbush Shrubland. Palatable perennials include: <i>Atriplex</i> spp., <i>Maireana</i> spp., <i>Rhagodia eremaea</i> , <i>Ptilotus</i> spp. Increaser species include: <i>Cassia phyllodinea</i> , <i>Eremophila pterocarpa</i> , <i>E. platycalyx</i> . Pastoral use limitations: Moderately to highly susceptible to accelerated water erosion where perennials are degraded. Vegetation condition %: VG/G 8, F 31, P/VP 61. Erosion incidence %: min 46, mod 17, sev 1. 157 obs.
Unit 5: Creeklines (< 2%)	Moderately close to close (PFC 30-50%) fringing woodlands or tall shrublands dominated by <i>Acacia burkittii</i> . Trees (to 6 m): <i>A. aneura</i> , <i>Pittosporum phylliraeoides</i> , <i>Casuarina obesa</i> . Tall shrubs (up to 6 m): <i>A. burkittii</i> , <i>Grevillea</i> sp., <i>A. sclerosperma</i> , <i>A. tetragonophylla</i> , <i>Santalum spicatum</i> . Mid shrubs (1-2 m): <i>Grevillea paniculata</i> , <i>G. sp.</i> , <i>A. craspedocarpa</i> , <i>A. tetragonophylla</i> , <i>Callistemon phoeniceus</i> . Low shrubs (< 1 m): <i>Ptilotus obovatus</i> , <i>P. divaricatus</i> , <i>Rhagodia</i> sp., <i>R. eremaea</i> , <i>Scaevola spinescens</i> , <i>Enchylaena tomentosa</i> , <i>Sida calyxhymenia</i> , <i>Solanum orbiculatum</i> , <i>Chenopodium gaudichaudianum</i> , <i>Gunniopsis quadrifida</i> . Perennial grasses: <i>Cymbopogon</i> sp., <i>Eragrostis setifolia</i> , <i>Enteropogon acicularis</i> , <i>Eriachne pulchella</i> .	2 inventory sites, 3 condition sites and traversed Vegetation type: Creekline Shrubland. Palatable perennials include: <i>Ptilotus</i> spp., <i>Rhagodia</i> spp., <i>Enchylaena tomentosa</i> , <i>Sida calyxhymenia</i> , <i>Chenopodium gaudichaudianum</i> , <i>Cymbopogon</i> sp., <i>Eragrostis setifolia</i> , <i>Enteropogon acicularis</i> , <i>Eriachne pulchella</i> .

Trillbar land system 131 km² (0.15% of survey area)

Land type: 5; Pastoral potential: moderate.

Gently sloping stony plains with low rises of metamorphic rocks and gilgaied drainage foci; supports more or less saline shrublands of snakewood, mulga, bluebush and samphire with patches of tussock grassland.

Geology: Archaean dolerite and metamorphic rocks, Proterozoic basalt, Tertiary laterite and shallow Quaternary colluvium and alluvium.

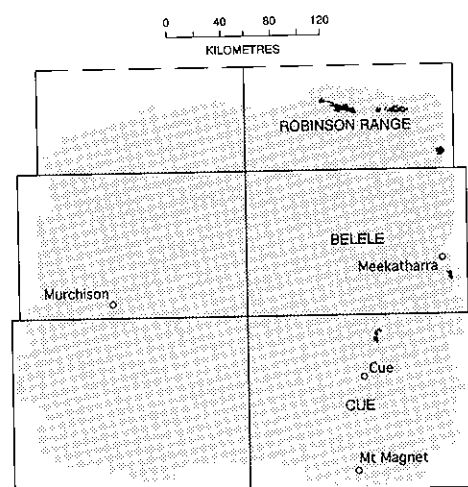
Geomorphology: Erosional and depositional surfaces; low rounded greenstone rises to 20 m high; broad, undulating stony plains, heavily mantled by mixed pebbles with variable grove formations in areas of more concentrated flow; saline lower plains mostly flat and interspersed with gilgaied depressions and drainage floors with minor channel development; relief mainly < 25 m.

Vegetation and pastoral use: Mainly Stony Snakewood Shrublands of low to moderate productivity with many areas degraded by pastoral or mining activities and dominated by unpalatable *Acacia*, *Hakea* and *Cassia* species; non-saline stony plains with Mulga Grove Woodland; lower saline plains will support halophytic shrubs of value for perennial forage but few areas remain in fair or good condition; gilgaied drainage foci carry highly productive tussock grasslands supplemented by palatable shrubs; the lower units are grazed preferentially but system not normally susceptible to accelerated erosion owing to extensive surface mantling; minor susceptibility on unit 4.

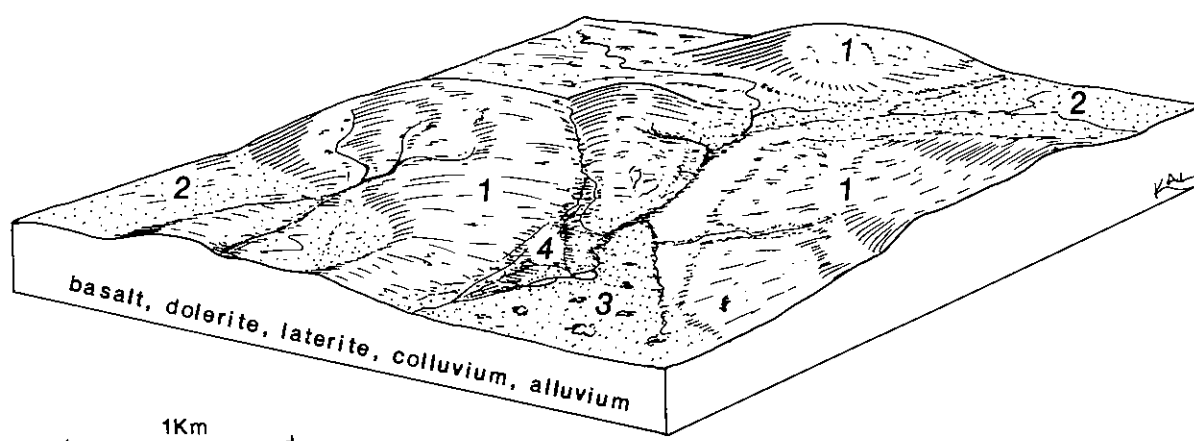
Estimated carrying capacity, good condition: 12 ha/dse.

Range condition summary (56 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
91	7	2	0	0	21	79



- Unit: 1. Undulating stony plains.
 2. Saline stony plains.
 3. Gilgai plains.
 4. Drainage tracts.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 1: Undulating stony plains (55%)</p> <p>Gently undulating (slopes < 3%) stony plains with rises and low greenstone ridges to 20 m; often weakly to moderately saline in lower, flatter parts of unit; covered with moderately dense to dense quartz or ironstone mantles. Lower plains show irregular grove formations receiving concentrated flow. Soils are duplexes or red earths, sandy loams or sandy clay loams over clay loams or light to medium clays < 1 m deep overlying granite or metamorphic parent material; pH 5.5-8.0 with variable trends. Principal profile forms: Dr2.13, Gn2.11, Um5.31.</p>	<p>a) Plains and slopes: Very scattered to scattered (PFC < 20%) tall shrublands dominated by <i>Acacia cuspidifolia</i> or <i>A. xiphophylla</i>. Trees (2-8 m): <i>A. aneura</i>, <i>A. cuspidifolia</i>. Tall shrubs (2-4 m): <i>A. cuspidifolia</i>, <i>A. victoriae</i>, <i>A. xiphophylla</i>, <i>A. tetragonophylla</i>, <i>Hakea preissii</i>. Mid shrubs (1-2 m): <i>A. cuspidifolia</i>, <i>A. tetragonophylla</i>, <i>A. victoriae</i>, <i>Cassia desolata</i>. Low shrubs (< 1 m): <i>C. desolata</i>, <i>C. hamersleyensis</i>, <i>Enchylaena tomentosa</i>, <i>Scaevola spinescens</i>.</p> <p>b) Mulga groves: Scattered to moderately close (PFC 10-30%) woodlands dominated by <i>Acacia aneura</i>, <i>A. craspedocarpa</i>, <i>Eremophila fraseri</i> or <i>E. freelingii</i>. Trees (to 6 m): <i>A. pruinocarpa</i>, <i>A. aneura</i>, <i>A. cuspidifolia</i>, <i>A. kempeana</i>, <i>A. victoriae</i>, <i>A. tetragonophylla</i>, <i>A. craspedocarpa</i>. Mid shrubs (1-2 m): <i>E. fraseri</i>, <i>E. freelingii</i>, <i>E. forrestii</i>. Low shrubs (< 1 m): <i>E. freelingii</i>, <i>E. compacta</i>, <i>E. maculata</i>, <i>E. forrestii</i>, <i>Scaevola spinescens</i>, <i>Solanum lasiophyllum</i>, <i>Ptilotus obovatus</i>, <i>P. roei</i>, <i>Sida calyxhymenia</i>. Perennial grass: <i>Eragrostis eriopoda</i>.</p>	<p>4 inventory sites, 1 condition site and traversed</p> <p>Vegetation type: a) Stony Snakewood Shrubland. Palatable perennials include: <i>Enchylaena tomentosa</i>, <i>Cassia hamersleyensis</i>, <i>Scaevola spinescens</i>. Vegetation condition %: VG/G 0, F 23, P/VP 77. Erosion incidence %: min 4, mod 4. 26 obs.</p> <p>b) Mulga Grove Woodland. Palatable perennials include: <i>Eremophila compacta</i>, <i>E. forrestii</i>, <i>E. maculata</i>, <i>Ptilotus</i> spp., <i>Sida calyxhymenia</i>, <i>Eragrostis eriopoda</i>. Increaser species include: <i>Acacia cuspidifolia</i>, <i>A. victoriae</i>, <i>C. desolata</i>, <i>H. preissii</i>. Pastoral use limitations: Susceptible to increases in cover by unpalatable species.</p>
<p>Unit 2: Saline stony plains (25%)</p> <p>Gently sloping (< 1%) saline stony plains in lower parts of system adjacent to units 5 and 6; usually strewn with a moderately dense to dense quartz mantle. Soils are duplex red sandy loams over light clays or deep red earths > 1 m deep overlying weathering metamorphic rocks; pH 8.0-8.5 with an alkaline reaction trend. Principal profile forms: Dr2.13, Gc2.22.</p>	<p>Very scattered to scattered (PFC < 20%) shrublands dominated by <i>Halosarcia</i> sp. and <i>Acacia xiphophylla</i>. Trees (to 6 m): <i>A. aneura</i>. Tall shrubs (2-6 m): <i>A. aneura</i>, <i>A. cuspidifolia</i>, <i>A. sclerosperma</i>, <i>A. victoriae</i>, <i>A. xiphophylla</i>, <i>Hakea arida</i>. Mid shrubs (1-2 m): <i>Halosarcia</i> sp., <i>Frankenia</i> sp., <i>Cassia desolata</i>, <i>C. chatelainiana</i>, <i>Enchylaena tomentosa</i>, <i>Eremophila freelingii</i>, <i>Maireana melanocoma</i>, <i>M. planifolia</i>, <i>M. pyramidata</i>, <i>M. triptera</i>, <i>Ptilotus obovatus</i>, <i>Scaevola spinescens</i>, <i>Solanum lasiophyllum</i>, <i>Rhagodia eremaea</i>.</p>	<p>2 inventory sites, 3 condition sites and traversed</p> <p>Vegetation type: Stony Snakewood Shrubland or Samphire Shrubland. Palatable perennials include: <i>Cassia chatelainiana</i>, <i>Enchylaena tomentosa</i>, <i>Maireana</i> spp., <i>Ptilotus obovatus</i>, <i>Scaevola spinescens</i>, <i>Rhagodia eremaea</i>. Increaser species include: <i>Acacia cuspidifolia</i>, <i>A. victoriae</i>, <i>Cassia desolata</i>, <i>Hakea arida</i>, <i>H. preissii</i>. Pastoral use limitations: None under controlled grazing. Vegetation condition %: VG/G 0, F 11, P/VP 89. Erosion incidence %: min 6. 18 obs.</p>
<p>Unit 3: Gilgai plains (15%)</p> <p>Restricted plains with gilgai depressions, occurring as drainage foci up to 1 km wide with channelled drainage lines and swamp floors; gilgai relief to 1 m; floors of depressions often strewn with very light quartz or ironstone mantles; plains carry denser quartz mantles. Soils are red or brown light to medium cracking clays, > 1 m deep; pH 6.5-8.0 with an alkaline reaction trend. Principal profile form: Ug6.31.</p>	<p>Tussock grassland with <i>Eragrostis setifolia</i>, <i>E. sp.</i>, <i>Eriachne flaccida</i> and <i>Eremophila maculata</i>. Trees (to 12 m): <i>Acacia aneura</i>, <i>Grevillea striata</i>, <i>Hakea suberea</i>, <i>Pittosporum phylliraeoides</i>. Tall shrubs (> 2 m): <i>A. victoriae</i>, <i>A. farnesiana</i>, <i>E. longifolia</i>, <i>E. laanii</i>, <i>H. preissii</i>. Mid shrubs (1-2 m): <i>Chenopodium nitriaceum</i>, <i>C. auricomum</i>, <i>Ptilotus lazaridis</i>, <i>Eleocharis pallens</i>, <i>Pimelea holroydii</i>, <i>Marselia drummondii</i>, <i>Enchylaena tomentosa</i>, <i>Solanum lasiophyllum</i>, <i>Eremophila maculata</i>, <i>Rhagodia eremaea</i>. Perennial grasses (locally dense): <i>Eragrostis setifolia</i>, <i>E. sp.</i>, <i>Eriachne benthamii</i>, <i>E. flaccida</i>.</p>	<p>4 inventory sites and traversed</p> <p>Vegetation type: Alluvial Tussock Grassland. Palatable perennials include: <i>Eragrostis setifolia</i>, <i>Eriachne</i> spp., <i>Ptilotus lazaridis</i>, <i>Chenopodium</i> spp., <i>Eremophila maculata</i>, <i>Enchylaena tomentosa</i>, <i>Rhagodia eremaea</i>. Pastoral use limitations: Subject to seasonal inundation and preferential grazing.</p>

Trillbar I.s.—continued

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 4: Drainage tracts (5%)		
Disorganised narrow drainage tracts; upper parts with dendritic channels < 20 m wide; grading into broader, less distinct slow drainage zones on unit 3; occasional larger channels also occur. Soils are probably deep clays.	Very scattered to scattered (PFC < 20%) mixed shrublands. Tall shrubs (> 2 m): <i>Acacia victoriae</i> , <i>A. tetragonophylla</i> , <i>A. aneura</i> , <i>Hakea arida</i> . Mid and low shrubs (< 2 m): <i>Eremophila compacta</i> , <i>Scaevola spinescens</i> , <i>Rhagodia eremaea</i> , <i>Lepidium platypetalum</i> , <i>Solanum lasiophyllum</i> .	1 condition site and traversed Vegetation type: Stony Snakewood Shrubland. Palatable perennials include: <i>Eremophila compacta</i> , <i>Lepidium platypetalum</i> , <i>Rhagodia eremaea</i> . Pastoral use limitations: None with controlled grazing.

Violet land system (W) 1078 km² (1.26% of survey area)

Land type: 7; Pastoral potential: moderate.

Gently undulating gravelly plains on greenstone, laterite and hardpan, with low stony rises and minor saline plains; supports mulga and bowgada-dominated shrublands, with dense mulga groves and patchy halophytic shrublands.

Geology: Archaean greenstone, Upper Proterozoic basalt, Tertiary laterite and veneers of Quaternary alluvium and colluvium.

Geomorphology: Erosional surfaces; remnants of old plateau as gravelly sand plains above gently undulating outcrops of laterite and weathered greenstones; broad, lower stony plains on greenstone or red-brown hardpan, often densely mantled by pebbles of mixed lithology and with sluggish, occasionally channelled, drainage floors; relief mostly < 10 m.

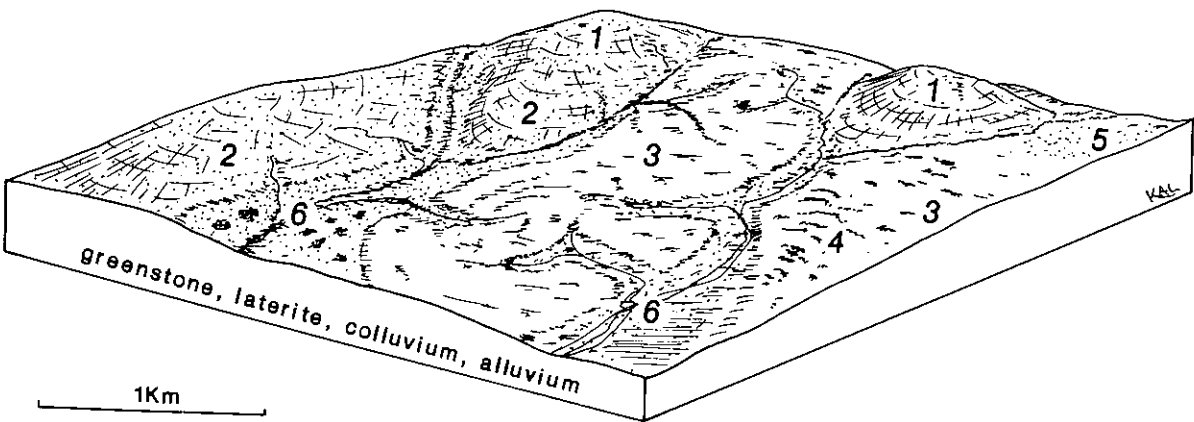
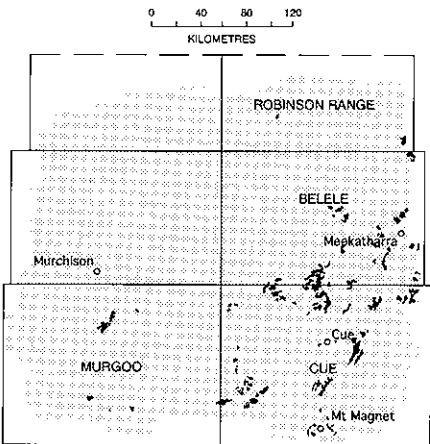
Vegetation and pastoral use: Mainly Stony Mulga Mixed Shrubland and Lateritic Acacia Shrubland with Mulga Grove Woodland communities in drainage foci and Bluebush and Samphire Shrublands on saline drainage floors; moderately productive when in fair to good condition. Groves and washes carry isolated dense Grove Woodland, the fringes of which tend to be preferentially grazed and prone to degradation; lower saline stony plains carry sparse halophytes; unit 6 is moderately susceptible and unit 2 slightly susceptible to accelerated erosion if vegetation is degraded or soil surface disturbed.

Estimated carrying capacity, good condition: 12 ha/dse.

Range condition summary (260 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
92	6	2	0	25	43	32

- Unit: 1. Low lateritic rises.
2. Sandy surfaced gravelly plains.
3. Stony plains.
4. Mulga groves.
5. Saline stony plains.
6. Drainage tracts.



Violet I.s.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 1: Low lateritic rises (10%)</p> <p>Gently sloping (< 1%) lateritic interfluves and stripped rises up to 1 km wide with crests up to 4 m high; strewn with moderately dense to dense ironstone gravel; also areas of exposed parent material on crests. Soils are dark red gravelly loamy sands < 30 cm deep overlying ironstone gravels; pH 5.5 with an acidic trend. Principal profile form: Uc1.43.</p>	<p>Scattered (PFC 10-20%) mixed or tall shrublands with <i>Acacia aneura</i> and <i>A. aff. quadrimarginea</i> the dominant species. Trees and tall shrubs (2-4 m): <i>A. aneura</i>, <i>A. aff. quadrimarginea</i>, <i>Thryptomene</i> sp., <i>Eremophila latrobei</i>, <i>E. forrestii</i>, <i>E. linearis</i>. Low shrubs (< 1 m): <i>E. compacta</i>, <i>E. latrobei</i>, <i>Ptilotus schwartzii</i>, <i>P. obovatus</i>, <i>Solanum lasiophyllum</i>, <i>Sida calyxhymenia</i>, <i>Rhagodia eremaea</i>.</p>	<p>2 inventory sites, 2 condition sites and traversed</p> <p>Vegetation type: Stony Mulga Mixed Shrubland. Palatable perennials include: <i>Eremophila forrestii</i>, <i>E. latrobei</i>, <i>E. compacta</i>, <i>Ptilotus</i> spp., <i>Sida calyxhymenia</i>, <i>Rhagodia eremaea</i>. Pastoral use limitations: None with controlled grazing.</p>
<p>Unit 2: Sandy surfaced gravelly plains (20%)</p> <p>Gently undulating plains with slopes to 2% and relief to 3 m; characterised by sandy soils with moderately dense mantles of lateritic gravels. Soils are dark red gravelly clayey sands or fine sandy loams < 1 m deep with abundant laterite and ironstone inclusions throughout the profile; over granite, laterite or greenstone; pH 5.5-6.5 with an acidic to neutral trend. Principal profile forms: Uc5.21, Uc1.43, Um5.51.</p>	<p>Moderately close (PFC 20-30%) tall shrublands dominated by <i>Acacia aneura</i> or <i>A. ramulosa</i>. Trees (to 8 m): <i>A. aneura</i>, <i>A. pruinocarpa</i>. Tall shrubs (> 2 m): <i>Canthium latifolium</i>, <i>C. lineare</i>, <i>A. aneura</i>, <i>A. ramulosa</i>, <i>A. quadrimarginea</i>, <i>A. tetragonophylla</i>, <i>A. aff. coolgardiensis</i>. Mid shrubs (1-2 m): <i>A. aneura</i>, <i>A. ramulosa</i>, <i>Eremophila forrestii</i>, <i>E. compacta</i>, <i>C. chatelainiana</i>, <i>C. nemophila</i>, <i>Maireana convexa</i>, <i>M. thesioides</i>, <i>M. tomentosa</i>, <i>M. aff. planifolia</i>, <i>M. villosa</i>, <i>M. aff. villosa</i>, <i>M. georgei</i>, <i>Ptilotus obovatus</i>, <i>P. schwartzii</i>, <i>Sida calyxhymenia</i>, <i>S. sp.</i>, <i>Solanum lasiophyllum</i>, <i>Rhagodia eremaea</i>. Perennial grasses: <i>Eragrostis eriopoda</i>, <i>E. lanipes</i>, <i>Monachather paradoxa</i>, <i>Thyridolepis multiculmis</i>.</p>	<p>4 inventory sites, 2 condition sites and traversed</p> <p>Vegetation type: Lateritic Acacia Shrubland. Palatable perennials include: <i>Eremophila forrestii</i>, <i>E. latrobei</i>, <i>E. compacta</i>, <i>Cassia chatelainiana</i>, <i>Maireana</i> spp., <i>Ptilotus</i> spp., <i>Sida</i> spp., <i>Rhagodia eremaea</i>, <i>Eragrostis</i> spp., <i>Monachather paradoxa</i>, <i>Thyridolepis multiculmis</i>. Pastoral use limitations: None with controlled grazing. Vegetation condition %: VG/G 36, F 37, P/VP 27. 41 obs.</p>
<p>Unit 3: Stony plains (50%)</p> <p>Very gently undulating plains with slopes < 1% and relief to 5 m; usually strewn with moderately dense ironstone or quartz mantles. Soils are shallow red earths, clay loams or fine sandy loams to 40 cm mainly overlying greenstone or hardpan; pH 5.0-6.0 with an acidic or neutral reaction trend. Principal profile forms: Uc1.43, Um5.51.</p>	<p>Very scattered to scattered (PFC < 20%) mixed shrublands dominated by <i>Acacia aneura</i>, <i>Eremophila linearis</i> or <i>E. aff. compacta</i>. Trees (to 6 m): <i>A. pruinocarpa</i>, <i>A. aneura</i>. Tall shrubs (> 2 m): <i>A. victoriae</i>, <i>A. craspedocarpa</i>, <i>A. tetragonophylla</i>, <i>A. cuthbertsonii</i>, <i>E. linearis</i>, <i>E. latrobei</i>. Mid shrubs (1-2 m): <i>Cassia sturtii</i>, <i>E. forrestii</i>, <i>E. fraseri</i>. Low shrubs (< 1 m): <i>E. linearis</i>, <i>E. aff. compacta</i>, <i>E. spathulata</i>, <i>Ptilotus obovatus</i>, <i>P. rotundifolius</i>, <i>P. roei</i>, <i>P. schwartzii</i>, <i>Solanum lasiophyllum</i>, <i>Rhagodia eremaea</i>, <i>Maireana melanocoma</i>, <i>M. planifolia</i>. Perennial grass: <i>Monachather paradoxa</i>.</p>	<p>3 inventory sites, 19 condition sites and traversed</p> <p>Vegetation type: Stony Mulga Mixed Shrubland. Palatable perennials include: <i>Eremophila latrobei</i>, <i>E. aff. compacta</i>, <i>Ptilotus</i> spp., <i>Maireana</i> spp., <i>Rhagodia eremaea</i>. Pastoral use limitations: None with controlled grazing; not normally susceptible to accelerated erosion under pastoral use. Vegetation condition %: VG/G 22, F 43, P/VP 35. Erosion incidence %: min 5, mod 1. 148 obs.</p>
<p>Unit 4: Mulga groves (5%)</p> <p>Elliptical or linear grove formations up to 500 m long and 100 m wide generally transverse to direction of sheet flow; commonly occurring as slight depressions in areas of broad, ill-defined drainage (unit 6) and also on unit 3. Soils are red earths, reddish brown sandy clay loams or fine sandy loams > 1 m deep with ironstone fractions throughout the profile; pH 5.0-7.0 with neutral or acidic reaction trend. Principal profile form: Um5.52.</p>	<p>Close to closed (PFC > 30%) low woodland dominated by <i>Acacia aneura</i> or <i>A. pruinocarpa</i>. Trees (to 8 m): <i>A. aneura</i>, <i>A. pruinocarpa</i>, <i>Hakea suberea</i>. Tall shrubs (> 2 m): <i>A. aneura</i>, <i>A. tetragonophylla</i>, <i>Canthium latifolium</i>, <i>C. lineare</i>. Mid shrubs (1-2 m): <i>Eremophila georgei</i>, <i>E. gilesii</i>, <i>E. forrestii</i>, <i>Rhagodia eremaea</i>, <i>Sida calyxhymenia</i>, <i>S. platycalyx</i>, <i>Ptilotus obovatus</i>, <i>Maireana convexa</i>, <i>M. aff. tomentosa</i>, <i>M. planifolia</i>, <i>Solanum lasiophyllum</i>, <i>Lycium australe</i>. Perennial grasses: <i>Monachather paradoxa</i>, <i>Eriachne helmsii</i>.</p>	<p>4 inventory sites and traversed</p> <p>Vegetation type: Mulga Grove Woodland. Palatable perennials include: <i>Eremophila forrestii</i>, <i>E. latrobei</i>, <i>Rhagodia eremaea</i>, <i>Sida</i> spp., <i>Ptilotus obovatus</i>, <i>Maireana</i> spp., <i>Monachather paradoxa</i>. Pastoral use limitations: None with controlled grazing.</p>

Violet I.s.—continued

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 5: Saline stony plains (10%)</p> <p>Lower saline stony plains with grades < 1%; often occurring on margins of system below low breakaways or greenstone hills; generally with moderately dense quartz or ironstone mantles. Soils are duplexes, deep red fine sandy loams over light to medium clays < 50 cm deep; pH 7.5-9.5 with an alkaline trend. Principal profile form: Dr2.13.</p>	<p>Very scattered (PFC < 10%) low shrublands dominated by <i>Maireana</i> spp. Tall or mid shrubs (> 1 m, infrequent): <i>Acacia aneura</i>, <i>A. victoriae</i>. Low shrubs (< 1 m): <i>M. aff. tomentosa</i>, <i>M. triptera</i>, <i>M. georgei</i>, <i>M. pyramidata</i>, <i>Halosarcia</i> sp., <i>Frankenia</i> spp., <i>Dissocarpus paradoxa</i>. Perennial grass: <i>Eragrostis dielsii</i>.</p>	<p>1 inventory site and traversed</p> <p>Vegetation type: Bluebush Shrubland or Samphire Shrubland. Palatable perennials include: <i>Maireana</i> spp., <i>Eragrostis dielsii</i>, <i>Frankenia</i> spp., <i>Lepidium platypetalum</i>. Pastoral use limitations: None with controlled grazing.</p>
<p>Unit 6: Drainage tracts (5%)</p> <p>Channelled or unchannelled zones to 500 m wide though usually < 300 m; channels are narrow and braided < 1 m deep; often draining onto broader zones with no channelling. Soils are alluvial sands, silts and loams with little profile development < 1 m deep on hardpan; pH 6.5-7.0 with a neutral reaction trend.</p>	<p>Moderately close (PFC 20-30%) tall shrublands dominated by <i>Acacia aneura</i>. Trees (to 8 m): <i>A. aneura</i>, <i>A. pruinocarpa</i>. Tall shrubs (> 2 m): <i>A. aneura</i>, <i>A. ramulosa</i>, <i>A. sclerosperma</i>, <i>A. tetragonophylla</i>, <i>Canthium latifolium</i>, <i>Santalum spicatum</i>. Mid shrubs (1-2 m): <i>A. aneura</i>, <i>Eremophila fraseri</i>, <i>E. punicea</i>, <i>E. georgei</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>Scaevola spinescens</i>, <i>Sida calyxhymenia</i>, <i>Solanum lasiophyllum</i>, <i>Rhagodia eremaea</i>, <i>Maireana convexa</i>, <i>M. georgei</i>, <i>M. triptera</i>, <i>M. villosa</i>, <i>Cassia chatelainiana</i>. Perennial grass: <i>Cymbopogon</i> sp.</p>	<p>1 inventory site and traversed</p> <p>Vegetation type: Creekline Shrubland. Palatable perennials include: <i>Ptilotus obovatus</i>, <i>Rhagodia eremaea</i>, <i>Sida calyxhymenia</i>, <i>Maireana</i> spp., <i>Cassia chatelainiana</i>, <i>Cymbopogon</i> sp. Pastoral use limitations: Moderately susceptible to erosion where degraded.</p>

Waguin land system (W) 748 km² (0.87% of survey area)

Land type: 7; Pastoral potential: low.

Sandplains and stripped granite or laterite surfaces with low fringing breakaways and lower plains; supports bowgada shrublands with sparse wanderrie grasses, mulga shrublands and minor mixed halophytes.

Geology: Massive Archaean granite, Tertiary laterite and aeolian sand; also minor Quaternary colluvium and alluvium.

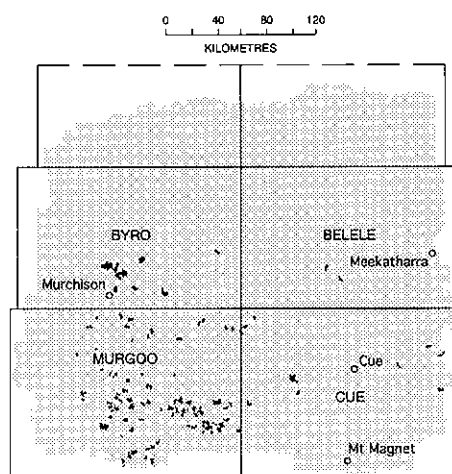
Geomorphology: Depositional and erosional surfaces; residual sandplains on lateritic plateaux, locally fringed with low breakaways, above gently inclined and locally saline plains variably strewn with lateritic or granite mantles; lower plains carrying sheet flow and with some vegetation growing; narrow drainage floors with occasional channels; over relief to 20 m.

Vegetation and pastoral use: Mainly Lateritic Acacia Shrubland and Granitic Mulga Shrubland; palatable forage is provided principally by annual species and sparse perennial shrubs and herbs. Minor occurrences of Sandplain Wanderrie Grass Shrubland and Stony Snakewood or Mixed Halophytic Shrublands provide moderate value perennial forage when in good condition; pockets of chenopod shrubs occur along drainage tracts; unit 3 is moderately susceptible to accelerated erosion.

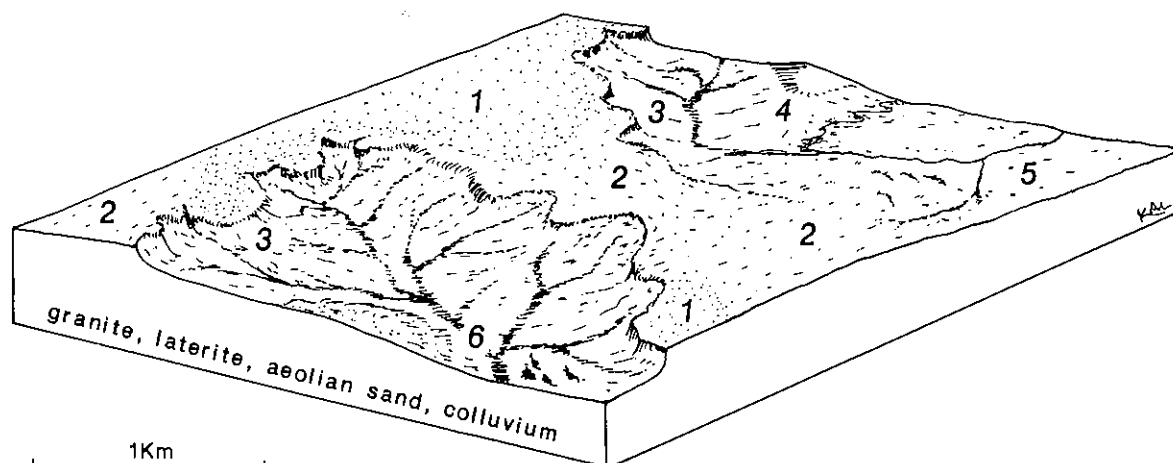
Estimated carrying capacity, good condition: 20 ha / dse.

Range condition summary (102 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
92	8	0	0	22	46	32



- Unit:
1. Sand plains.
 2. Stripped surfaces, plateaux remnants and low breakaways.
 3. Footslopes below breakaways.
 4. Stony plains with sandy soils over granite.
 5. Alluvial plains.
 6. Drainage floors.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Sand plains (20%)		1 inventory site, 2 condition sites and traversed
Gently sloping remnant tracts of sand up to 2 km in extent and elevated several metres above surrounding plains, sometimes with sparse mantle of ironstone gravel. Soils are dark red earthy sands overlying weathered granite < 1 m deep; pH 6.5 with a neutral trend. Principal profile form: Uc5.21.	Moderately close (PFC 20-30%) tall shrublands dominated by <i>Acacia ramulosa</i> or <i>Thryptomene decussata</i> . Trees and tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. ramulosa</i> , <i>T. decussata</i> , <i>Eremophila forrestii</i> , <i>E. granitica</i> . Low shrubs (< 1 m): <i>T. decussata</i> , <i>Hemigenia</i> sp., <i>E. forrestii</i> , <i>Solanum lasiophyllum</i> . Perennial grasses: <i>Eragrostis eriopoda</i> , <i>Eriachne helmsii</i> , <i>Monachather paradoxa</i> , <i>Thyridolepis multiculmis</i> .	Vegetation type: Sandplain Wanderrie Grassy Shrubland. Palatable perennials include: <i>Eremophila forrestii</i> , <i>Eragrostis</i> spp., <i>Monachather paradoxa</i> , <i>Thyridolepis multiculmis</i> . Pastoral use limitations: None with controlled grazing. Vegetation condition %: VG/G 53, F 40, P/V 7. 15 obs.
Unit 2: Stripped surfaces, plateaux remnants and low breakaways (40%)		3 inventory sites, 2 condition sites and traversed
Gently sloping stripped lateritic surfaces, plateaux remnants and low breakaways (up to 20 m high) of ferricrete, silcrete and weathered granite and with mantles of laterite, granite and quartz. Soils are very shallow skeletal lithosols or occasional pockets of brown duplexes overlying granite or laterite, < 50 cm deep; pH 6.0 with an acidic trend. Principal profile forms: Uc1.43, Db1.51.	Scattered (PFC 10-20%) tall shrublands dominated by <i>Acacia ramulosa</i> . Tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. burkittii</i> , <i>A. ramulosa</i> , <i>Callitris heuglii</i> . Mid shrubs (1-2 m): <i>A. aff. ramulosa</i> , <i>A. exocarpoides</i> , <i>Eremophila exilifolia</i> , <i>E. georgei</i> , <i>E. forrestii</i> , <i>E. latrobei</i> , <i>E. oldfieldii</i> , <i>Thryptomene racemulosa</i> . Low shrubs (< 1 m): <i>Calytrix</i> sp., <i>E. forrestii</i> , <i>Ptilotus schwartzii</i> , <i>P. obovatus</i> , <i>Borya nitida</i> , <i>Rhagodia eremaea</i> , <i>R.</i> sp., <i>Maireana villosa</i> , <i>M. thesioides</i> , <i>Sida calyxhymenia</i> , <i>S.</i> sp., <i>Solanum lasiophyllum</i> , <i>Verticordia</i> sp., <i>Eriostemon brucei</i> .	Vegetation type: Lateritic Acacia Shrubland. Palatable perennials include: <i>Eremophila forrestii</i> , <i>E. latrobei</i> , <i>Ptilotus</i> spp., <i>Rhagodia</i> spp., <i>Sida</i> spp., <i>Maireana</i> spp. Pastoral use limitations: None with controlled grazing. Vegetation condition %: VG/G 16, F 56, P/V 28. 57 obs.
Unit 3: Footslopes below breakaways (10%)		1 inventory site and traversed
Mostly short footslopes extending 100-500 m below breakaways and outcrops of deeply weathered rocks, slopes around 1%, lightly to moderately mantled by mixed pebbles and gravels and some pallid zone deposits locally. Soils are red duplex or shallow gradational red earth types, sandy loams over sandy clay loams or sandy clays, < 50 cm deep over granite, pH 6.0 with a neutral reaction trend. Principal profile forms: Dr1.51, Gn2.11.	Very scattered to scattered (PFC < 20%) low shrublands dominated by mixed halophytic shrubs or mixed shrublands dominated by <i>Acacia xiphophylla</i> or <i>A. aneura</i> . Tall shrubs (2-4 m): <i>A. xiphophylla</i> , <i>A. aneura</i> , <i>A. grasbyi</i> , <i>Eremophila oldfieldii</i> . Mid shrubs (1-2 m): <i>Cassia nemophila</i> , <i>C. phyllodinea</i> , <i>C. sturtii</i> , <i>A. tetragonophylla</i> . Low shrubs (< 1 m): <i>Maireana glomerifolia</i> , <i>M. thesioides</i> , <i>M. triptera</i> , <i>M. georgei</i> , <i>Ptilotus beardii</i> , <i>Frankenia</i> spp., <i>P. obovatus</i> , <i>Solanum lasiophyllum</i> .	Vegetation type: Bluebush or Mixed Halophyte Shrublands. Palatable perennials include: <i>Maireana</i> spp., <i>Ptilotus</i> spp., <i>Enchylaena tomentosa</i> , <i>Rhagodia</i> spp. Pastoral use limitations: Moderately susceptible to accelerated erosion where degraded.
Unit 4: Stony plains with sandy soils over granite (10%)		2 condition sites and traversed
Erosional plains with mantles and frequent outcrops of granite and quartz; slopes 0.3-1%. Soils are probably shallow, earthy or granitic siliceous sands over granite.	Very scattered to scattered (PFC < 20%) mixed shrubland. Tall and mid shrubs (> 1 m): <i>Acacia aneura</i> , <i>A. burkittii</i> , <i>A. ramulosa</i> , <i>Eremophila latrobei</i> , <i>E. glutinosa</i> , <i>E. stronglyphylla</i> , <i>Thryptomene racemulosa</i> . Low shrubs (< 1 m): <i>Ptilotus obovatus</i> , <i>P. schwartzii</i> , <i>T. racemulosa</i> , <i>Maireana villosa</i> , <i>Rhagodia drummondii</i> , <i>Mirbelia spinosa</i> , <i>Hemigenia</i> sp., <i>Sida calyxhymenia</i> , <i>Solanum lasiophyllum</i> , <i>Borya nitida</i> .	Vegetation type: Granitic Mulga Shrubland. Palatable perennials include: <i>Ptilotus</i> spp., <i>Eremophila latrobei</i> , <i>Rhagodia drummondii</i> , <i>Sida calyxhymenia</i> , <i>Maireana</i> spp. Pastoral use limitations: None with controlled grazing.

Waguin I.s.—continued

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 5: Alluvial plains (15%)</p> <p>Depositional wash plains and fans receiving sheet flow from higher units 2, 3 and 4. May have transverse groves of vegetation. Soils are dark red loamy sands over hardpan at variable depth. Principle profile form: Uc5.21.</p>	<p>Mainly very scattered (PFC < 10%) tall and mixed shrublands dominated by <i>Acacia ramulosa</i> and <i>A. aneura</i>, with close to closed (PFC > 30%) tall shrublands of similar composition in groves. Tall and mid shrubs (> 1 m): <i>A. ramulosa</i>, <i>A. aneura</i>, <i>A. craspedocarpa</i>, <i>A. daviesioides</i>, <i>Eremophila georgei</i>, <i>Ptilotus obovatus</i>, <i>Solanum lasiophyllum</i>. Low shrubs: (< 1 m) <i>Maireana convexa</i>, <i>M. villosa</i>, <i>Eremophila latrobei</i>, <i>Rhagodia eremaea</i>, <i>Sida</i> spp.</p>	<p>1 inventory site and traversed</p> <p>Vegetation type: Hardpan Mulga Shrubland and Mulga Grove Woodland. Palatable perennials include: <i>Ptilotus</i> spp., <i>Maireana convexa</i>, <i>M. villosa</i>, <i>Eremophila latrobei</i>, <i>Rhagodia eremaea</i>, <i>Sida</i> spp. Pastoral use limitations: None under controlled grazing.</p>
<p>Unit 6: Drainage floors (5%)</p> <p>Narrow (up to 100 m wide) floors with shallow channels. Soils are probably sandy clay loams over hardpan.</p>	<p>As for unit 5.</p>	<p>Traversed</p> <p>Vegetation type: Hardpan Mulga Shrubland. Palatable perennials include: As for unit 5. Pastoral use limitations: Mildly susceptible to accelerated erosion if vegetation degraded.</p>

Weenyung land system 153 km² (0.18% of survey area)

Land type: 16; Pastoral potential: high.

Sandy alluvial plains interspersed with higher sandy plains and broad drainage floors supporting halophytic shrublands and wanderrie shrublands; system is restricted to the west of the area.

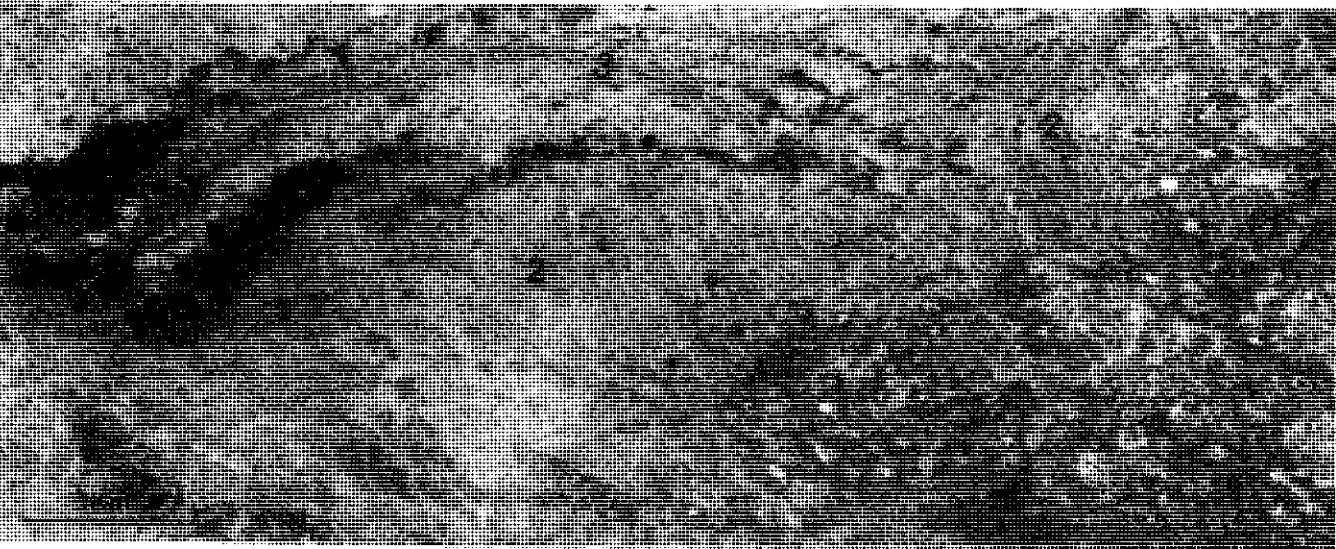
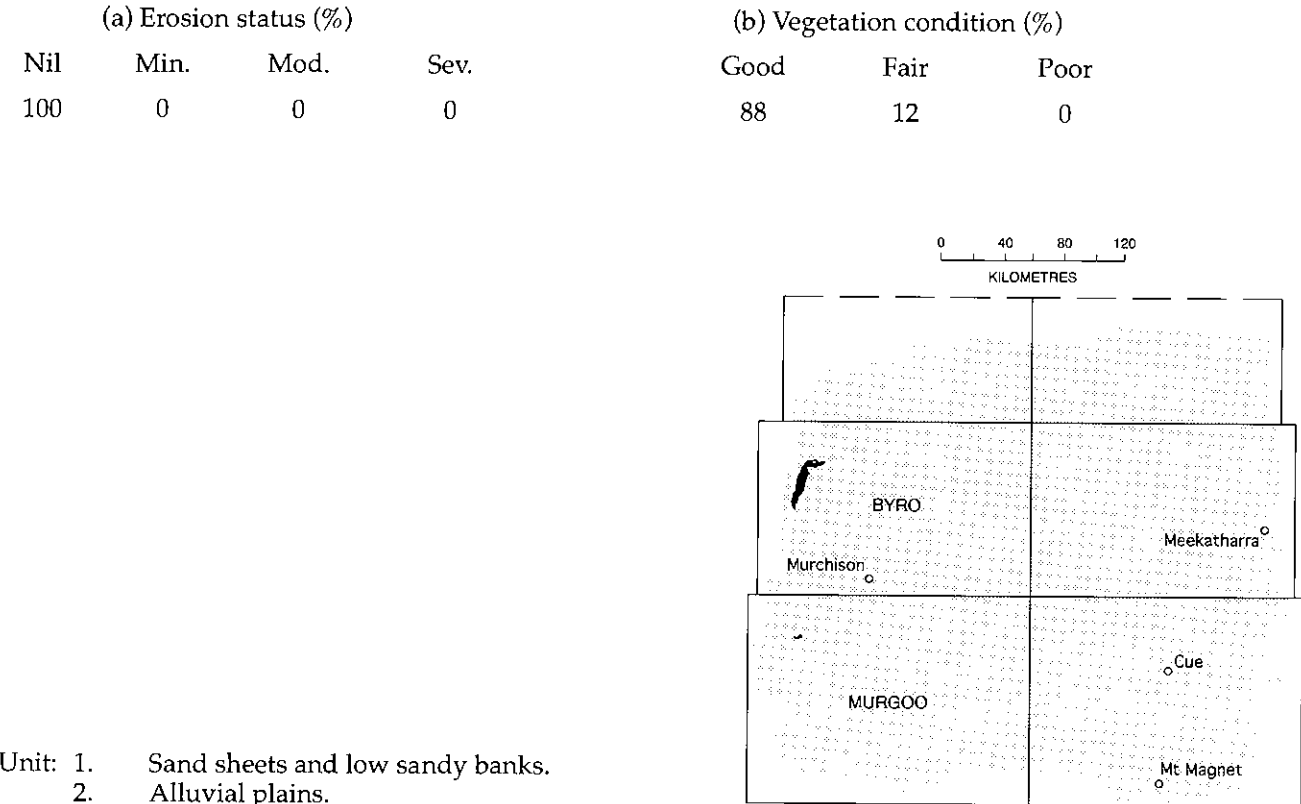
Geology: Quaternary alluvium.

Geomorphology: Sandy depositional surfaces; minor residual sandplains above almost flat alluvial plains with numerous small drainage foci and broad drainage floors with little channelling; overall relief mostly < 3 m.

Vegetation and pastoral use: Mixed Halophytic and Saltbush Shrublands with extensive *Melaleuca* thickets; past use has been limited by lack of groundwater suitable for stock and present condition of perennials is mostly good; sandplain unit supports Sandplain Wanderrie Grassy Shrubland with supplementary halophytic shrubs; parts of unit 2 are probably moderately susceptible to accelerated erosion if degraded.

Estimated carrying capacity, good condition: 7 ha/dse.

Range condition summary (33 traverse observations):



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 1: Sand sheets and low sandy banks (20%)</p> <p>Flat tracts of red sand, up to 1 m above surrounding plains; occasional linear or elliptical low dunes or banks flanking plains and drainage foci. Soils are dark red earthy and siliceous sands > 1 m deep; pH 5.5-6.0 with an acidic trend. Principal profile forms: Uc5.21, Uc1.23.</p>	<p>Moderately close (PFC 20-30%) tall shrublands dominated by <i>Acacia ramulosa</i>. Trees (to 8 m): <i>A. aneura</i>, <i>A. pruinocarpa</i>, <i>Eucalyptus coolabah</i>. Tall shrubs (> 2 m): <i>A. ramulosa</i>, <i>A. tetragonophylla</i>, <i>Grevillea stenobotrya</i>. Mid shrubs (1-2 m): <i>Eremophila forrestii</i>, <i>E. latrobei</i>, <i>Cassia sturtii</i>, <i>Pimelea microcephala</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>Maireana planifolia</i>, <i>Rhagodia eremaea</i>, <i>Sida</i> sp., <i>Scaevola spinescens</i>, <i>Solanum lasiophyllum</i>. Perennial grass: <i>Monachather paradoxa</i>.</p>	<p>1 inventory site and traversed</p> <p>Vegetation type: Sandplain Wanderrie Grassy Shrubland. Palatable perennials include: <i>Ptilotus obovatus</i>, <i>Eremophila forrestii</i>, <i>E. latrobei</i>, <i>Maireana planifolia</i>, <i>Rhagodia eremaea</i>, <i>Sida</i> sp., <i>Scaevola spinescens</i>, <i>Monachather paradoxa</i>. Pastoral use limitations: None with controlled grazing.</p>
<p>Unit 2: Alluvial plains (70%)</p> <p>Broad tracts of almost flat saline alluvial plains subject to flooding interspersed with numerous bare claypans and densely vegetated swamps, usually < 100 m in diameter. Soils are yellowish-red or reddish duplexes, clayey sands over light to medium clays > 1 m deep; pH 7.0 with an alkaline trend. Principal profile form: Dr1.53.</p>	<p>Scattered to moderately close (PFC 10-30%) low or mid shrublands dominated by <i>Cratystylis subspinescens</i>, <i>Atriplex bunburyana</i>, <i>Maireana platycarpa</i> or <i>M. pyramidata</i>. Tall shrubs (> 2 m): <i>Melaleuca uncinata</i>, <i>Acacia tetragonophylla</i>, <i>A. victoriae</i>, <i>Hakea preissii</i>. Mid shrubs (1-2 m): <i>Eremophila pterocarpa</i>, <i>Cassia desolata</i>, <i>C. phyllodinea</i>, <i>C. sturtii</i>, <i>Cratystylis subspinescens</i>, <i>Lycium australe</i>. Low shrubs (< 1 m): <i>Atriplex bunburyana</i>, <i>A. amnicola</i>, <i>A. vesicaria</i>, <i>Chenopodium gaudichaudianum</i>, <i>Cratystylis subspinescens</i>, <i>Enchylaena tomentosa</i>, <i>Frankenia</i> sp., <i>Lycium australe</i>, <i>Maireana atkinsiana</i>, <i>M. integra</i>, <i>M. platycarpa</i>, <i>M. pyramidata</i>, <i>M. tomentosa</i>, <i>Ptilotus beardii</i>, <i>P. obovatus</i>, <i>Scaevola spinescens</i>. Perennial grass: <i>Eragrostis setifolia</i>.</p>	<p>1 inventory site, 4 condition sites and traversed</p> <p>Vegetation type: Saltbush or Bluebush Shrubland. Palatable perennials include: <i>Atriplex</i> spp., <i>Cratystylis subspinescens</i>, <i>Chenopodium gaudichaudianum</i>, <i>Enchylaena tomentosa</i>, <i>Maireana</i> spp., <i>Ptilotus</i> spp., <i>Scaevola spinescens</i>, <i>Eragrostis setifolia</i>. Pastoral use limitations: Probably moderate susceptibility to accelerated erosion. Vegetation condition %: VG/G 81, F 19, P/VP 0. 16 obs.</p>
<p>Unit 3: Broad drainage tracts (10%)</p> <p>Drainage tracts to 1.5 km wide, carrying mainly internally drained flows. Soils are red duplexes or red clays > 1 m deep; pH 7.0 with a neutral trend.</p>	<p>Close (PFC 30-50%) tall or mixed height shrubland dominated by <i>Melaleuca uncinata</i>. Tall and mid shrubs (> 1 m): <i>M. uncinata</i>, <i>M. glomerata</i>, <i>Acacia</i> sp., <i>Lycium australe</i>, <i>Scaevola spinescens</i>. Low shrubs (< 1 m): <i>Cratystylis subspinescens</i>, <i>L. australe</i>, <i>Cassia chatelainiana</i>, <i>Eremophila maculata</i>, <i>Frankenia</i> sp., <i>Ptilotus divaricatus</i>.</p>	<p>1 inventory site and traversed</p> <p>Vegetation type: Mixed Halophyte Shrubland. Palatable perennials include: <i>Cratystylis subspinescens</i>, <i>Eremophila maculata</i>, <i>Cassia chatelainiana</i>, <i>Scaevola spinescens</i>, <i>Ptilotus divaricatus</i>. Pastoral use limitations: None with controlled grazing.</p>

Weld land system (W) 350 km² (0.41% of survey area)

Land type: 1; Pastoral potential: very low.

Rugged ranges and ridges of mainly Archaean metamorphosed sedimentary rocks; supports acacia shrublands; major system of the Weld Range and Jack Hills.

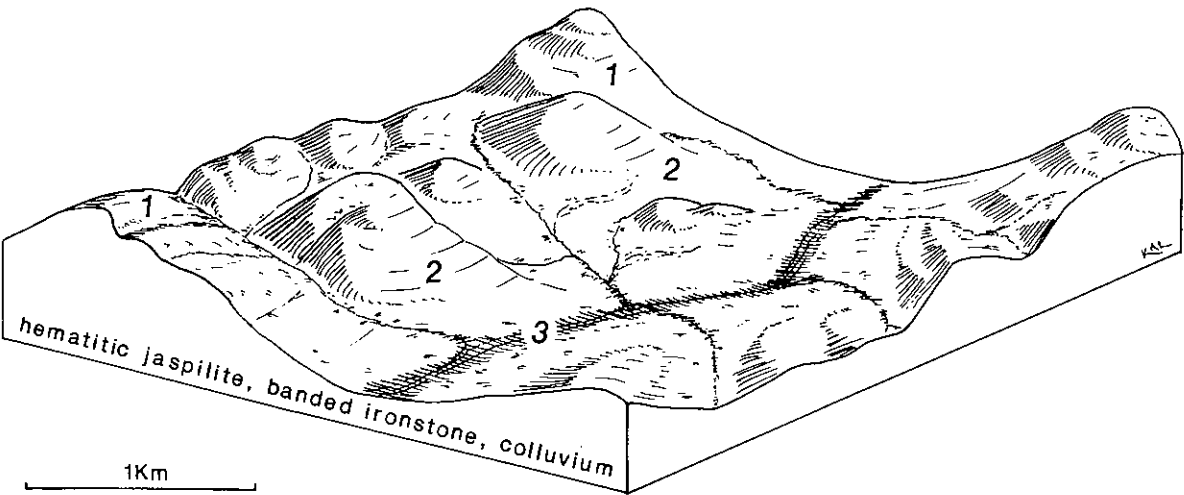
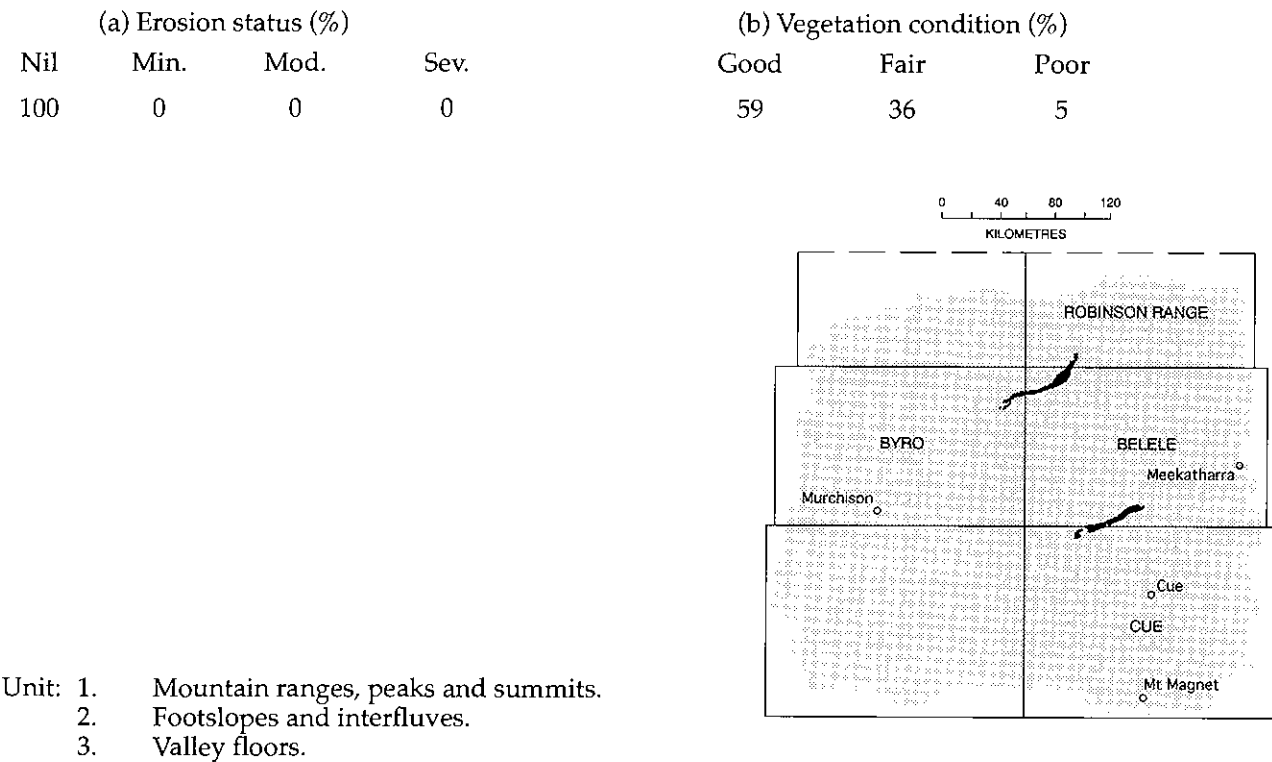
Geology: Archaean metamorphic rocks, mainly metasedimentary types; hematitic jaspilite, banded ironstone with quartzite wacke and schistose hornblende.

Geomorphology: Erosional surfaces; mountain ranges of strike belts and ridges with peaks 200 m or more above the new plateau plains; lower, rounded hill spurs flanking major ranges; steep hillslopes with extensive loose mantling and rock outcrop; lateritised ridges with caves; valley floors and undulating interfluvies often intensely dissected by narrow rectangular drainage tracts with incised channels; sheds most colluvium and drainage to pediment Yarrameedie land system.

Vegetation and pastoral use: Mostly Rocky Hill Mixed Shrubland unsuited to grazing and poorly accessible to stock; minor Stony Mulga Mixed Shrubland on hill spurs and slopes; valley floors support locally accessible shrublands; condition is mostly good or fair; system is not susceptible to erosion unless stony mantle is disturbed.

Estimated carrying capacity, good condition: 30 ha/dse.

Range condition summary (59 traverse observations):



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Mountain ranges, peaks and summits (50%)	<p>Scattered (PFC 10-20%) tall shrublands dominated by <i>Acacia</i> aff. <i>citrinoviridis</i> or <i>A. aneura</i>. Trees (2-4 m): <i>A. aneura</i>, <i>A. aff. citrinoviridis</i>, <i>A. pruinocarpa</i>. Tall shrubs (> 2 m): <i>A. aneura</i>, <i>A. aff. citrinoviridis</i>, <i>A. grasbyi</i>, <i>A. quadrimarginea</i>, <i>A. ramulosa</i>, <i>A. cuthbertsonii</i>, <i>Canthium lineare</i>. Mid shrubs (1-2 m): <i>A. aff. citrinoviridis</i>, <i>A. aneura</i>, <i>A. ramulosa</i>, <i>Thryptomene</i> sp., <i>T. decussata</i>, <i>Eremophila georgei</i>, <i>E. glutinosa</i>, <i>E. latrobei</i>, <i>E. linearis</i>, <i>Dodonaea viscosa</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>P. schwartzii</i>, <i>P. rotundifolius</i>, <i>Corchorus</i> sp., <i>Tribulus platypterus</i>, <i>Solanum ashbyi</i>, <i>S. lasiophyllum</i>, <i>S. sp.</i>, <i>Sarajusticia kempeana</i>, <i>Mirbelia spinosa</i>, <i>M. sp.</i>, <i>Stylidium</i> sp., <i>Heliotropium</i> aff. <i>ovalifolium</i>, <i>Cheilanthes lasiophylla</i>, <i>C. austrotenuifolia</i>, <i>Spyridium</i> sp. (MRS 174). Perennial grasses: <i>Amphipogon strictus</i>, <i>Cymbopogon</i> sp., <i>Eriachne mucronata</i>, <i>E. helmsii</i>, <i>Eragrostis eriopoda</i>, <i>Triodia</i> sp.</p>	<p>4 inventory sites and traversed</p> <p>Vegetation type: Rocky Hill Mixed Shrubland. Palatable perennials include: <i>Eremophila latrobei</i>, <i>Tribulus platypterus</i>, <i>Ptilotus</i> spp., <i>Sida</i> sp., <i>Eragrostis eriopoda</i>, <i>Eriachne mucronata</i>. Pastoral use limitations: Steep upper slopes and crests are mostly inaccessible to domestic stock.</p>
Unit 2: Footslopes and interfluvies (40%)	<p>Very scattered to scattered (PFC < 20%) mixed shrublands dominated by <i>Acacia ramulosa</i> or <i>Ptilotus rotundifolius</i>. Trees (2-4 m): <i>A. aneura</i>. Tall shrubs (> 2 m): <i>A. aneura</i>, <i>A. aff. citrinoviridis</i>, <i>A. grasbyi</i>, <i>A. ramulosa</i>, <i>A. linophylla</i>, <i>A. quadrimarginea</i>, <i>A. tetragonophylla</i>. Mid shrubs (1-2 m): <i>Eremophila freelingii</i>, <i>E. macmilliana</i>, <i>E. cuneifolia</i>. Low shrubs (< 1 m): <i>P. rotundifolius</i>, <i>P. obovatus</i>, <i>P. schwartzii</i>, <i>Halgania gustafsenii</i>, <i>Cassia sturtii</i>, <i>Maireana georgei</i>. Perennial grasses: <i>Eriachne mucronata</i>, <i>Eragrostis lanipes</i>, <i>Cymbopogon ambiguus</i>, <i>Monachather paradoxa</i>.</p>	<p>2 inventory sites and traversed</p> <p>Vegetation type: Stony Mulga Mixed Shrubland. Palatable perennials include: <i>Ptilotus</i> spp., <i>Maireana georgei</i>, <i>Eriachne mucronata</i>, <i>Eragrostis lanipes</i>, <i>Monachather paradoxa</i>. Pastoral use limitations: None with controlled grazing. Vegetation condition %: VG/G 50, F 40, P/V/P 10. 30 obs.</p>
Unit 3: Valley floors (10%)	<p>Scattered (PFC 10-20%) tall shrublands dominated by <i>Acacia ramulosa</i> on sandy floors or <i>A. grasbyi</i> on creek margins. Trees (2-4 m): <i>A. aneura</i>, <i>A. cuthbertsonii</i>, <i>A. cyperophylla</i>, <i>A. pruinocarpa</i>, <i>Canthium lineare</i>. Tall shrubs (> 2 m): <i>A. linophylla</i>, <i>A. tetragonophylla</i>. Mid shrubs (1-2 m): <i>A. ramulosa</i>, <i>A. tetragonophylla</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>Sida filiformis</i>, <i>Halgania gustafsenii</i>, <i>Hibiscus sturtii</i>. Perennial grasses: <i>Eragrostis lanipes</i>, <i>Eriachne mucronata</i>, <i>Monachather paradoxa</i>.</p>	<p>1 inventory site and traversed</p> <p>Vegetation type: Creekline Shrubland. Palatable perennials include: <i>Ptilotus obovatus</i>, <i>Sida filiformis</i>, <i>Eragrostis lanipes</i>, <i>Eriachne mucronata</i>, <i>Monachather paradoxa</i>. Pastoral use limitations: None with controlled grazing. Vegetation condition %: VG/ G 76, F 24, P/V/P 0. 25 obs.</p>

Wiluna land system (W) 1294 km² (1.51% of survey area)

Land type: 2; Pastoral potential: moderate.

Low greenstone hills with occasional lateritic breakaways and broad stony slopes, lower saline stony plains and broad drainage tracts; supports sparse mulga shrublands with patches of halophytic shrubs.

Geology: Archaean amphibolite, basalt and schistose rocks with Tertiary laterite capping; Quaternary colluvium on slopes and Quaternary alluvium on lowlands.

Geomorphology: Predominantly erosional surfaces; residual lateritised plateaux with stripped surfaces and eroding breakaways, generally 10 to 30 m high above steep footslopes with schists or quartz outcropping; rounded hills of basalt or jaspilite with occasional linear strike ridges and spurs; rounded lower footslopes dissected by narrow valleys and alluvial fans; broad stony plains, some saline, mantled by ironstone, quartz and greenstone fragments; drainage floors with more or less grooved vegetation and minor channels; overall relief mainly 20 to 40 m, locally higher.

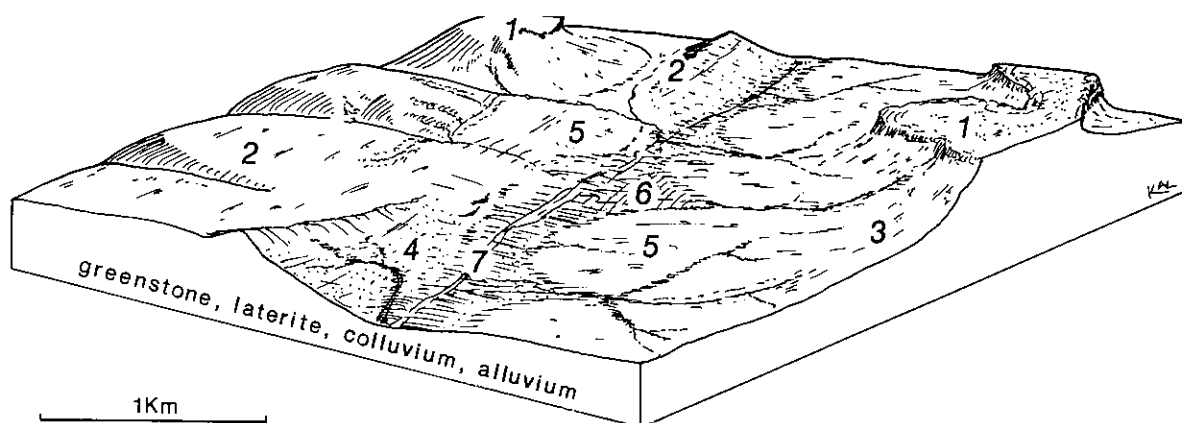
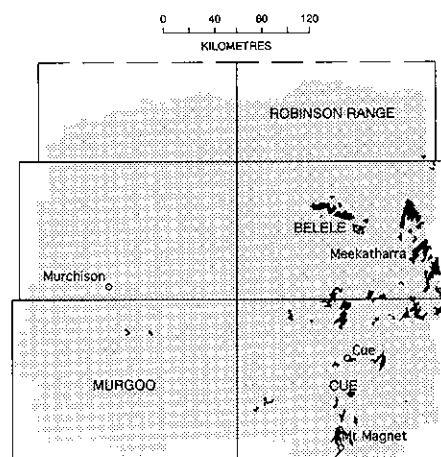
Vegetation and pastoral use: Mainly Mulga Chenopod Shrubland, Granitic Mulga Shrubland and Stony Mulga Mixed Shrubland with some Mulga Grove Woodland. When in good condition, a variety of palatable low shrubs and perennial herbs provide durable reserves but have often been reduced by overgrazing; alluvial fans and partly saline drainage floors carry preferentially grazed Bluebush or Mulga Chenopod Shrubland, but have mainly been more or less degraded: units 4, 6 and 7 are mildly to moderately susceptible to accelerated erosion when degraded; the system shows extensive disturbance and localised erosion as a result of mining activities.

Estimated carrying capacity, good condition: 12 ha/dse.

Range condition summary (253 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
96	3	1	0	25	35	40

- Unit: 1. Lateritic plateaux and breakaways.
 2. Low hills, spurs and strike ridges.
 3. Stony footslopes.
 4. Sandy surfaced gravelly plains.
 5. Stony plains and interfluvies.
 6. Alluvial fans and plains.
 7. Drainage floors.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Lateritic plateaux and breakaways (5%) Weathered plateau remnants with indurated surfaces and breakaway faces elevated up to 30 m above surrounding plains; plateau slopes and crests with laterite mantle and outcrop. Soils are mostly skeletal lithosol confined to shallow pockets of acidic sands.	Scattered (PFC 10-20%) tall shrublands with <i>Acacia aneura</i> and <i>Eremophila</i> spp. Tall and mid shrubs (> 1 m): <i>A. aneura</i> , <i>A. burkittii</i> , <i>E. forrestii</i> , <i>E. georgei</i> , <i>E. latrobei</i> , <i>Thryptomene decussata</i> , <i>Dodonaea viscosa</i> . Low shrubs (< 1 m): <i>E. forrestii</i> , <i>Sida calyxhymenia</i> , <i>S. cardiophylla</i> , <i>Hemigenia</i> sp., <i>Micromyrtus sulphurea</i> , <i>Ptilotus schwartzii</i> .	1 inventory site and traversed Vegetation type: Rocky Hill Mixed Shrubland. Palatable perennials include: <i>Eremophila forrestii</i> , <i>E. latrobei</i> , <i>Sida</i> spp., <i>Ptilotus schwartzii</i> . Pastoral use limitations: Poorly accessible to stock.
Unit 2: Low hills, spurs and strike ridges (25%) Rounded laterite or greenstone hills and spurs to 25 m high with variable slopes to 5%, occasional narrow (< 100 m wide) linear strike ridges of jaspilite up to 5 km long with dense laterite and quartz mantles. Soils are dark red gravelly loamy sands or brown earthy sands < 50 cm deep overlying weathered metamorphic parent material; pH 5.5-6.5 with a neutral to acidic trend. Principal profile forms: Uc1.43, Uc5.21.	Scattered to moderately close (PFC 10-30%) tall or mixed height shrublands dominated by <i>Eremophila macmillaniana</i> and <i>Acacia aneura</i> . Tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. ramulosa</i> , <i>Santalum spicatum</i> . Mid and low shrubs (< 2 m): <i>E. forrestii</i> , <i>E. latrobei</i> , <i>E. compacta</i> , <i>E. macmillaniana</i> , <i>Ptilotus rotundifolius</i> , <i>P. schwartzii</i> , <i>Olearia humilis</i> , <i>Cassia helmsii</i> , <i>Solanum lasiophyllum</i> . Perennial grass: <i>Eragrostis eriopoda</i> .	2 inventory sites and traversed Vegetation type: Rocky Hill Mixed Shrubland. Palatable perennials include: <i>Eremophila forrestii</i> , <i>E. compacta</i> , <i>E. latrobei</i> , <i>Ptilotus</i> spp., <i>Eragrostis eriopoda</i> . Pastoral use limitations: None with controlled grazing.
Unit 3: Stony footslopes (20%) Broad concave footslopes with upper slopes to 10% decreasing to 1% downslope; mantled with dense ironstone, quartz or basalt pebbles and with occasional greenstone or quartz outcrops; total unit relief to 25 m. Soils are shallow red earths or hard-setting duplexes < 50 cm deep on weathered basalt or greenstone; pH 6.5-8.0 with a neutral trend. Principal profile forms: Uc1.43, Um5.51, Dr2.52.	Scattered to moderately close (PFC 10-30%) tall or mixed height shrublands dominated by <i>Acacia aneura</i> , <i>A. sp.</i> (MRS 372) or <i>A. microcalyx</i> . Trees (to 10 m): <i>A. aneura</i> , <i>A. pruinocarpa</i> . Tall shrubs (to 6 m): <i>A. aneura</i> , <i>A. sp.</i> (MRS 372), <i>A. grasbyi</i> , <i>A. tetragonophylla</i> , <i>A. quadrimarginea</i> , <i>A. burkittii</i> , <i>Hakea preissii</i> , <i>Canthium lineare</i> . Mid shrubs (1-2 m): <i>A. aneura</i> , <i>A. microcalyx</i> , <i>A. tetragonophylla</i> , <i>Cassia sturtii</i> , <i>C. nemophila</i> , <i>C. desolata</i> , <i>C. phyllodinea</i> , <i>Eremophila latrobei</i> , <i>E. linearis</i> , <i>E. forrestii</i> , <i>E. macmillaniana</i> . Low shrubs (< 1 m): <i>E. compacta</i> , <i>C. nemophila</i> , <i>Maireana triptera</i> , <i>M. villosa</i> , <i>M. thesioides</i> , <i>M. georgei</i> , <i>M. convexa</i> , <i>M. melanocoma</i> , <i>M. planifolia</i> , <i>Ptilotus obovatus</i> , <i>P. schwartzii</i> , <i>Sida calyxhymenia</i> , <i>S. sp.</i> , <i>Enchylaena tomentosa</i> , <i>Rhagodia eremaea</i> , <i>R. drummondii</i> , <i>Solanum lasiophyllum</i> , <i>S. orbiculatum</i> .	4 inventory sites, 6 condition sites and traversed Vegetation type: Mulga Chenopod Shrubland. Palatable perennials include: <i>Eremophila compacta</i> , <i>E. forrestii</i> , <i>Maireana</i> spp., <i>Sida</i> spp., <i>Enchylaena tomentosa</i> , <i>Rhagodia</i> spp., <i>Ptilotus</i> spp. Pastoral use limitations: None with controlled grazing. Vegetation condition %: VG/G 27, F 44, P/VP 29. 51 obs.
Unit 4: Sandy surfaced gravelly plains (5%) Gently undulating plains and slopes lower than units 1 and 2; slopes < 2% and covered with gravelly ironstone mantles. Soils are dark red gravelly fine sandy loams or earthy sands < 50 cm deep with laterite and ironstone throughout; pH 5.5-7.0 with a neutral trend. Principal profile forms: Uc5.21, Um5.51.	Scattered (PFC 10-20%) mixed <i>Acacia</i> shrublands. Tall shrubs (< 2 m): <i>A. aneura</i> , <i>A. aff. quadrimarginea</i> , <i>A. tetragonophylla</i> , <i>A. ramulosa</i> , <i>A. grasbyi</i> . Mid shrubs (1-2 m): <i>A. grasbyi</i> , <i>A. craspedocarpa</i> , <i>Cassia sturtii</i> , <i>Eremophila fraseri</i> , <i>E. freelingii</i> . Low shrubs (< 1 m): <i>E. freelingii</i> , <i>E. macmillaniana</i> , <i>C. helmsii</i> , <i>C. nemophila</i> , <i>Ptilotus obovatus</i> , <i>P. schwartzii</i> , <i>Maireana thesioides</i> , <i>M. villosa</i> , <i>Solanum lasiophyllum</i> . Perennial grasses: <i>Monachather paradoxa</i> , <i>Thyridolepis multiculmis</i> , <i>Eragrostis eriopoda</i> .	1 inventory site, 2 condition sites and traversed Vegetation type: Lateritic <i>Acacia</i> Shrubland. Palatable perennials include: <i>Ptilotus</i> spp., <i>Maireana thesioides</i> , <i>Eremophila latrobei</i> , <i>E. compacta</i> , <i>Monachather paradoxa</i> . Pastoral use limitations: Mildly susceptible to accelerated erosion.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 5: Stony plains and interfluves (35%)	Scattered (PFC 10-20%) tall shrublands dominated by <i>Acacia aneura</i> or <i>A. grasbyi</i> . Trees (to 8 m): <i>A. aneura</i> , <i>A. pruinocarpa</i> . Tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. grasbyi</i> , <i>A. tetragonophylla</i> , <i>A. victoriae</i> , <i>Eremophila fraseri</i> , <i>E. spathulata</i> , <i>E. forrestii</i> , <i>E. glutinosa</i> , <i>Spartothamnella teucriflora</i> . Low shrubs (< 1 m): <i>E. spathulata</i> , <i>E. compacta</i> , <i>C. helmsii</i> , <i>Ptilotus obovatus</i> , <i>P. roei</i> , <i>P. rotundifolius</i> , <i>P. schwartzii</i> , <i>Maireana triptera</i> , <i>M. thesioides</i> , <i>M. convexa</i> , <i>M. melanocoma</i> , <i>M. lanosa</i> , <i>M. georgei</i> , <i>Rhagodia eremaea</i> , <i>Sida calyxhymenia</i> , <i>Solanum lasiophyllum</i> . Perennial grass (rare): <i>Eragrostis eriopoda</i> .	4 inventory sites, 7 condition sites and traversed Vegetation type: Mulga Chenopod Shrubland or Stony Mulga Mixed Shrubland. Generally low in production potential but with good reserves of palatable perennials when in good condition. Palatable perennials include: <i>Eremophila compacta</i> , <i>E. forrestii</i> , <i>Ptilotus</i> spp., <i>Maireana</i> spp., <i>Rhagodia eremaea</i> , <i>Atriplex bunburyana</i> . Pastoral use limitations: Not normally susceptible to accelerated erosion. Vegetation condition %: VG/G 22, F 33, P/VP 45. Erosion incidence %: min 2. 124 obs.
Unit 6: Alluvial fans and plains (2%)	Very scattered (PFC < 10%) low or mixed shrublands. Tall and mid shrubs (> 1 m): <i>Acacia aneura</i> , <i>A. victoriae</i> , <i>Eremophila</i> aff. <i>margarethae</i> , <i>E. fraseri</i> . Low shrubs (< 1 m): <i>Maireana triptera</i> , <i>M. tomentosa</i> , <i>M. pyramidata</i> .	1 inventory site and traversed Vegetation type: Bluebush Shrubland. Palatable perennials include: <i>Maireana</i> spp. Pastoral use limitations: Moderately susceptible to accelerated erosion where degraded.
Unit 7: Drainage floors (8%)	Moderately close (PFC 20-30%) woodlands or tall shrublands dominated by <i>Acacia aneura</i> or <i>A. victoriae</i> . Trees (to 8 m): <i>A. aneura</i> . Tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. tetragonophylla</i> , <i>A. sclerosperma</i> , <i>A. victoriae</i> , <i>Eremophila longifolia</i> , <i>Hakea preissii</i> . Mid shrubs (1-2 m): <i>Cassia sturtii</i> , <i>E. aff. latrobei</i> , <i>E. forrestii</i> , <i>E. fraseri</i> , <i>E. macmillaniana</i> , <i>Spartothamnella teucriflora</i> . Low shrubs (< 1 m): <i>Rhagodia eremaea</i> , <i>Solanum lasiophyllum</i> , <i>Enchylaena tomentosa</i> , <i>Scaevola spinescens</i> , <i>Ptilotus obovatus</i> , <i>E. compacta</i> , <i>Maireana pyramidata</i> , <i>Dissocarpus paradoxa</i> , <i>Sida calyxhymenia</i> , <i>S. sp.</i> , <i>Abutilon</i> sp., <i>C. chatelainiana</i> . Perennial grasses: <i>Themeda australis</i> , <i>Eragrostis xerophila</i> , <i>E. setifolia</i> .	2 inventory sites and traversed Vegetation type: Mulga Grove Woodland or Creekline Grass Shrubland. Palatable perennials include: <i>Eremophila forrestii</i> , <i>E. aff. latrobei</i> , <i>E. compacta</i> , <i>Spartothamnella teucriflora</i> , <i>Rhagodia eremaea</i> , <i>Enchylaena tomentosa</i> , <i>Scaevola spinescens</i> , <i>Ptilotus obovatus</i> , <i>Maireana pyramidata</i> , <i>Sida</i> spp., <i>Abutilon</i> spp., <i>Cassia chatelainiana</i> , <i>Eragrostis</i> spp. Pastoral use limitations: Mild susceptibility to accelerated erosion where degraded. Vegetation condition %: VG/G 10, F 35, P/VP 55. Erosion incidence %: nil 25, mod 10. 20 obs.

Wolarry land system 368 km² (0.43% of survey area)

Land type: 17; Pastoral potential: high.

Saline pans, clayey lakes and ephemeral swamps fringed by sandplains, sand dunes and low banks; supports a wide variety of saline chenopod shrublands and tall acacia shrublands.

Geology: Quaternary playa deposits of alluvium and aeolian sand.

Geomorphology: Depositional surfaces; internal drainage system with sandplain residuals on margins; long, curved sandy banks and fringing elliptical dunes above duplex plains around gypsiferous ellipsoid lake beds and shallow clayey pans and swamps; alluvial plains with diffuse unchannelled drainage patterns; overall relief mostly < 10 m.

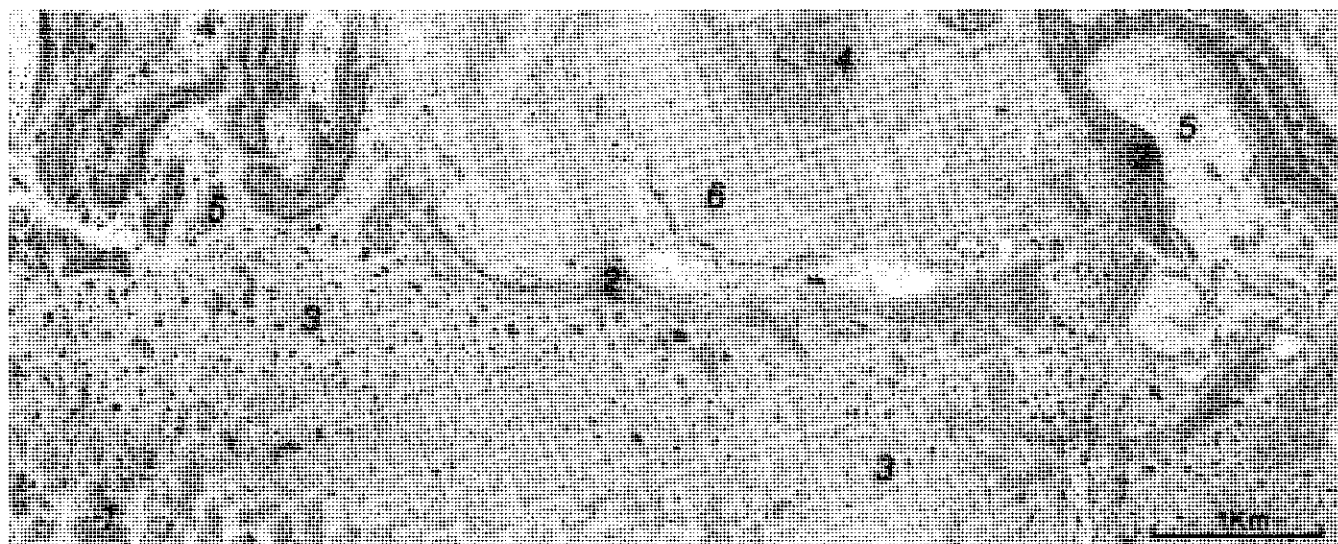
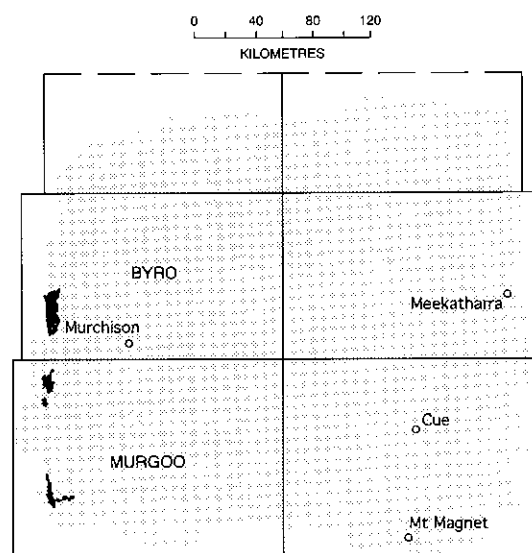
Vegetation and pastoral use: Mainly Bluebush, Saltbush and Samphire Shrublands with non-saline vegetation limited to the crests of dunes and banks; grazing is widely limited by distance to fresh water or by provision of brackish supplies which restrict grazing radius and tend to result in local overgrazing and /or selective overuse of units 1 and 2; diverse perennial forage sufficient for year-round grazing under appropriate stocking; unit 3 is moderately susceptible to accelerated erosion when degraded; unit 2 is susceptible to wind erosion where shrub cover is reduced.

Estimated carrying capacity, good condition: 7 ha/dse.

Range condition summary (78 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
73	23	4	0	28	39	33

- Unit: 1. Sandplains and low banks.
 2. Fringing sand dunes.
 3. Alluvial plains.
 4. Saline alluvial and gypsiferous plains.
 5. Claypans and swamps
 6. Lake beds.



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Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 1: Sandplains and low banks (15%)</p> <p>Areas of undulating remnant sandplain mainly towards margins of system or surrounding unit 2; often with small sandy banks to 1 m high. Soils are probably deep, red uniform earthy sands.</p>	<p>Scattered to moderately close (PFC 10-30%) tall shrublands dominated by <i>Acacia ramulosa</i>, <i>A. sclerosperma</i> or <i>A. tetragonophylla</i>. Also scattered (PFC 10-20%) mixed shrublands dominated by <i>Maireana pyramidata</i>. Tall shrubs (> 2 m): <i>A. ramulosa</i>, <i>A. tetragonophylla</i>, <i>A. sclerosperma</i>, <i>A. grasbyi</i>, <i>Hakea preissii</i>. Mid shrubs (1-2 m): <i>Eremophila forrestii</i>, <i>Hibiscus</i> sp., <i>M. pyramidata</i>. Low shrubs (> 1 m): <i>M. pyramidata</i>, <i>Cassia phyllodinea</i>, <i>Chenopodium gaudichaudianum</i>, <i>Ptilotus obovatus</i>, <i>Rhagodia eremaea</i>, <i>Solanum lasiophyllum</i>, <i>S. orbiculatum</i>. Perennial grasses: <i>Eriachne helmsii</i>, <i>Monachather paradoxa</i>.</p>	<p>2 condition sites and traversed</p> <p>Vegetation type: Sandplain Wanderrie Grassy Shrubland or Bluebush Shrubland. Palatable perennials include: <i>Monachather paradoxa</i>, <i>Eremophila forrestii</i>, <i>Maireana pyramidata</i>, <i>Chenopodium gaudichaudianum</i>, <i>Ptilotus obovatus</i>, <i>Rhagodia eremaea</i>. Pastoral use limitations: None with controlled grazing.</p>
<p>Unit 2: Fringing sand dunes (15%)</p> <p>Elliptical and reticulate dunes to 4 m high fringing saline plains and lakes (units 4, 5 and 6); saline in places, steep slopes often with areas of redistribution on slopes with windward aspects. Soils are red or yellowish red uniform siliceous sands or earthy sands > 1 m deep. Principal profile forms: Uc1.23, Uc5.21, downslope tending duplex, with clayey subsoils.</p>	<p>Moderately close (PFC 30-50%) tall shrublands dominated by <i>Acacia sclerosperma</i> or <i>Scaevola spinescens</i>. Tall shrubs (> 2 m): <i>A. sclerosperma</i>, <i>A. ramulosa</i>, <i>A. tetragonophylla</i>. Mid shrubs (1-2 m): <i>S. spinescens</i>, <i>Stylobasium spathulatum</i>, <i>Eremophila forrestii</i>, <i>Cassia desolata</i>, <i>Melaleuca uncinata</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>P. divaricatus</i>, <i>Chenopodium gaudichaudianum</i>, <i>Maireana integra</i>, <i>M. lanosa</i>, <i>M. villosa</i>, <i>Rhagodia eremaea</i>, <i>Enchylaena tomentosa</i>, <i>Scaevola tomentosa</i>, <i>Cassia chatelainiana</i>, <i>Solanum lasiophyllum</i>, <i>S. orbiculatum</i>. Perennial grass: <i>Eriachne helmsii</i>.</p>	<p>2 inventory sites and traversed</p> <p>Vegetation type: Sand Dune Shrubland. Palatable perennials include: <i>Enchylaena tomentosa</i>, <i>Cassia chatelainiana</i>, <i>Chenopodium gaudichaudianum</i>, <i>Maireana</i> spp., <i>Scaevola tomentosa</i>, <i>Ptilotus</i> spp. Pastoral use limitations: Susceptible to wind erosion where shrub cover is reduced. Vegetation condition %: VG/G 7, F 33, P/VP 60. Erosion incidence %: min 30. 15 obs.</p>
<p>Unit 3: Alluvial plains (45%)</p> <p>Plains above and surrounding brackish ephemeral lakes and claypans with relief to 5 m and slopes usually < 1% often interspersed and interrupted by disintegrated drainage tracts and foci as in units 5 and 6; often moderately saline in lower parts, tending less so upslope. Soils are duplex types, reddish-brown loamy sands over red sandy loams or red clayey sands over light clays < 1 m deep mainly over red-brown hardpan; pH 6.5-7.0 with neutral or alkaline reaction trends. Principal profile forms: Dr2., Dr1.56.</p>	<p>Scattered to moderately close (PFC 10-30%) low shrublands dominated by <i>Atriplex</i> spp. and <i>Maireana</i> spp. with overstorey <i>Acacia xiphophylla</i> on higher areas. Tall shrubs (> 2 m): <i>A. xiphophylla</i>, <i>A. tetragonophylla</i>, <i>Eremophila pantonii</i>, <i>Hakea preissii</i>, <i>H. arida</i>, <i>Melaleuca uncinata</i>. Mid shrubs (1-2 m): <i>E. pterocarpa</i>, <i>E. platycalyx</i>, <i>Cassia phyllodinea</i>. Low shrubs (< 1 m): <i>Atriplex bunburyana</i>, <i>A. vesicaria</i>, <i>Chenopodium gaudichaudianum</i>, <i>Cassia phyllodinea</i>, <i>Enchylaena tomentosa</i>, <i>Maireana atkinsiana</i>, <i>M. integra</i>, <i>M. georgei</i>, <i>M. polypterygia</i>, <i>M. platycarpa</i>, <i>M. pyramidata</i>, <i>M. tomentosa</i>, <i>Ptilotus beardii</i>, <i>P. obovatus</i>, <i>Rhagodia eremaea</i>, <i>Scaevola spinescens</i>.</p>	<p>2 inventory sites, 4 condition sites and traversed</p> <p>Vegetation type: Bluebush or Saltbush Shrubland. Palatable perennials include: <i>Atriplex</i> spp., <i>Chenopodium gaudichaudianum</i>, <i>Enchylaena tomentosa</i>, <i>Maireana</i> spp., <i>Ptilotus</i> spp., <i>Rhagodia eremaea</i>, <i>Scaevola spinescens</i>. Increaser species include: <i>Eremophila pterocarpa</i>, <i>Hakea arida</i>, <i>H. preissii</i>. Pastoral use limitations: Mildly susceptible to accelerated erosion and increases in unpalatable shrubs where degraded. Vegetation condition %: VG/G 45, F 38, P/VP 17. Erosion incidence %: min 25, mod 4. 24 obs.</p>
<p>Unit 4: Saline alluvial and gypsiferous plains (10%)</p> <p>Strongly saline plains surrounding saline lakebeds; also minor expanses of low gypseous dunes; slope is generally negligible; total unit relief is < 2 m. Soils are red earthy sands or yellowish red light clays over light medium clays with some duplex types < 1 m deep; pH 9.0 with a strongly alkaline trend. Principal profile forms: Uc6., Uf6.21, Dr2.</p>	<p>Scattered to moderately close (PFC 10-30%) low shrublands dominated by <i>Atriplex</i> sp. or <i>Halosarcia</i> sp. with sparse <i>Acacia sclerosperma</i> on kopi outcrops. Tall and mid shrubs (> 1 m): <i>A. sclerosperma</i>, <i>A. tetragonophylla</i>, <i>Eremophila youngii</i>. Low shrubs (< 1 m): <i>Atriplex amnicola</i>, <i>A. sp.</i>, <i>Frankenia magnifica</i>, <i>Halosarcia halocnemoides</i>, <i>H. indica</i>, <i>Lawrencia squamata</i>, <i>Lycium australe</i>, <i>Solanum lasiophyllum</i>.</p>	<p>2 inventory sites, 1 condition site and traversed</p> <p>Vegetation type: Saltbush or Samphire Shrubland. Palatable perennials include: <i>Atriplex</i> spp., <i>Lycium australe</i>. Pastoral use limitations: High salinity levels of dominant perennial species in lower parts associated with seasonal waterlogging reduces grazing potential.</p>

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 5: Claypans and swamps (5%)</p> <p>Mainly circular drainage foci < 300 m in diameter. Soils are brown light clays over medium clays up to 1 m deep; pH 9.0 with an alkaline trend.</p>	<p>Moderately close to close (PFC 20-50%) tall shrublands or low woodlands with <i>Eucalyptus coolabah</i>, dense fringes of <i>Melaleuca uncinata</i> and <i>Muehlenbeckia cunninghamii</i>. Trees and tall shrubs (> 2 m): <i>Eucalyptus coolabah</i>, <i>M. uncinata</i>, <i>M. glomerata</i>, <i>Hakea preissii</i>, <i>Muehlenbeckia cunninghamii</i>. Mid and low shrubs (< 2 m): <i>Atriplex amnicola</i>, <i>M. cunninghamii</i>.</p>	<p>1 inventory site and traversed</p> <p>Vegetation type: Saltbush Shrubland. Palatable perennials include: <i>Atriplex amnicola</i>. Pastoral use limitations: None with controlled grazing.</p>
<p>Unit 6: Lakebeds (10%)</p> <p>Elliptical to circular lakebeds up to 4 km long and 2 km wide; salinity is variable with some larger terminal lakes strongly saline and others with some through flow less so. Soils are brown light clays over medium clays or yellowish red light clays < 1 m deep; pH 9.0 with a strongly alkaline trend. Principal profile form: Uf6.12.</p>	<p>(a) Moderately close (PFC 20-30%) low shrublands dominated by <i>Atriplex amnicola</i> with <i>Halosarcia</i> spp., and <i>Muehlenbeckia cunninghamii</i>.</p> <p>(b) Scattered (PFC 10-20%) woodland with <i>Eucalyptus coolabah</i>, <i>Melaleuca glomerata</i>, <i>M. uncinata</i>, <i>Atriplex amnicola</i> and <i>Scaevola spinescens</i> on areas of broad sluggish drainage.</p> <p>(c) Saline lakebeds often bare of perennial vegetation except for fringing communities of <i>Halosarcia</i> spp. or <i>Atriplex</i> spp.</p>	<p>2 inventory sites and traversed</p> <p>Vegetation type: Samphire Shrubland, Saltbush Shrubland or unvegetated. Palatable perennials include: <i>Atriplex amnicola</i>, <i>Scaevola spinescens</i>. Pastoral use limitations: Seasonal inundation limits access some years; otherwise high salinity levels in pasture perennials necessitates stock having access to good quality water supplies.</p>

Wongong land system 317 km² (0.37% of survey area)

Land type: 8; Pastoral potential: high.

Almost flat saline stony plains on Permian rocks, with minor alluvial plains and sluggish drainage tracts supporting mostly chenopod shrublands with scattered acacias; in the far west of the area.

Geology: Early Permian siltstones, sandstones and shales of the Lyons formation (Sakmarian series) with Quaternary colluvium and alluvium.

Geomorphology: Erosional surfaces formed by weathering of the Permian plateau; remnant sandplain tracts with low disorganised banks; broad stony plains and occasional low rises with sparse outcrops of parent rock; lower alluvial plains with duplex soils, adjacent to unchannelled tracts carrying through drainage; overall relief mostly < 8 m.

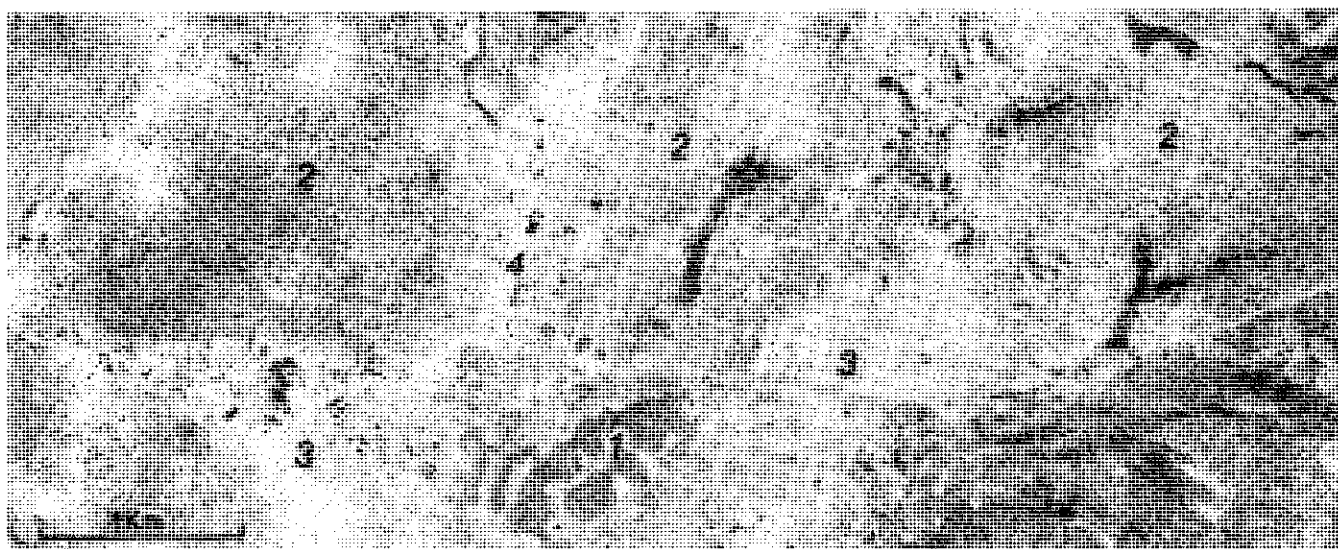
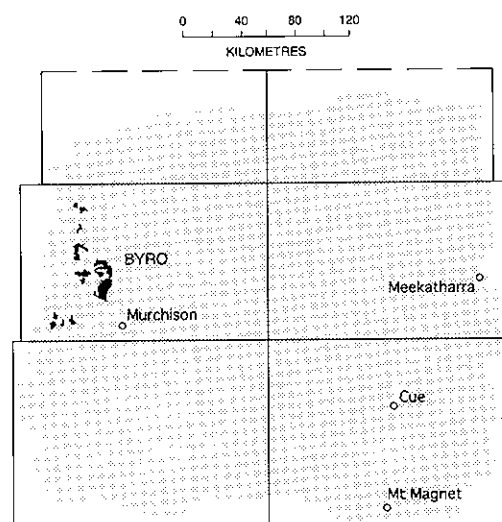
Vegetation and pastoral use: Mainly sparse Bluebush, Stony Snakewood and Mixed Halophytic Shrublands which respond with annual herbage in good seasons and in good condition provide sufficient perennial forage shrubs to sustain grazing throughout the year, but has been widely overused and degraded; units 2 and 3 are mildly susceptible to accelerated erosion when degraded.

Estimated carrying capacity, good condition: 7 ha/dse.

Range condition summary (62 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
77	18	5	0	13	32	55

- Unit:**
1. Scattered sandy banks.
 2. Undulating stony plains.
 3. Alluvial plains.
 4. Drainage tracts.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 1: Scattered sandy banks (5%)</p> <p>Sandy banks usually < 1 km long and < 300 m wide; generally elevated up to 2 m above surrounding low-lying plains. Soils are probably red uniform earthy sands.</p>	<p>Scattered to moderately close (PFC 10-30%) tall shrublands dominated by <i>Acacia ramulosa</i>. Tall and mid shrubs (> 1 m): <i>A. ramulosa</i>, <i>A. murrayana</i>, <i>Calytrix muricata</i>, <i>Eremophila forrestii</i>, <i>Thryptomene</i> sp., <i>Pityrodia paniculata</i>. Low shrubs (< 1 m): <i>P. paniculata</i>, <i>Pimelea microcephala</i>, <i>Rhagodia eremaea</i>, <i>Solanum orbiculatum</i>. Perennial grasses: <i>Monachather paradoxa</i>, <i>Eragrostis lanipes</i>.</p>	<p>Traversed</p> <p>Vegetation type: Sandplain Wanderrie Grassy Shrubland. Palatable perennials include: <i>Eremophila forrestii</i>, <i>Rhagodia eremaea</i>, <i>Eragrostis lanipes</i>, <i>Monachather paradoxa</i>. Pastoral use limitations: None with controlled grazing.</p>
<p>Unit 2: Undulating stony plains (70%)</p> <p>Extensive tracts of very gently undulating, slightly saline plains with occasional low stony rises up to 5 m; slopes usually < 1%; lightly to moderately strewn with quartz, ironstone or mixed pebbles. Soils are dark red duplex types, loamy sands over light clays < 1 m deep overlying Permian sedimentary rocks; pH 7.5 with neutral or alkaline reaction trend. Principal profile form: Dr2.13.</p>	<p>Very scattered to scattered (PFC < 20%) tall or mixed height shrublands with <i>Acacia xiphophylla</i> and a prominent low shrub layer dominated by <i>Maireana</i> spp., <i>Frankenia</i> spp., or <i>Ptilotus</i> spp. Trees and tall shrubs (> 2 m): <i>A. xiphophylla</i>, <i>Acacia aneura</i>, <i>A. cuspidifolia</i>, <i>A. grasbyi</i>, <i>A. tetragonophylla</i>, <i>A. victoriae</i>, <i>Eremophila pterocarpa</i>, <i>E. platycalyx</i>, <i>E. freelingii</i>, <i>Cassia desolata</i>. Low shrubs (< 1 m): <i>Maireana atkinsiana</i>, <i>M. integra</i>, <i>M. georgei</i>, <i>M. glomerifolia</i>, <i>M. platycarpa</i>, <i>M. pyramidata</i>, <i>M. triptera</i>, <i>Atriplex bunburyana</i>, <i>E. freelingii</i>, <i>Frankenia magnifica</i>, <i>F. pauciflora</i>, <i>F. setosa</i>, <i>Cassia phyllodinea</i>, <i>Enchylaena tomentosa</i>, <i>Ptilotus beardii</i>, <i>P. obovatus</i>, <i>P. polakii</i>, <i>Rhagodia eremaea</i>.</p>	<p>2 inventory sites, 8 condition sites and traversed</p> <p>Vegetation type: Stony Snakewood Shrubland, Bluebush Shrubland or Mixed Halophytic Shrubland. Palatable perennials include: <i>Maireana</i> spp., <i>Ptilotus</i> spp., <i>Atriplex bunburyana</i>, <i>Enchylaena tomentosa</i>, <i>Rhagodia eremaea</i>. Increaser species include: <i>Hakea preissii</i>, <i>Eremophila pterocarpa</i>. Pastoral use limitations: Areas with more run-on and deeper soils are subject to increases by <i>Hakea preissii</i> and <i>Eremophila pterocarpa</i> where degraded; slightly susceptible to accelerated erosion. Vegetation condition %: VG/G 16, F 35, P/VP 49. Erosion incidence %: min 14, mod 2. 49 obs.</p>
<p>Unit 3: Alluvial plains (20%)</p> <p>Alluvial plains occurring as shallow swales between sandy banks or as broad plains subject to sheet flow and draining onto unit 4; slopes are minimal, usually < 0.5% with relief to 1-2 m. Soils are dark red crusted duplex types, clayey sands over yellowish red light clays to > 1 m deep; pH 7.5 with an alkaline trend. Principal profile form: Dr1.23.</p>	<p>Very scattered to scattered (PFC < 20%) low shrublands dominated by <i>Maireana platycarpa</i> or <i>M. pyramidata</i> with very sparse tall shrubs. Tall shrubs (> 2 m): <i>Acacia cuspidifolia</i>, <i>A. sclerosperma</i>, <i>A. tetragonophylla</i>, <i>A. xiphophylla</i>, <i>Hakea preissii</i>. Low shrubs (< 1 m): <i>Atriplex bunburyana</i>, <i>M. atkinsiana</i>, <i>M. integra</i>, <i>M. glomerifolia</i>, <i>M. planifolia</i>, <i>M. platycarpa</i>, <i>M. pyramidata</i>, <i>M. triptera</i>, <i>Frankenia magnifica</i>, <i>F. setosa</i>, <i>Ptilotus beardii</i>, <i>P. obovatus</i>, <i>Rhagodia eremaea</i>, <i>Enchylaena tomentosa</i>, <i>Solanum lasiophyllum</i>.</p>	<p>1 inventory site, 3 condition sites and traversed</p> <p>Vegetation type: Bluebush Shrubland. Palatable perennials include: <i>Atriplex bunburyana</i>, <i>Maireana</i> spp., <i>Frankenia</i> spp., <i>Ptilotus</i> spp., <i>Rhagodia eremaea</i>, <i>Enchylaena tomentosa</i>. Pastoral use limitations: Moderately susceptible to accelerated erosion if perennial cover becomes degraded.</p>
<p>Unit 4: Drainage tracts(5%)</p> <p>Sluggish drainage tracts to 300 m wide similar to unit 3 but with narrow anastomosing channels with shallow incision. Soils probably duplex types similar to those of unit 3.</p>	<p>Scattered low shrublands similar in composition to unit 3.</p>	<p>Traversed</p> <p>Vegetation type: Bluebush Shrubland or Mixed Halophytic Shrubland. Palatable perennials include: As for unit 3. Pastoral use limitations: As for unit 3.</p>

Woodline land system 2932 km² (3.41% of survey area)

Land type: 14; Pastoral potential: low.

Almost flat sandy-surfaced hardpan wash plains supporting tall shrublands and woodlands dominated by broad-leaved mulga; in the south-east of the area.

Geology: Quaternary cemented alluvium with aeolian sand.

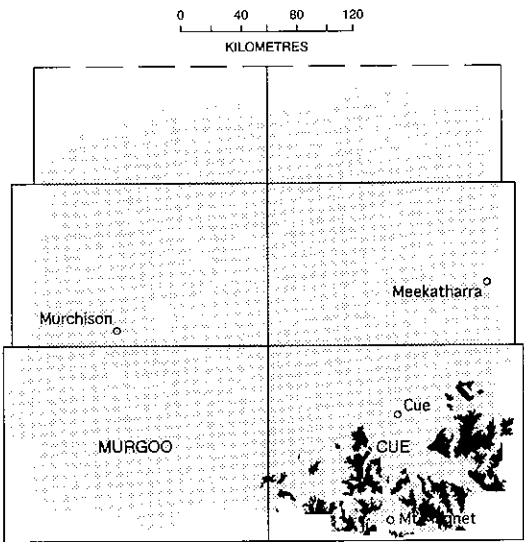
Geomorphology: Depositional surfaces; broad wash plains on red-brown hardpan, receiving run-on from higher granite systems and residual old plateau, characterised by stone free surfaces and moderately deep soils and by areas with indistinct groves and intergroves, mostly aligned downslope; sandplain tracts; diffuse more concentrated drainage tracts, mostly unchannelled (rarely with incised channels); relief mostly < 3 m.

Vegetation and pastoral use: Extensive Hardpan Mulga Shrubland with tracts of Mulga Grove Woodland and Sandplain Acacia Shrubland; condition mostly fair although many palatable understorey shrubs and perennial grasses having been lost from wide areas, reducing available forage to larger, less palatable shrubs and annual grass and forb species; more productive drainage tracts often receive preferential grazing pressure and are mildly susceptible to accelerated erosion; formerly subject to extensive timber cutting.

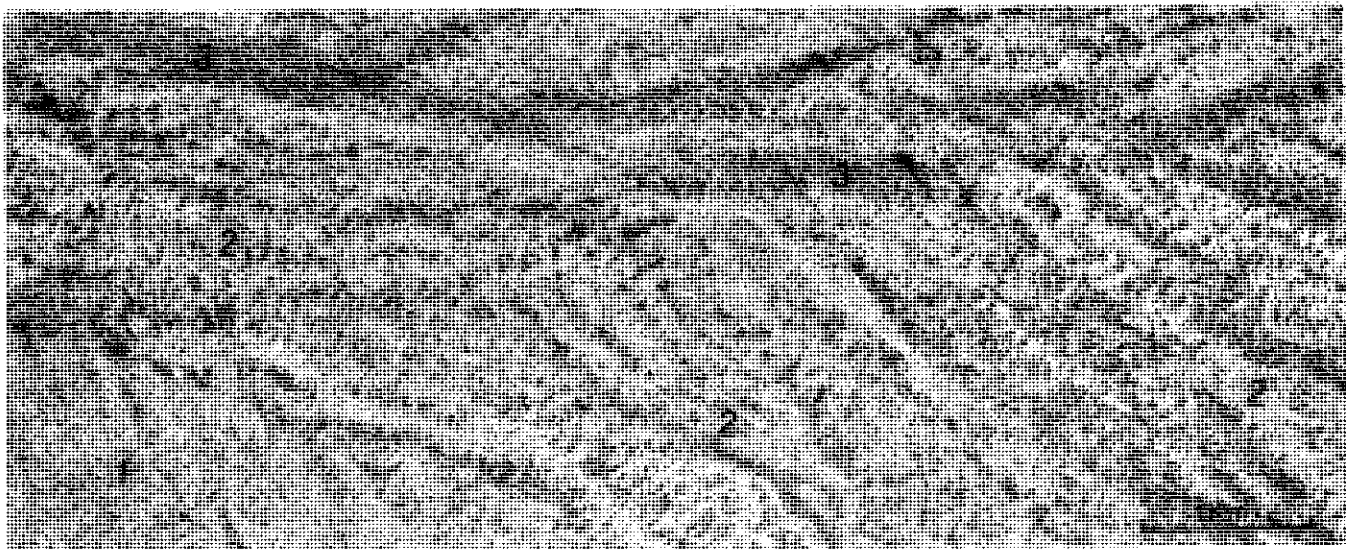
Estimated carrying capacity, good condition: 20 ha/dse.

Range condition summary (542 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
96	3	1	0	23	52	25



- Unit: 1. Sand plains.
2. Hardpan plains.
3. Drainage tracts.



Woodline I.s.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Sand plains (10%) Slightly elevated plains of red sand, up to 2 km in extent. Soils are dark red earthy sands or clayey sands, mostly full depth (> 1 m); pH 6.0 with an acidic trend. Principal profile form: Uc5.21.	Scattered to moderately close (PFC 10-30%) tall shrublands or grassy shrublands dominated by <i>Acacia aneura</i> or <i>A. ramulosa</i> . Trees (2-4 m): <i>A. aneura</i> , <i>Canthium lineare</i> , <i>Hakea suberea</i> . Tall shrubs (> 2 m): <i>A. ramulosa</i> , <i>A. aneura</i> . Mid shrubs (1-2 m): <i>A. ramulosa</i> , <i>Eremophila forrestii</i> , <i>E. granitica</i> , <i>E. gilesii</i> , <i>E. georgei</i> , <i>Spartothamnella teucriflora</i> . Low shrubs (< 1 m): <i>E. gilesii</i> , <i>E. forrestii</i> , <i>E. aff. compacta</i> , <i>Ptilotus obovatus</i> , <i>P. schwartzii</i> , <i>Rhagodia eremaea</i> , <i>Mirbelia spinosa</i> , <i>M. convexa</i> , <i>M. villosa</i> , <i>M. aff. villosa</i> , <i>M. georgei</i> , <i>M. thesioides</i> , <i>Sida</i> sp. Perennial grasses: <i>Eragrostis eriopoda</i> , <i>Eriachne helmsii</i> , <i>Monachather paradoxa</i> , <i>Triodia</i> sp.	1 inventory site, 2 condition sites and traversed Vegetation type: Sandplain Wanderrie Grassy Shrubland or Sandplain Acacia Shrubland. Palatable perennials include: <i>Eremophila forrestii</i> , <i>E. aff. compacta</i> , <i>Spartothamnella teucriflora</i> , <i>Ptilotus</i> spp., <i>Maireana</i> spp., <i>Sida</i> sp., <i>Rhagodia eremaea</i> , <i>Eragrostis eriopoda</i> , <i>Monachather paradoxa</i> . Pastoral use limitations: None with controlled grazing. Vegetation condition %: VG/G 29, F 58, P/P 13. 38 obs.
Unit 2: Hardpan plains (80%) Almost flat, extensive and very uniform wash plains usually 5-10 km wide, subject to sheet flow from old plateaux or granite catchments, interrupted by patchy transverse grove formations, 50-100 m long and up to 30 m wide; flattest areas without groving patterns. Soils are red or dark red hardpan sandy clay loams or deep red earths mainly 40-80 cm deep over hardpan; pH 5.5-6.5 with a neutral to acidic reaction trend. Principal profile form: Um5.31.	a) Hardpan plains and intergroves; Scattered to moderately close (PFC 10-30%) low mulga woodlands dominated by <i>Acacia aneura</i> or <i>A. craspedocarpa</i> . Trees (to 6 m): <i>A. aneura</i> , <i>A. pruinocarpa</i> . Tall shrubs (> 2 m): <i>A. aneura</i> , <i>A. craspedocarpa</i> , <i>A. tetragonophylla</i> , <i>A. ramulosa</i> , <i>Grevillea</i> sp. Mid shrubs (1-2 m): <i>A. craspedocarpa</i> , <i>A. tetragonophylla</i> , <i>Eremophila forrestii</i> , <i>E. georgei</i> , <i>E. latrobei</i> , <i>E. punicea</i> , <i>Spartothamnella teucriflora</i> . Low shrubs (< 1 m): <i>E. punicea</i> , <i>E. forrestii</i> , <i>E. gilesii</i> , <i>Ptilotus obovatus</i> , <i>P. schwartzii</i> , <i>Rhagodia eremaea</i> , <i>Maireana villosa</i> , <i>M. pyramidata</i> , <i>M. planifolia</i> , <i>M. convexa</i> . Perennial grasses: <i>Eragrostis eriopoda</i> , <i>Monachather paradoxa</i> . b) Groves: Close (PFC 30-50%) woodlands dominated by <i>A. aneura</i> , <i>A. craspedocarpa</i> . Trees (to 8 m): <i>A. aneura</i> , <i>A. pruinocarpa</i> . Tall and mid shrubs (> 1 m): <i>A. craspedocarpa</i> , <i>Eremophila forrestii</i> , <i>E. georgei</i> , <i>Spartothamnella teucriflora</i> . Low shrubs (< 1 m): <i>E. punicea</i> , <i>Sida calyxhymenia</i> , <i>Maireana villosa</i> , <i>M. convexa</i> , <i>Mirbelia spinosa</i> , <i>Ptilotus obovatus</i> , <i>Rhagodia eremaea</i> .	5 inventory sites, 42 condition sites and traversed Vegetation type: Hardpan Mulga Shrubland, minor Mulga Grove Woodland. Palatable perennials include: <i>E. latrobei</i> , <i>Spartothamnella teucriflora</i> , <i>Ptilotus</i> spp., <i>Maireana</i> spp., <i>Sida calyxhymenia</i> , <i>Rhagodia eremaea</i> , <i>Eremophila forrestii</i> , <i>Eragrostis eriopoda</i> , <i>Monachather paradoxa</i> . Pastoral use limitations: Slight susceptibility to accelerated erosion where degraded or along tracks where they interrupt and concentrate sheet flow; formerly subject to extensive timber cutting. Vegetation condition %: VG/G 22, F 53, P/P 25. Erosion incidence %: min 2, mod 1. 489 obs.
Unit 3: Drainage tracts (10%) Diffuse unchannelled flat surfaced drainage tracts up to 1 km wide, but mainly 50-200 m, carrying concentrated sheet flow after heavy rains; slopes minimal; total relief usually < 1 m except for occasional incised channels up to 2 m; drainage often becomes dispersed for several kilometres and reforms downslope. Soils are red hardpan sandy clay loams or red earths to 1 m deep, with extensive development of cryptogamic crusting; some parts more regularly flooded are deep silty sands; pH 6.0 with a neutral trend. Principal profile form: Um5.31.	Moderately close to close (PFC 30-50%) woodlands dominated by <i>Acacia aneura</i> , <i>A. burkittii</i> , or <i>A. ramulosa</i> . Trees (to 6 m): <i>A. aneura</i> , <i>A. burkittii</i> . Tall shrubs (> 2 m): <i>A. ramulosa</i> , <i>A. tetragonophylla</i> , <i>A. craspedocarpa</i> . Mid shrubs (1-2 m): <i>Eremophila forrestii</i> , <i>E. clarkei</i> , <i>Chamelaucium micranthum</i> , <i>Cassia nemophila</i> , <i>C. aff. chatelainiana</i> , <i>E. punicea</i> , <i>E. latrobei</i> , <i>E. gilesii</i> . Low shrubs (< 1 m): <i>E. punicea</i> , <i>E. clarkei</i> , <i>E. forrestii</i> , <i>Ptilotus obovatus</i> , <i>P. aff. schwartzii</i> , <i>Maireana thesioides</i> , <i>M. villosa</i> , <i>Sida calyxhymenia</i> , <i>S. sp.</i> , <i>Solanum lasiophyllum</i> . Perennial grasses: <i>Eragrostis eriopoda</i> , <i>Eriachne helmsii</i> , <i>Monachather paradoxa</i> , <i>Stipa elegantissima</i> .	4 inventory sites and traversed Vegetation type: Hardpan Mulga Shrubland or Creekline Shrubland. Palatable perennials include: <i>Eremophila forrestii</i> , <i>E. latrobei</i> , <i>Cassia aff. chatelainiana</i> , <i>Ptilotus</i> spp., <i>Maireana</i> spp., <i>Sida</i> spp., <i>Eragrostis eriopoda</i> , <i>Monachather paradoxa</i> . Pastoral use limitations: None under controlled grazing and not normally susceptible to accelerated erosion.

Woodrarrung land system 371 km² (0.43% of survey area)

Land type: 1; Pastoral potential: very low.

Rugged sandstone ranges with rocky slopes and boulder strewn valleys and gorges supporting tall acacia shrublands; in the south-west of the area.

Geology: Late Proterozoic sandstone and siltstone of the Coomberarie and Woodrarrung formations, both of the Badgeradda group.

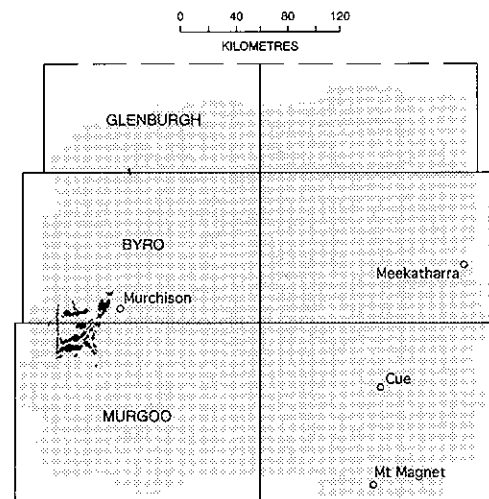
Geomorphology: Erosional surfaces; rugged ranges and lateral spurs with peaks to 100 m; linear ridges, parallel to the divide of the Victoria Sandplain region, extending north-south for 30 km or more; steep-sided scree strewn valleys and gorges with alluvial floors and sharply incised drainage; footslopes with concave aspect, grading from steep upslope to gently inclined sandy plains with sandstone mantle; overall relief mainly 25 to 100 m.

Vegetation and pastoral use: Rocky Hill Mixed Shrubland and minor Sandplain Acacia Shrubland largely unsuited to pastoral production; upper parts inaccessible to domestic stock; lower slopes and alluvial valley floors provide some grazing value although palatable perennials are generally sparse; minor perennial grasses on sandy surfaced slopes; condition is mainly fair or good; probably feral goats have been responsible for much of recent grazing pressure; system not susceptible to accelerated erosion.

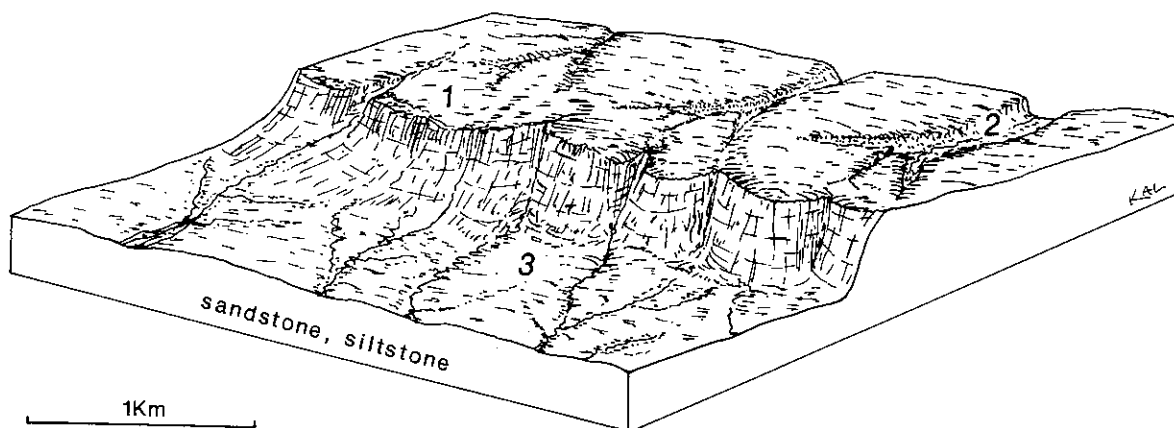
Estimated carrying capacity, good condition: 30 ha/dse.

Range condition summary (15 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
100	0	0	0	40	40	20



- Unit: 1. Stony hills and ridges.
 2. Valleys and shallow gorges.
 3. Footslopes with stony interfluves.



Woodrarrung I.s.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Stony hills and ridges (40%) Rather flat sandstone and siltstone crests and ridges with precipitous scarps to > 100 m high parallel to ridge lines; plateau-like crests dissected by steep truncated valleys or gorges to 30 m deep; densely mantled with large sandstone fragments; much sandstone outcrop. Soils are very shallow red earths or skeletal lithosols, yellowish red fine sandy loams over sandstone parent material, < 50 cm deep; pH 5.0-6.5 with a neutral to acidic trend. Principal profile forms: Uc1.43, Um1.43, Um5.51.	Scattered to moderately close (PFC 10-30%) tall shrublands dominated by <i>Acacia aneura</i> or <i>A. ramulosa</i> . Trees (some to 8 m): <i>A. aff. subtessarogona</i> , <i>A. aneura</i> , <i>A. burkittii</i> . Tall shrubs (> 2 m): <i>A. ramulosa</i> , <i>A. grasbyi</i> , <i>A. tetragonophylla</i> , <i>A. cuthbertsonii</i> , <i>A. xiphophylla</i> , <i>Hakea arida</i> , <i>H. preissii</i> . Mid shrubs (1-2 m): <i>Eremophila platycalyx</i> , <i>E. aff. margarethae</i> , <i>E. fraseri</i> , <i>E. aff. punicea</i> , <i>Grevillea deflexa</i> , <i>G. didymobotrya</i> , <i>Thryptomene decussata</i> . Low shrubs (< 1 m): <i>E. aff. macmillaniana</i> , <i>E. aff. punicea</i> , <i>E. latrobei</i> , <i>Solanum ashbyi</i> , <i>Ptilotus obovatus</i> , <i>P. schwartzii</i> , <i>Sida calyxhymenia</i> , <i>Maireana thesioides</i> , <i>M. villosa</i> , <i>M. triptera</i> , <i>Cassia phyllodinea</i> . Perennial grasses: <i>Thyridolepis multiculmis</i> , <i>Monachather paradoxa</i> , <i>Eragrostis eriopoda</i> , <i>Eriachne helmsii</i> .	3 inventory sites and traversed Vegetation type: Rocky Hill Mixed Shrubland. Palatable perennials include: <i>Eremophila latrobei</i> , <i>Ptilotus</i> spp., <i>Sida calyxhymenia</i> , <i>Maireana</i> spp., <i>Thyridolepis multiculmis</i> , <i>Monachather paradoxa</i> , <i>Eragrostis eriopoda</i> . Pastoral use limitations: Higher parts generally inaccessible to domestic stock.
Unit 2: Valley and shallow gorges (10%) Streamline dissections to 30 m deep and 500 m wide with most < 200 m wide and extending to 3 km upslope; sides are steep (20%) to vertical; large sandstone outcrops very common; talus slopes mantled by dense layers of platy sandstone fragments; valley floors frequently channelled. Soils are skeletal sands.	Moderately close (PFC 20-30%) woodland dominated by large <i>Acacia aff. subtessarogona</i> , <i>A. sp.</i> (MRS13; <i>A. ramulosa</i> type) or <i>A. ramulosa</i> . Trees (to 15 m): <i>A. aff. subtessarogona</i> . Tall shrubs (> 2 m): <i>A. sp.</i> (MRS13); <i>A. ramulosa</i> , <i>A. wiseana</i> . Mid and low shrubs (< 2 m): <i>Thryptomene</i> sp., <i>Eremophila</i> sp., <i>Grevillea</i> sp., <i>Pimelea microcephala</i> , <i>Eriostemon brucei</i> , <i>Solanum orbiculatum</i> , <i>S. sp.</i>	1 inventory site and traversed Vegetation type: Rocky Hill Mixed Shrubland. Pastoral use limitations: Poor accessibility to domestic stock combined with very low potential pastures.
Unit 3: Footslopes with stony interfluvies (50%) Steep upper slopes with grades to > 10% descending to inclined sandy surfaced pediment plains with grades < 4%; sandstone mantling and outcropping common in upper slopes, becoming smaller and less frequent downslope. Soils are lithosols or shallow red earths, yellowish-red loamy sands with sandstone inclusions throughout the profile, usually very shallow (< 20 cm) over sandstone but isolated pockets on lower slopes tending deeper.	Moderately close (PFC 20-30%) tall shrublands dominated by <i>Acacia grasbyi</i> or <i>A. sp.</i> (MRS13; <i>A. ramulosa</i> type). Tall shrubs (> 2 m): <i>A. grasbyi</i> , <i>A. sp.</i> MRS13, <i>A. ramulosa</i> , <i>A. murrayana</i> . Mid shrubs (1-2 m): <i>Thryptomene</i> sp., <i>Eremophila latrobei</i> , <i>E. georgei</i> , <i>E. glutinosa</i> , <i>E. forrestii</i> , <i>Pityrodia paniculata</i> , <i>Grevillea didymobotrya</i> . Low shrubs (< 1 m): <i>E. glutinosa</i> , <i>T. sp.</i> , <i>Solanum ashbyi</i> , <i>S. orbiculatum</i> , <i>Dianella revoluta</i> , <i>Ptilotus schwartzii</i> , <i>Sida cardiophylla</i> . Perennial grass (lower slopes): <i>Monachather paradoxa</i> .	2 inventory sites and traversed Vegetation type: Rocky Hill Mixed Shrubland or Sandplain Acacia Shrubland (lower plains and slopes). Palatable perennials include: <i>Eremophila latrobei</i> , <i>E. forrestii</i> , <i>Ptilotus schwartzii</i> , <i>Sida cardiophylla</i> , <i>Monachather paradoxa</i> . Pastoral use limitations: None with controlled grazing.

Wooleen land system 55 km² (0.06% of survey area)

Land type: 19; Pastoral potential: high.

Saline, vegetated lake beds with almost flat, fringing saline alluvial plains and occasional elliptical sandy banks, supporting mostly halophytic shrublands and tussock grasslands.

Geology: Quaternary alluvial deposits; playa sand, clay and gravels, unconsolidated alluvium and minor aeolian deposits.

Geomorphology: Depositional surfaces; saline plains and lake beds on a major bend of the upper Murchison River, with sandy banks and low dunes fringing lake beds; saline plains of alkaline lacustrine deposits on lake margins; broad lake beds with much internal drainage; relief is < 3 m.

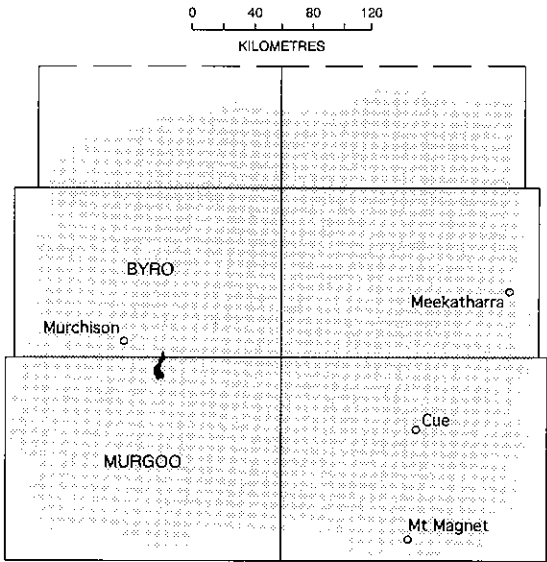
Vegetation and pastoral use: Saltbush and Mixed Halophytic Shrublands provides excellent annual grazing and resilient drought reserves; lake beds support valuable Alluvial Tussock Grasslands (salt water couch and lovegrass) although access is limited in flood years; system is slightly susceptible to accelerated erosion on unit 1.

Estimated carrying capacity, good condition: 7 ha/dse.

Range condition summary (11 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
91	9	0	0	45	55	10

- Unit:
1. Alluvial plains.
 2. Saline flood plains.
 3. Drainage zones.
 4. Lake beds.



Wooleen l.s.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Alluvial plains (10%) Gently sloping plains slightly higher than units 2 and 3; subject to sheet flow and locally with small, meandering channels draining into Lake Wooleen. Soils are probably deep red duplex types.	Scattered to close (PFC 10-50%) low shrublands with numerous chenopods; or <i>Eucalyptus coolabah</i> woodlands with dense understorey of <i>Muehlenbeckia cunninghamii</i> or chenopod shrubs. Trees (to 10 m): <i>E. coolabah</i> . Tall shrubs (> 2 m): <i>Acacia victoriae</i> , <i>A. tetragonophylla</i> , <i>Eremophila pterocarpa</i> , <i>Melaleuca uncinata</i> . Mid and low shrubs (< 1 m): <i>Melaleuca uncinata</i> , <i>Atriplex amnicola</i> , <i>Muehlenbeckia cunninghamii</i> , <i>Scaevola spinescens</i> , <i>Cratystylis subspinescens</i> .	Traversed Vegetation type: Saltbush or Mixed Halophyte Shrubland. Palatable perennials include: <i>Atriplex amnicola</i> , <i>Cratystylis subspinescens</i> , <i>Scaevola spinescens</i> . Pastoral use limitations: Moderately susceptible to erosion where degraded.
Unit 2: Saline flood plains (25%) Highly saline flat plains fringing major lakebeds; slope and relief generally minimal. Saline surface crusting common in lower parts. Soils are brown or reddish-brown clay types, locally with sandy surface deposits, fine sandy clays over light or medium clays > 1 m deep; pH 7.5-8.0 with an alkaline trend. Principal profile forms: Uf5.31, Uf6.71.	Scattered to moderately close (PFC 10-30%) low shrublands dominated by <i>Frankenia</i> spp. or <i>Halosarcia</i> spp. Low shrubs (< 1 m): <i>F. aff. desertorum</i> , <i>H. indica</i> , <i>H. doleiformis</i> , <i>Atriplex amnicola</i> , <i>Maireana aff. amoena</i> . Perennial grass: <i>Sporobolus virginicus</i> .	2 inventory sites and traversed Vegetation type: Mixed Halophyte or Samphire Shrubland. Palatable perennials include: <i>Atriplex amnicola</i> , <i>Maireana aff. amoena</i> , <i>Sporobolus virginicus</i> . Pastoral use limitations: High salinity levels of perennial pasture plants and subject to seasonal waterlogging.
Unit 3: Drainage zones (5%) Broad tracts carrying flood flows from Murchison R, locally channelled and slightly incised. Soils are probably duplexes or clays with alluvial sediments in flow channels.	Patchy fringing tall shrublands and low woodlands dominated by <i>Eucalyptus coolabah</i> and <i>Melaleuca uncinata</i> , with <i>Muehlenbeckia cunninghamii</i> .	Traversed
Unit 4: Lake beds (60%) Flat, saline lakebeds up to 17 km long and 3 km wide; lake floor is characterised by meandering internal drainage lines. Soils are probably similar to unit 2.	Scattered (PFC 10-20%) low shrublands or grasslands with <i>Halosarcia</i> spp. dominant on lake fringes giving way to increased <i>Sporobolus virginicus</i> towards lake centre.	Traversed Vegetation type: Samphire Shrubland and Alluvial Tussock Grassland. Palatable perennials include: <i>Sporobolus virginicus</i> . Pastoral use limitations: Lake subject to inundation; plants on lake margins have high salt content.

Wooramel land system (G) 56 km² (0.07% of survey area)

Land type: 13; Pastoral potential: low.

Sandy-surfaced wash plains on hardpan supporting tall acacia shrublands and patches of mulga woodland; a very minor system in this area, only in far north-west.

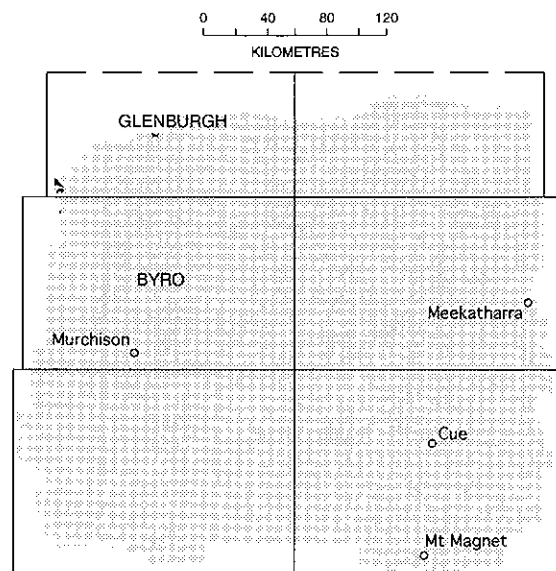
Geology: Partly consolidated Quaternary alluvium and colluvium with veneers of aeolian sand.

Geomorphology: Depositional surfaces; flat to gently undulating plains of alluvium, sandy banks and plains on hardpan with light stony mantles, dissected by occasional sluggish drainage zones; relief to 8 m.

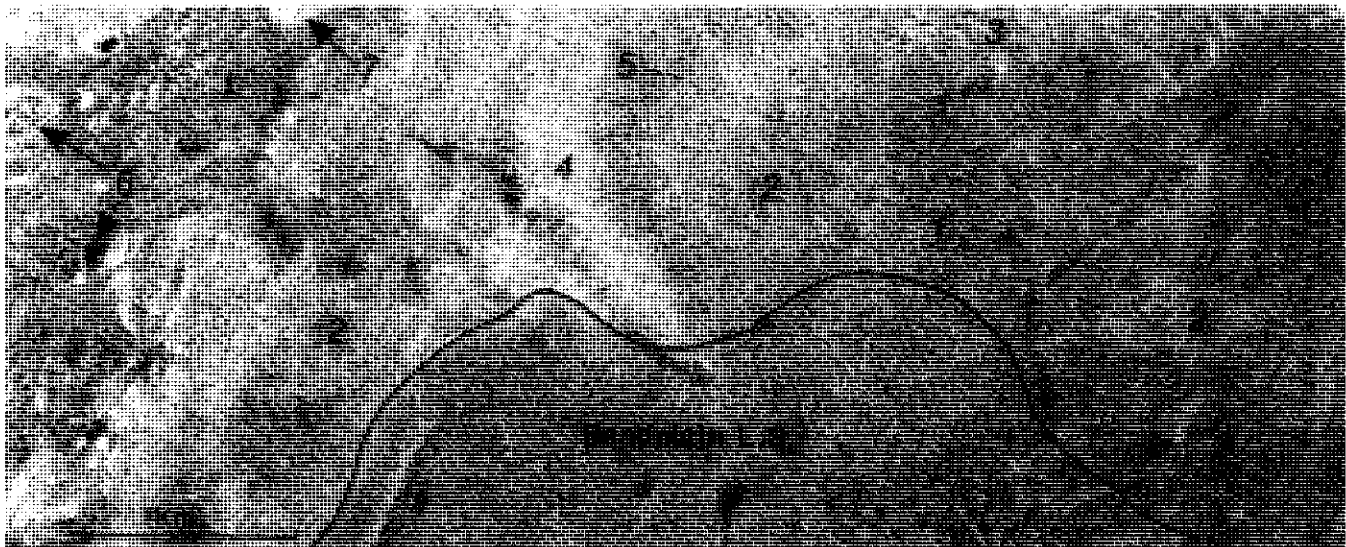
Vegetation and pastoral use: Sandplain Acacia Shrubland and Hardpan Mulga Shrubland; mostly moderately stable and resistant to normal grazing pressures in good condition; provides some perennial reserves as shrubs and scattered wanderrie grasses; annual forage is abundant in good seasons; owing to low relief and sandy surfaces the system is not normally susceptible to accelerated erosion.

Estimated carrying capacity, good condition: 20 ha/dse.

Range condition summary: Not adequately traversed; Payne *et al.* (1987) report that in the adjacent Carnarvon Basin, 36% was in good condition, 28% was fair and 36% was in poor condition.



- Unit: 1. Sandy banks and sand sheets.
2. Sandy surfaced plains.
3. Hardpan plains.
4. Stony plains.
5. Narrow drainage lines.
6. Drainage foci.
7. Claypans.



Wooramel I.s. (adapted from Payne *et al.* 1987)

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Sandy banks and sand sheets (30%) Sandy banks and sand sheets up to 2 m above units 2 or 3, slopes up to 1%. Soils are dark red or dark reddish brown loamy sands with increasing clay content down profile, > 1 m deep, locally with sparse quartz strew and siliceous or ferruginous inclusions, pH 5.5-6.0 with an acidic trend. Principal profile form: Uc5.21.	(i) Scattered to moderately close tall shrublands dominated by <i>Acacia ramulosa</i> or <i>Eremophila forrestii</i> . (ii) Moderately close low shrublands dominated by <i>E. forrestii</i> with scattered low trees and tall shrubs. (PFC 10-25%). Trees (2-8 m): <i>Eucalyptus dichromophloia</i> , <i>Acacia pruinocarpa</i> , <i>A. aneura</i> , <i>Canthium lineare</i> . Tall shrubs (> 2 m): <i>Acacia ramulosa</i> , <i>A. aff. coolgardiensis</i> . Mid and low shrubs (< 2 m): <i>Eremophila forrestii</i> , <i>E. latrobei</i> , <i>Ptilotus schwartzii</i> , <i>Eremophila latrobei</i> , <i>Solanum lasiophyllum</i> . Perennial grasses: <i>Monachather paradoxa</i> , <i>Eragrostis lanipes</i> , <i>Eriachne helmsii</i> .	Vegetation type: Sandplain Acacia Shrubland. Low shrub association (ii) is probably a successional stage following loss of tall shrub layer to fire, drought; increased <i>Eremophila forrestii</i> (on sites in good condition) provided useful drought reserves. Palatable perennials include: <i>Maireana planifolia</i> , <i>Eremophila latrobei</i> , <i>E. forrestii</i> . Pastoral use limitations: None under controlled grazing.
Unit 2: Sandy surfaced plains (55%) Flat plains with or without sparse surface gravels, slopes 0.1-0.8%. Soils are dark red or dusky red sandy clay loam or clayey sand grading to light sandy clay loam, 45 cm to > 1 m deep, with or without weak pan development or gravel inclusions (quartz, ironstone or mixed), pH 5.5-6.5 with acidic or neutral trends. Principal profile forms: Gn4.12, Gn4.11, Gn2.11, Um6.13, Um6.23, Uc5.11, Uc5.13.	Moderately close tall shrublands often occurring as groves, with sparse trees, dominated by <i>Acacia aneura</i> , <i>A. ramulosa</i> or <i>Eremophila forrestii</i> . (PFC 15-30%). Trees (4-8 m): <i>A. aneura</i> , <i>A. pruinocarpa</i> , <i>Eucalyptus coolabah</i> , <i>Canthium lineare</i> , <i>C. attenuatum</i> . Tall shrubs (2-3 m): <i>Acacia ramulosa</i> , <i>A. aff. coolgardiensis</i> , <i>A. tetragonophylla</i> , <i>Cassia</i> spp., <i>Scaevola spinescens</i> . Mid and low shrubs (< 2 m): <i>Eremophila forrestii</i> , <i>E. gibsoni</i> , <i>Ptilotus obovatus</i> , <i>Cassia desolata</i> , <i>Maireana planifolia</i> . Perennial grasses: <i>Monachather paradoxa</i> , <i>Eriachne helmsii</i> , <i>Eragrostis lanipes</i> .	Vegetation type: Sandplain Acacia Shrubland or Hardpan Mulga Shrubland. Palatable perennials include: <i>Eremophila latrobei</i> , <i>Maireana planifolia</i> , <i>Maireana convexa</i> . Pastoral use limitations: None under controlled grazing.
Unit 3: Hardpan plains (5%) Flat plains with little or no slope. Soils are dark red sandy loams containing quartz gravel, underlain by hardpan at variable depth, pH5.0-6.0 with an acidic trend. Principal profile form: Uc5.21.	Moderately close shrublands about 2 m high, dominated by <i>Acacia</i> aff. <i>coolgardiensis</i> with sparse tall and low shrubs. Tall shrubs (2-3 m): <i>A. ramulosa</i> , <i>A. murrayana</i> , <i>A. cuthbertsonii</i> . Low shrubs (1-2 m): <i>Acacia</i> aff. <i>coolgardiensis</i> , <i>Eremophila forrestii</i> , <i>E. gibsonii</i> , <i>Ptilotus schwartzii</i> , <i>Maireana planifolia</i> , <i>M. convexa</i> . Perennial grasses: <i>Monachather paradoxa</i> , <i>Eriachne helmsii</i> .	Vegetation type: Sandplain Acacia Shrubland or Hardpan Mulga Shrubland. Palatable perennials include: <i>Maireana planifolia</i> , <i>M. convexa</i> . Pastoral use limitations: None under controlled grazing.
Unit 4: Stony plains (5%) Small areas of gently undulating plains with a sparse to moderate mantle of calcrete, quartzitic and ferruginised pebbles. Soils are shallow acidic loams underlain by hardpan.	Very scattered or scattered shrublands of <i>Acacia aneura</i> , <i>A. cuthbertsonii</i> , <i>A. tetragonophylla</i> , <i>Eremophila fraseri</i> , <i>E. freelingii</i> , <i>Cassia desolata</i> , <i>C. helmsii</i> .	Vegetation type: Hardpan Mulga Shrubland. Very sparse edible perennials augmented by annual grasses and forbs in favourable seasons. Pastoral use limitations: None with controlled grazing.

Wooramel l.s. (adapted from Payne *et al.* 1987) —continued

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 5: Narrow drainage lines (< 1%) Mixed alluvial deposits, locally calcreted. Sluggish unchannelled drainage zones, slopes 0.1-0.3%. Soils are dark red sandy clay loams, > 1 m deep, pH 6.5 with a neutral trend. Principal profile form: Um6.24.	Moderately close low woodlands dominated by <i>Acacia aneura</i> . Trees and tall shrubs (2-5 m): <i>A. aneura</i> , <i>Eucalyptus coolabah</i> , <i>Acacia ramulosa</i> , <i>A. tetragonophylla</i> , <i>A. pruinocarpa</i> . Low shrubs (1-2 m): <i>Ptilotus obovatus</i> , <i>Sida calyxhymenia</i> , <i>Chenopodium gaudichaudianum</i> , <i>Spartothamnella teucriflora</i> , <i>Rhagodia eremaea</i> . Perennial grass: <i>Monachather paradoxa</i> .	Vegetation type: Acacia Creekline Shrubland. Perennials augmented by annual grasses and forbs in favourable seasons. Pastoral use limitations: None under controlled grazing.
Unit 6: Drainage foci (1%) Small, rounded foci with clay soils.	Close shrublands dominated by <i>Acacia tetragonophylla</i> , <i>A. aneura</i> or <i>A. cuthbertsonii</i> .	Vegetation type: Creekline Shrubland. Pastoral use limitations: None with controlled grazing.
Unit 7: Claypans (1%) Small, bare claypans.	Usually unvegetated.	

Yagahong land system (W) 141 km² (0.16% of survey area)

Land type: 1; Pastoral potential: very low.

Rough greenstone ridges, hills and cobble-strewn footslopes supporting mulga shrublands; closely resembles Gabanintha land system.

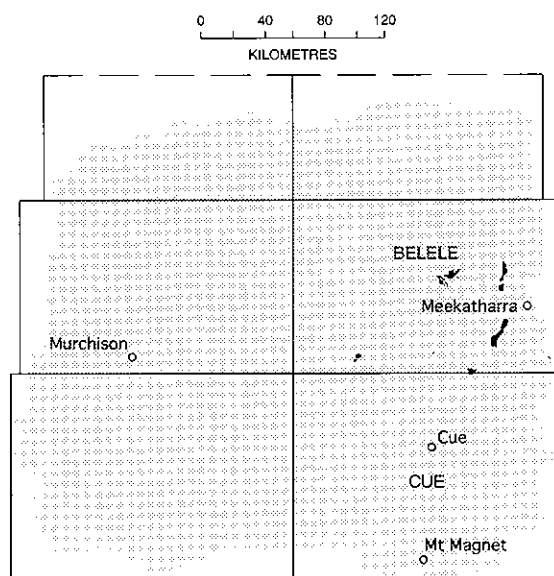
Geology: Metamorphosed Archaean gabbro and amphibolitic schists; minor Upper Proterozoic basalt, slate and dolerite of mixed origins.

Geomorphology: Erosional surfaces formed through weathering of the ancient plateau; rugged hilly ridges with plateau remnants on very persistent crystalline rocks with a distinct benched and rectangular formation; often precipitous scarps falling away to rounded cobbled slopes with skeletal soils, sharply dissected interfluvial with moderately intense, rectangular drainage lines, often with narrow channels; relief to 120 m.

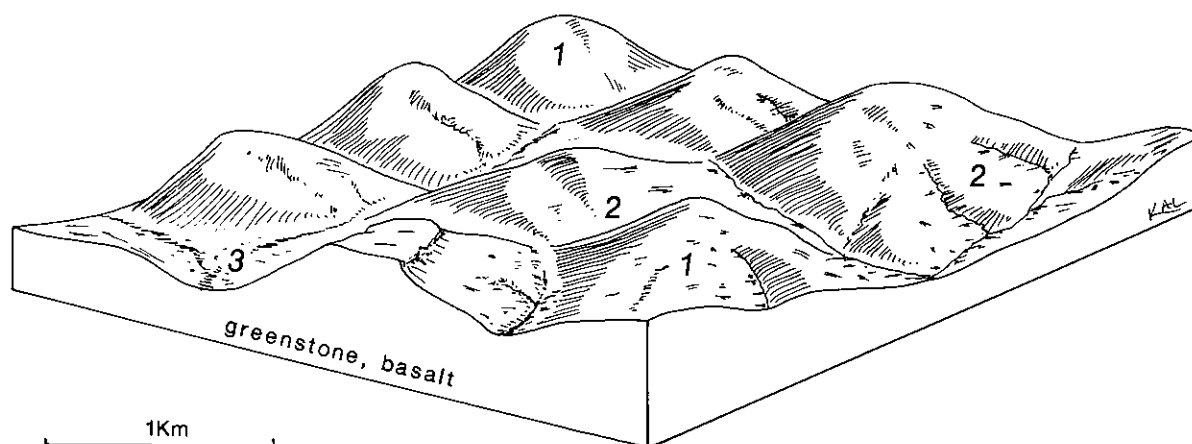
Vegetation and pastoral use: Rocky Hill Mixed Shrubland with minor Stony Mulga Mixed Shrubland; largely inaccessible to stock and generally unsuited to pastoral use; accessible parts of lower footslopes, stony plains and drainage lines show much deterioration of vegetation; system is not normally susceptible to soil erosion, owing to protective mantles and skeletal soils.

Estimated carrying capacity, good condition: 30 ha/dse.

Range condition summary (8 traverse observations): not adequately sampled; lower marginal units locally degraded; upper units probably mainly in good condition.



- Unit: 1. Hills, ridges and crests.
 2. Lower slopes and interfluvial.
 3. Creeks and drainage tracts.



Yagahong I.s.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 1: Hills, ridges and crests (50%)</p> <p>Rough greenstone hills and ridges to 10 km long and 3 km wide with crests to 120 m and slopes ranging from precipitous to < 10% on hill slopes; extensive greenstone mantles and outcrops in parallel forming benched slopes. Soils are stony lithosols, dark red clayey sands in pockets overlying greenstone parent material at shallow depth. Principal profile forms probably: Uc1.43, Um5.51.</p>	<p>Scattered to moderately close (PFC 10-30%) tall shrublands dominated by <i>Acacia</i> sp. Trees and tall shrubs (to 6 m): <i>A. aneura</i>, <i>A. sp.</i>, <i>Grevillea</i> aff. <i>stenobotrya</i>. Mid shrubs (1-2 m): <i>Eremophila macmillaniana</i>, <i>E. aff. forrestii</i>, <i>E. aff. exilifolia</i>, <i>Cassia sturtii</i>. Low shrubs (< 1 m): <i>Tribulus platypterus</i>, <i>Ptilotus obovatus</i>, <i>P. roei</i>, <i>P. rotundifolius</i>, <i>Maireana planifolia</i>, <i>Solanum lasiophyllum</i>, <i>Sida rohlenae</i>.</p>	<p>2 inventory sites and traversed</p> <p>Vegetation type: Rocky Hill Mixed Shrubland. Palatable perennials include: <i>Eremophila</i> aff. <i>forrestii</i>, <i>Tribulus platypterus</i>, <i>Ptilotus</i> spp., <i>Maireana</i> spp., <i>Sida rohlenae</i>. Pastoral use limitations: Higher parts are inaccessible to stock.</p>
<p>Unit 2: Lower slopes and interfluves (40%)</p> <p>Stony slopes with rounded interfluves to 500 m wide with slopes to 5%, also minor lower stony plains below slopes. Generally covered with moderate mantles of basalt, diorite or quartz boulders and cobbles. Soils are mainly shallow clayey or loamy lithosols.</p>	<p>Scattered (PFC 10-20%) tall or mixed shrublands dominated by <i>Acacia aneura</i>, <i>Cassia</i> spp. or <i>Eremophila</i> spp. Trees and tall shrubs (> 2 m): <i>A. aneura</i>, <i>A. tetragonophylla</i>, <i>A. sclerosperma</i>, <i>A. sp.</i> RJC5804. Mid and low shrubs (< 2 m): <i>C. helmsii</i>, <i>C. sturtii</i>, <i>E. macmillaniana</i>, <i>E. glutinosa</i>, <i>Indigofera</i> sp., <i>Cheilanthes</i> spp.</p>	<p>1 inventory site and traversed</p> <p>Vegetation type: Rocky Hill Mixed Shrubland and Stony Mulga Mixed Shrubland. Palatable perennials include: <i>Ptilotus</i> spp., <i>Maireana</i> spp. Pastoral use limitations: None under controlled grazing.</p>
<p>Unit 3: Creeks and drainage tracts (10%)</p> <p>Dendritic drainage lines < 50 m wide on upper slopes becoming broader downslope (to 150 m) with narrow incised channels mostly < 10 m wide. Soils are probably duplexes, loamy sands over light clays or alluvial sandy loams on channel margins with little profile development over greenstone or hardpan.</p>	<p>Moderately close to close (PFC 20-50%) mulga woodlands dominated by <i>Acacia aneura</i>. Trees and tall shrubs (to 6 m): <i>A. aneura</i>, <i>A. sclerosperma</i>, <i>A. tetragonophylla</i>, <i>A. victoriaea</i>, <i>Eremophila fraseri</i>. Mid shrubs (1-2 m): <i>Cassia nemophila</i>, <i>C. sturtii</i>, <i>Dodonaea</i> sp. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>Solanum lasiophyllum</i>, <i>Rhagodia eremaea</i>, <i>S. ashbyi</i>, <i>Scaevola spinescens</i>. Perennial grass: <i>Cymbopogon ambiguus</i>.</p>	<p>Traversed</p> <p>Vegetation type: Creekline Shrubland. Palatable perennials include: <i>Ptilotus obovatus</i>, <i>Scaevola spinescens</i>, <i>Rhagodia eremaea</i>. Pastoral use limitations: Mild susceptibility to accelerated erosion where degraded.</p>

Yalbalgo land system (G) 127 km² (0.15% of survey area)

Land type: 10; Pastoral potential: low.

Gently undulating sandplain with parallel linear sand dunes and interdunal swales; supports tall acacia shrublands and sparse wanderrie grasses; a very minor system in this area, only in mid west.

Geology: Quaternary aeolian sand.

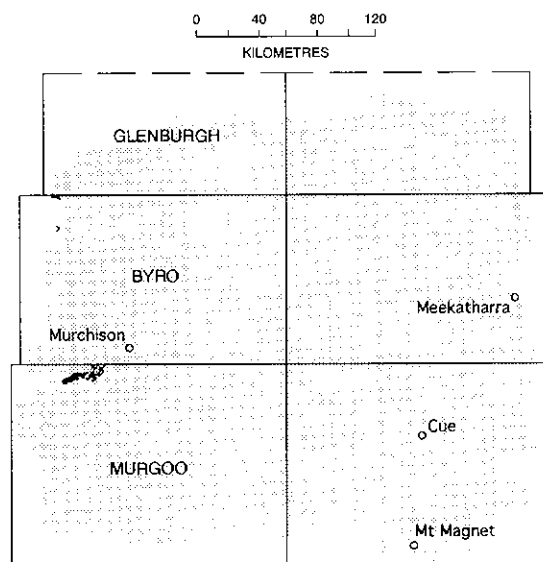
Geomorphology: Depositional surfaces; broad plains of red sand, of low relief other than parallel to reticulate dunes, mostly 0.5 to 1.5 km apart and aligned north-south (on New Forest station) elsewhere more east-west; 5 to 15 m high; drainage features absent except for scattered diffuse foci, draining from interdunal plains; relief < 20 m.

Vegetation and pastoral use: Sandplain Wanderrie Grassy Shrubland; scattered palatable perennial shrubs and sparse wanderrie grasses; reasonably resistant to light grazing pressure; dunes are stable, well protected by tall shrubs; system not normally susceptible to erosion unless denuded.

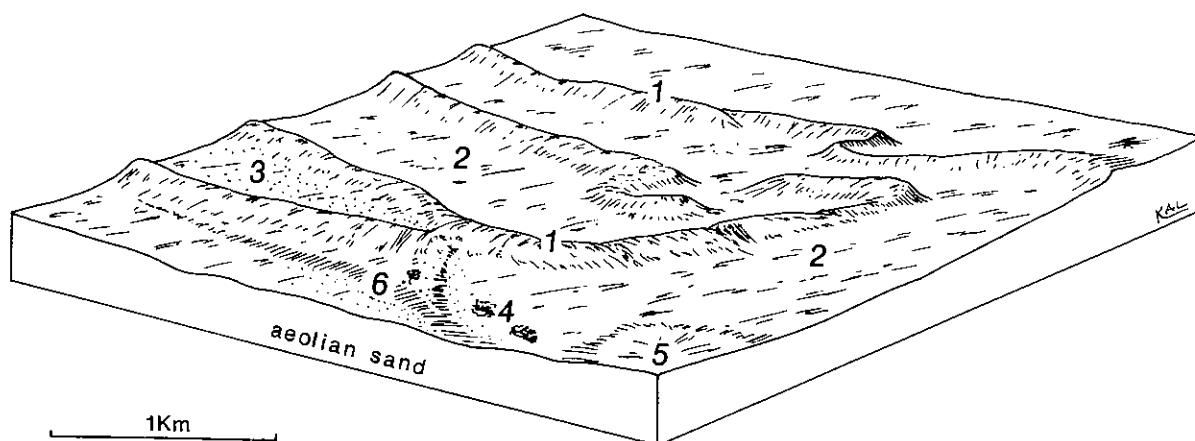
Estimated carrying capacity, good condition: 20 ha/dse.

Range condition summary (16 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
94	6	0	0	56	38	6



- Unit: 1. Linear dunes.
 2. Sandy swales.
 3. Interdunal plains.
 4. Drainage foci.
 5. Restricted stony plains.
 6. Sandy drainage floors.



Yalbalgo I.s. (adapted from Payne *et al.* 1987)

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Linear dunes (25%) Convergent to parallel longitudinal sand dunes, with rounded crests, frequently 5-10 km long and mostly 10 to 20 m above intervening swales and plains, slopes up to 21%. Soils are unconsolidated dark red or dusky red siliceous sands, > 1 m deep, pH 5.0 with neutral or acidic trends. Principal profile form: Uc1.23.	Very scattered to moderately close (PFC < 30%) tall shrublands dominated by <i>Acacia sclerosperma</i> and <i>A. ramulosa</i> . Trees and tall shrubs (2-6 m): <i>A. ramulosa</i> , <i>A. sclerosperma</i> , <i>A. murrayana</i> , <i>Eucalyptus obtusiflora</i> , <i>Grevillea stenobotrya</i> , <i>Eremophila maitlandii</i> . Low shrubs (< 2 m): <i>Thryptomene</i> sp., <i>E. forrestii</i> , <i>E. granitica</i> , <i>Pityrodia</i> spp., <i>Pimelea microcephala</i> , <i>Solanum lasiophyllum</i> , <i>Sida</i> sp. Perennial grasses: <i>Eragrostis lanipes</i> , <i>Eriachne helmsii</i> , <i>Thyridolepis multiculmis</i> .	1 inventory site and traversed Vegetation type: Sandplain Acacia Shrubland. Perennials augmented by annual grasses and forbs in favourable seasons. Palatable perennials include: <i>Eragrostis lanipes</i> , <i>Eremophila forrestii</i> , <i>Thyridolepis multiculmis</i> . Pastoral use limitations: None under controlled grazing and not normally susceptible to accelerated erosion.
Unit 2: Sandy swales (60%) Broad sandy swales, flat or gently sloping (up to 1%). Soils are dark red or dusky red earthy sands, loamy sand or sandy loam, > 1 m deep, pH 5.5-8.0 with neutral or acidic trends. Principal profile form: Uc5.21.	Very scattered to moderately close (PFC < 30%) tall shrublands usually dominated by <i>Acacia ramulosa</i> . Trees (2-8 m): <i>A. pruinocarpa</i> , <i>Eucalyptus eudesmioides</i> , <i>E. oldfieldii</i> . Tall shrubs (> 2 m): <i>A. ramulosa</i> , <i>A. murrayana</i> , <i>A. sclerosperma</i> , <i>A. aff. coolgardiensis</i> , <i>Stylobasium spathulatum</i> . Mid and low shrubs (< 2 m): <i>Eremophila forrestii</i> , <i>Maireana planifolia</i> , <i>Solanum lasiophyllum</i> , <i>Cassia helmsii</i> , <i>Ptilotus obovatus</i> , <i>Rhagodia eremaea</i> . Perennial grasses: <i>Eragrostis lanipes</i> , <i>Monachather paradoxa</i> , <i>Eriachne helmsii</i> .	1 inventory site and traversed Vegetation type: Sandplain Acacia Shrubland. Palatable perennials include: <i>Maireana</i> spp., <i>Tribulus platypterus</i> , <i>Cassia chatelainiana</i> , <i>Monachather paradoxa</i> . Pastoral use limitations: None under controlled grazing.
Unit 3: Interdunal plains (10%) Flat plains, some sloping up to 1% and subject to sheet flow; very sparse surface gravels occur locally. Soils are earthy sands or deep red earths, dusky red or dark red sandy loams to light sandy clay loams with increasing clay content down profile, 30 cm to > 1 m deep, pH 5.5-6.5 with neutral or acidic trends. Principal profile forms: Uc5.21, 1.43, Um6.24, Gn3.11.	Scattered to moderately close (PFC < 30%) tall shrublands dominated by <i>Acacia pruinocarpa</i> and <i>A. ramulosa</i> . Trees (to 8 m): <i>A. pruinocarpa</i> , <i>A. aneura</i> , <i>Eucalyptus coolabah</i> , <i>Canthium lineare</i> . Tall shrubs (> 2 m): <i>A. ramulosa</i> , <i>A. aff. coolgardiensis</i> , <i>A. tetragonophylla</i> , <i>A. sclerosperma</i> . Mid and low shrubs (< 2 m): <i>Ptilotus obovatus</i> , <i>Cassia helmsii</i> , <i>Eremophila forrestii</i> , <i>E. fraseri</i> , <i>E. latrobei</i> , <i>Maireana planifolia</i> . Perennial grasses: <i>Monachather paradoxa</i> , <i>Eragrostis lanipes</i> , <i>Eriachne helmsii</i> .	Traversed Vegetation type: Sandplain Acacia Shrubland. Perennials augmented by annual grasses and forbs in favourable seasons. Palatable perennials include: <i>Tribulus platypterus</i> , <i>Eremophila latrobei</i> , <i>E. forrestii</i> , <i>Monachather paradoxa</i> . Pastoral use limitations: None under controlled grazing.
Unit 4: Drainage foci (1%) Discrete foci with flat or mounded surfaces. Soils are dusky red sandy loams, > 1 m deep, pH 5.5-6.0 with an acidic trend. Principal profile form: Uc5.21.	Close (PFC 30-50%) tall shrublands dominated by <i>Acacia pruinocarpa</i> and <i>A. ramulosa</i> . Trees and tall shrubs (up to 10 m): <i>A. pruinocarpa</i> , <i>A. ramulosa</i> , <i>A. tetragonophylla</i> , <i>Ptilotus obovatus</i> , <i>Eremophila forrestii</i> , <i>E. latrobei</i> , <i>Maireana planifolia</i> . Perennial grass: <i>Monachather paradoxa</i> .	Vegetation type: Sandplain Acacia Shrubland. Palatable perennials include: <i>Eremophila latrobei</i> , <i>Tribulus platypterus</i> , <i>Maireana planifolia</i> . Pastoral use limitations: None under controlled grazing.

Yalbalgo I.s. (adapted from Payne *et al.* 1987) —continued

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 5: Restricted stony plains (2%)		
Restricted interdunal plains with rock outcropping (or at shallow depth) and strewn with quartzite cobbles. Soils are red loamy sands, < 50 cm deep, pH 5.5 with an acidic trend. Principal profile form: Uc1.43.	Moderately close (PFC 20-30%) mid height shrublands dominated by <i>Acacia</i> aff. <i>coolgardiensis</i> . Trees: <i>A. pruinocarpa</i> . Tall shrubs: <i>A. ramulosa</i> . Mid and low shrubs: <i>A. aff. coolgardiensis</i> , <i>Ptilotus schwartzii</i> , <i>Eremophila latrobei</i> , <i>Cassia chatelainiana</i> . Perennial grass: <i>Monochather paradoxa</i> .	Vegetation type: Hardpan Mulga Shrubland. Palatable perennials include: <i>Eremophila latrobei</i> , <i>Cassia chatelainiana</i> . Pastoral use limitations: None under controlled grazing.
Unit 6: Sandy drainage floors (2%)		
Drainage tracts with minor channelling. Soils are probably sandy loams.	Variable woodlands or shrublands dominated by <i>Eucalyptus coolabah</i> , <i>Acacia</i> spp. and sparse perennial grasses (<i>Cenchrus ciliaris</i>).	Vegetation type: Creekline Shrubland.

Traversed

Yandil land system (W) 3402 km² (3.96% of survey area)

Land type: 14; Pastoral potential: low.

Flat hardpan wash plains, extensively uniform and carrying light to moderate mantles of small pebbles and gravels; occasional wanderrie banks and groves; supports mulga shrublands, but widely degraded.

Geology: Quaternary cemented alluvium derived principally from gneiss and granite with minor aeolian deposits.

Geomorphology: Depositional surfaces; almost flat plains on red-brown hardpan, draining systems based on granitic or greenstone colluvium; up to 10 km wide with lateral, elliptical grove formations where some slope is evident; wanderrie banks in lower parts or along central plains with more concentrated flow; washes often with small, braided channels and extensive scalded areas; occasional major channelled drainage lines; overall relief mostly < 3 m.

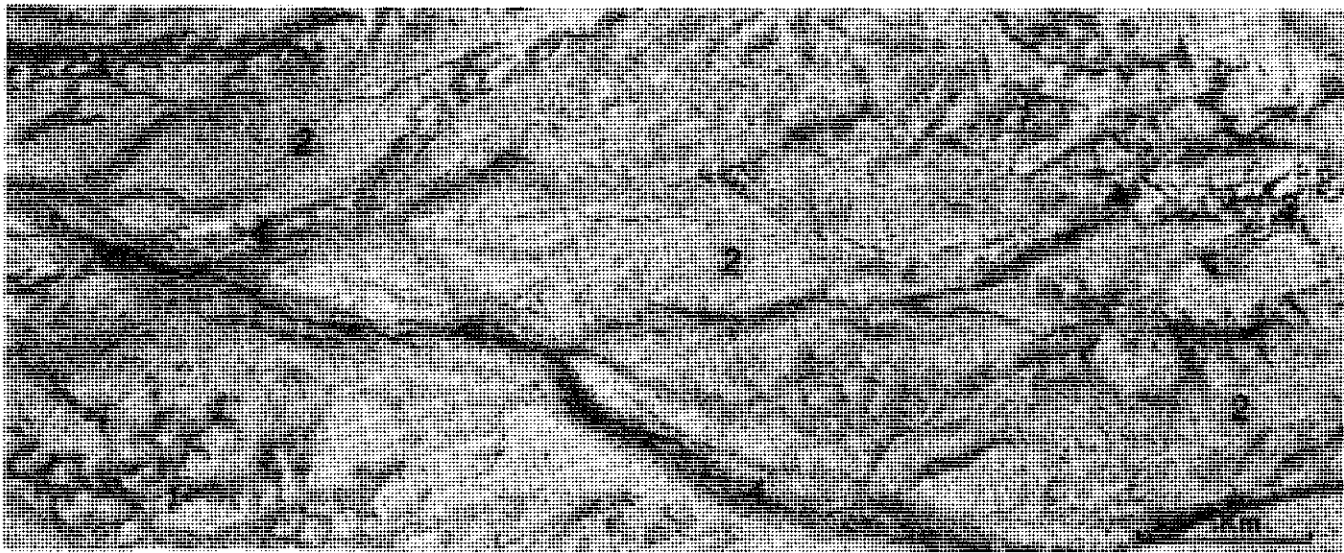
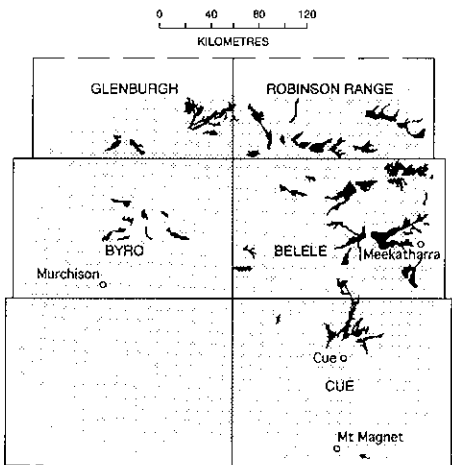
Vegetation and pastoral use: Mainly Hardpan Mulga Shrubland, potentially supporting a useful variety of palatable perennial shrubs and herbs but now widely degraded through preferential grazing and chronic overuse around easily obtained supplies of permanent fresh water; forage value is provided primarily by sparse browse species and profuse annual species; wash plains and intergroves often show marked reduction in populations of palatable shrubs and locally increasing, unpalatable shrubs; groves and wanderrie banks are often in slightly better condition and provide reasonable reserves; unmantled areas of major units (particularly unit 4) are moderately susceptible to accelerated erosion when degraded.

Estimated carrying capacity, good condition: 20 ha/dse.

Range condition summary (610 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
84	11	4	1	8	30	62

- Unit: 1. Wanderrie banks.
2. Hardpan plains.
3. Mulga groves.
4. Drainage tracts.



Yandil I.s.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 1: Wanderrie banks (5%)</p> <p>Reticulate and interconnecting sandy banks up to 500 m wide extending downslope for up to 2 km; up to 1 m above hardpan plains. Soils are earthy sands, with occasional increases in texture with depth, up to 1 m deep over hardpan; pH 6.0-6.5 with a neutral trend. Principal profile forms: Uc5.21, Gn2.12.</p>	<p>Scattered to moderately close (PFC 10-30%) tall or mixed shrublands mainly dominated by <i>Acacia aneura</i> and <i>Eremophila margarethae</i>. Trees and tall shrubs (to 6 m): <i>A. aneura</i>, <i>A. cuthbertsonii</i>, <i>A. tetragonophylla</i>, <i>A. victoriae</i>, <i>A. kempeana</i>, <i>Hakea preissii</i>. Mid shrubs (1-2 m): <i>Cassia helmsii</i>, <i>C. desolata</i>, <i>Eremophila forrestii</i>, <i>E. fraseri</i>, <i>E. latrobei</i>. Low shrubs (< 1 m): <i>E. margarethae</i>, <i>E. punicea</i>, <i>Ptilotus obovatus</i>, <i>Sida calyxhymentia</i>, <i>Scaevola spinescens</i>, <i>Maireana convexa</i>, <i>M. planifolia</i>, <i>Solanum lasiophyllum</i>. Perennial grasses: <i>Eriachne helmsii</i>, <i>Eragrostis lanipes</i>, <i>Monachather paradoxa</i>.</p>	<p>2 inventory sites, 1 condition site and traversed</p> <p>Vegetation type: Wanderrie Bank Grassy Shrubland. Palatable perennials include: <i>Eremophila forrestii</i>, <i>E. latrobei</i>, <i>Ptilotus obovatus</i>, <i>Sida calyxhymentia</i>, <i>Scaevola spinescens</i>, <i>Maireana</i> spp., <i>Eragrostis lanipes</i>, <i>Monachather paradoxa</i>. Pastoral use limitations: Slightly susceptible to accelerated erosion where degraded. Vegetation condition %: VG/G 15, F 50, P/NP 35. Erosion incidence %: min 4. 26 obs.</p>
<p>Unit 2: Hardpan plains (70%)</p> <p>Almost flat plains (slopes < 0.5%) 2-10 km wide, of very uniform appearance except where interspersed with occasional sandy banks and groves (units 1 and 3); receiving broad sheet flow from Koonmarra, Mindura or Narryer land systems; usually lightly strewn with quartz or mixed gravel and pebble fragments. Degraded areas susceptible to soil loss through sheeting and scalding, other areas receive surface deposition of clay and silt. Soils are hardpan loams, shallow red earths or light clays, mostly over hardpan < 50 cm deep; isolated areas with sandy clay loams over light clays up to 1 m deep; pH 6.0-7.0 with a neutral to alkaline trend. Principal profile forms: Um5.31, Uf6.71.</p>	<p>Scattered (PFC 10-20%) tall or mixed shrublands usually dominated by <i>Acacia aneura</i> and <i>A. tetragonophylla</i>. Trees (to 4 m): <i>A. aneura</i>, <i>A. pruinocarpa</i>, <i>A. quadrimarginea</i>, <i>Grevillea striata</i>, <i>Hakea suberea</i>, <i>Brachychiton gregorii</i>. Tall shrubs (> 2 m): <i>A. tetragonophylla</i>, <i>A. aff. citrinoviridis</i>, <i>A. aneura</i>, <i>A. grasbyi</i>, <i>A. ramulosa</i>, <i>Eremophila longifolia</i>, <i>E. fraseri</i>. Mid shrubs (1-2 m): <i>A. palustris</i>, <i>Cassia desolata</i>, <i>C. helmsii</i>, <i>E. spathulata</i>, <i>E. forrestii</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>P. rotundifolius</i>, <i>P. schwartzii</i>, <i>Rhagodia eremaea</i>, <i>Enchylaena tomentosa</i>, <i>Scaevola spinescens</i>, <i>Solanum lasiophyllum</i>, <i>Sida calyxhymentia</i>, <i>Maireana tomentosa</i>, <i>M. planifolia</i>, <i>M. convexa</i>, <i>M. villosa</i>.</p>	<p>5 inventory sites, 53 condition sites and traversed</p> <p>Vegetation types: Hardpan Mulga Shrubland. Palatable perennials include: <i>Maireana</i> spp., <i>Eremophila forrestii</i>, <i>E. latrobei</i>, <i>Spartothamnella teucriflora</i>, <i>Ptilotus</i> spp., <i>Rhagodia eremaea</i>, <i>Enchylaena tomentosa</i>, <i>Scaevola spinescens</i>. Pastoral use limitations: Locally susceptible to accelerated erosion where severely degraded. Vegetation condition %: VG/G 8, F 29, P/NP 63. Erosion incidence %: min 10, mod 2. 465 obs.</p>
<p>Unit 3: Mulga groves (1%)</p> <p>Elliptical grove formations and drainage foci up to 200 m long and 50 m wide; transverse to direction of sheet water flow; occurring infrequently on units 2 and 4. Soils are deep red earths or clay loams over light clays, up to 1 m deep; pH 5.5-6.5 with a neutral to acidic trend. Principal profile forms: Gn2.12, Uf6.71.</p>	<p>Close to closed (PFC > 30%) woodlands or tall shrublands dominated by <i>Acacia aneura</i>, <i>A. distans</i> or <i>A. tetragonophylla</i>. Trees (to 10 m): <i>A. aneura</i>, <i>A. distans</i>, <i>A. pruinocarpa</i>, <i>Canthium lineare</i>, <i>Santalum spicatum</i>, <i>Grevillea striata</i>. Tall shrubs (to 6 m): <i>A. distans</i>, <i>A. tetragonophylla</i>, <i>A. ramulosa</i>, <i>A. kempeana</i>, <i>A. sclerosperma</i>, <i>A. cuthbertsonii</i>, <i>A. craspedocarpa</i>, <i>Eremophila fraseri</i>, <i>Canthium latifolium</i>. Mid shrubs (1-2 m): <i>E. forrestii</i>, <i>E. macmillaniana</i>, <i>E. latrobei</i>, <i>E. spathulata</i>, <i>Cassia desolata</i>, <i>C. helmsii</i>, <i>Spartothamnella teucriflora</i>. Low shrubs (< 1 m): <i>Maireana planifolia</i>, <i>Ptilotus obovatus</i>, <i>C. chatelainiana</i>, <i>Sida</i> sp., <i>Scaevola spinescens</i>. Creepers: <i>Ipomoea</i> sp., <i>Leichardtia australis</i>. Perennial grasses: <i>Chrysopogon fallax</i>, <i>Eriachne helmsii</i>.</p>	<p>2 inventory sites and traversed</p> <p>Vegetation type: Mulga Grove Woodland. Palatable perennials include: <i>Eremophila forrestii</i>, <i>E. latrobei</i>, <i>Cassia chatelainiana</i>, <i>Spartothamnella teucriflora</i>, <i>Maireana planifolia</i>, <i>Ptilotus obovatus</i>, <i>Sida</i> sp., <i>Scaevola spinescens</i>, <i>Chrysopogon fallax</i>. Pastoral use limitations: None with controlled grazing.</p>

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 4: Drainage tracts (25%)		7 inventory sites, 6 condition sites and traversed
<p>Broad alluvial plains with negligible slope and receiving concentrated sheet flow from unit 2; with or without sparse pebbly quartz mantles. Up to 1.5 km wide (wider at confluences) with usually little channel development, although larger, well defined tracts have multiple, braided sandy channels and gutters. Some scalded tracts with hardpan exposures. Soils are deep red earths or hardpan loams up to 1 m deep over hardpan; pH 6.0-7.0 with a neutral to acidic trend. Principal profile forms: Gn2.12, Um5.31, Um5.41, Uc1.43.</p>	<p>Very scattered to moderately close (PFC < 30%) tall shrublands dominated by <i>Acacia aneura</i>. Trees (to 8 m): <i>A. aneura</i>, <i>A. cyperophylla</i>, <i>Eucalyptus coolabah</i>, <i>Hakea suberea</i>. Tall shrubs (> 2 m): <i>A. aneura</i>, <i>A. grasbyi</i>, <i>A. rhodophloia</i>, <i>A. tetragonophylla</i>, <i>A. kempeana</i>, <i>A. cuthbertsonii</i>, <i>Canthium lineare</i>, <i>Eremophila fraseri</i>. Mid shrubs (1-2 m): <i>A. craspedocarpa</i>, <i>A. palustris</i>, <i>Cassia desolata</i>, <i>C. helmsii</i>, <i>C. sturtii</i>, <i>E. forrestii</i>, <i>E. latrobei</i>, <i>E. granitica</i>, <i>Spartothamnella teucriflora</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>Maireana planifolia</i>, <i>E. compacta</i>, <i>Rhagodia eremaea</i>, <i>Enchylaena tomentosa</i>, <i>Solanum lasiophyllum</i>, <i>Sida calyxhymenia</i>, <i>S. cardiophylla</i>, <i>Grevillea deflexa</i>. Perennial grasses (mainly along channels): <i>Eriachne benthami</i>, <i>E. helmsii</i>, <i>E. sp.</i>, <i>Chrysopogon fallax</i>.</p>	<p>Vegetation type: Hardpan Mulga Shrubland and Creekline Grassy Shrubland. Palatable perennials include: <i>Sida calyxhymenia</i>, <i>Eremophila forrestii</i>, <i>E. latrobei</i>, <i>E. compacta</i>, <i>Spartothamnella teucriflora</i>, <i>Ptilotus</i> spp., <i>Maireana</i> spp., <i>Rhagodia eremaea</i>, <i>Enchylaena tomentosa</i>, <i>Sida</i> spp., <i>Hibiscus</i> sp. Pastoral use limitations: Mild to moderate susceptibility to accelerated erosion where degraded. Vegetation condition %: VG/G 4, F 28, P/VP 68. Erosion incidence %: min 25, mod 14, sev 2. 84 obs.</p>

Yanganoo land system (W) 12,433 km² (14.48% of survey area)

Land type: 14; Pastoral potential: moderate.

Almost flat hardpan wash plains, with or without small wanderrie banks and showing variable development of weak grooving; supports mulga shrublands; the most extensive system in survey area.

Geology: Quaternary cemented alluvium derived mainly from gneiss, granite and feldspathic schist; minor aeolian sand on margins.

Geomorphology: Depositional surfaces; broad plains carrying sheet flow flanking tributary and major drainages continuously for 10 to 60 km; loamy soils, locally mantled by ironstone quartz gravels and pebbles underlain by red-brown hardpan throughout; carries sheet drainage received from mainly granite-based colluvial systems; also plains with frequent indistinct irregular groves and patchy, small wanderrie banks; drainage tracts carrying more concentrated flow, mostly unchannelled, but occasionally with shallow braided channels; overall relief is mostly < 5 m.

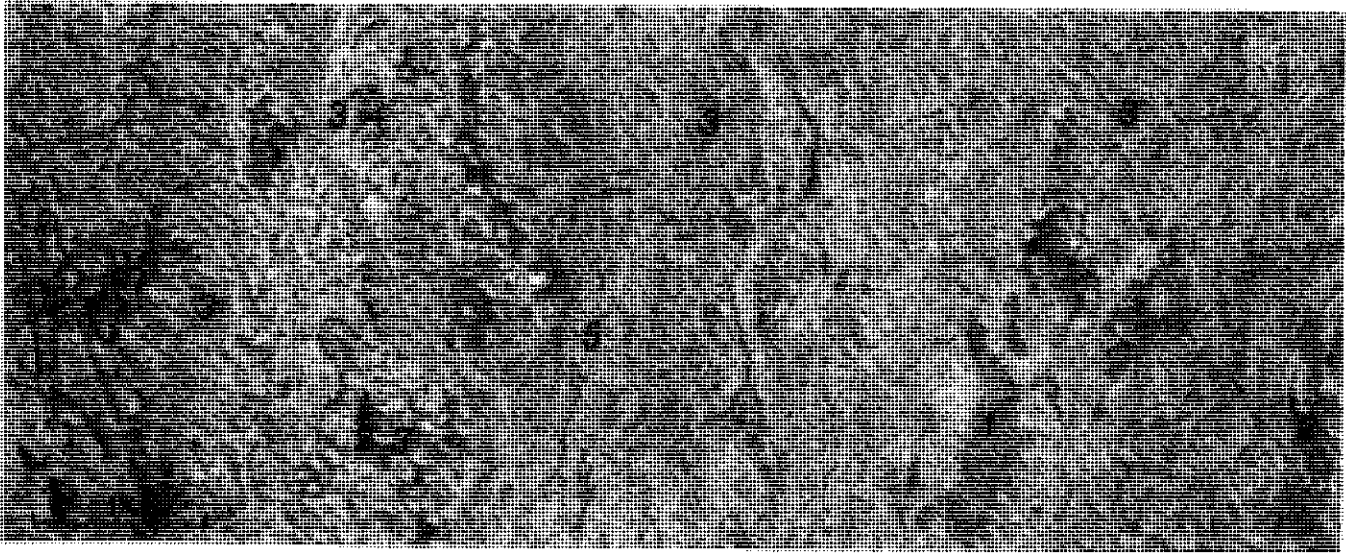
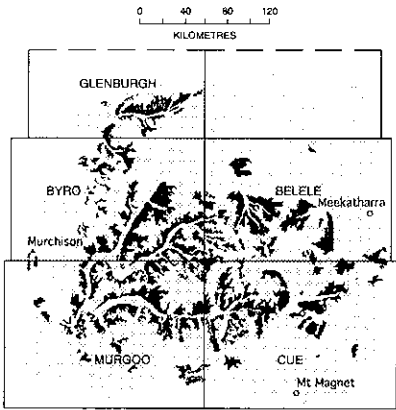
Vegetation and pastoral use: Extensive Hardpan Mulga Shrubland and minor Wanderrie Bank Grassy Shrubland of moderate productivity; in fair to good condition supports a well-mixed suite of non-halophytic palatable perennial shrubs and herbs; plentiful annual grasses and forbs in good seasons; in poor condition, palatable perennials (occurring as understorey and low shrub vegetation) are greatly reduced or virtually eliminated as a result of chronic overgrazing, but soil surfaces and seasonal herbage responses are resistant to degradation, conferring useful seasonal grazing but not suitable for use at other times; drainage tracts carrying concentrated flow support non-halophytic and some halophytic shrubs and are often preferentially grazed and degraded, with scalding or surface stripping to the hardpan; major unit locally susceptible to accelerated erosion when severely degraded, but much more susceptible to degradation and water starvation arising from inappropriately maintained roads and tracks.

Estimated carrying capacity, good condition: 12 ha/dse.

Range condition summary (1,796 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
90	7	3	0	20	40	40

- Unit:
- Sand plains.
 - Wanderrie banks.
 - Hardpan plains.
 - Mulga groves.
 - Drainage tracts.



Yanganoo I.s.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 1: Sand plains (2%)</p> <p>Occasional patches of sand plains mainly in transitional areas adjacent to Kalli land system; up to 2 km in extent. Soils are dark red earthy sands, > 1 m deep; pH 5.5-6.0 with a neutral to acidic trend. Principal profile form: Uc5.21.</p>	<p>Scattered (PFC 10-20%) mixed height grassy shrublands dominated by <i>Acacia</i> spp., <i>Eremophila margarethae</i>, <i>Monachather paradoxa</i> and occasionally <i>Solanum lasiophyllum</i>. Trees and tall shrubs (> 2 m): <i>Acacia aneura</i>, <i>A. pruinocarpa</i>, <i>A. ramulosa</i>, <i>Eucalyptus dichromophloia</i>. Mid shrubs (1-2 m): <i>E. forrestii</i>, <i>E. granitica</i>, <i>E. latrobei</i>, <i>A. kempeana</i>. Low shrubs (< 1 m): <i>E. margarethae</i>, <i>Ptilotus obovatus</i>, <i>Dianella revoluta</i>, <i>Maireana convexa</i>, <i>M. planifolia</i>, <i>Mirbelia spinosa</i>, <i>Rhagodia eremaea</i>, <i>S. lasiophyllum</i>. Perennial grasses: <i>Monachather paradoxa</i>, <i>Eriachne helmsii</i>, <i>Eragrostis eriopoda</i>, <i>E. lanipes</i>, <i>Thyridolepis multiculmis</i>.</p>	<p>2 inventory sites, 7 condition sites and traversed</p> <p>Vegetation type: Sandplain Wanderrie Grassy Shrubland. Palatable perennials include: <i>Monachather paradoxa</i>, <i>Eragrostis</i> spp., <i>Thyridolepis multiculmis</i>, <i>Eremophila forrestii</i>, <i>E. latrobei</i>, <i>Ptilotus obovatus</i>, <i>Maireana</i> spp., <i>Rhagodia eremaea</i>. Pastoral use limitations: None with controlled grazing.</p>
<p>Unit 2: Wanderrie banks (10%)</p> <p>Reticulate and interconnecting low sandy banks elevated up to 1 m above surrounding hardpan plain (unit 3); usually 50-100 m wide and extending up to 2 km long, commonly transverse to slope. Soils are dark red earthy sands < 1 m deep; occasionally over hardpan; pH 6.5-7.0 with a neutral trend. Principal profile form: Uc5.21.</p>	<p>Scattered to moderately close (PFC 10-30%) tall or mixed shrublands with perennial grasses, mainly dominated by <i>Acacia</i> spp. or <i>Eremophila</i> spp. Trees and tall shrubs (> 2 m): <i>A. aneura</i>, <i>A. grasbyi</i>, <i>A. kempeana</i>, <i>A. tetragonophylla</i>, <i>A. ramulosa</i>, <i>A. sclerosperma</i>, <i>A. xiphophylla</i>. Mid shrubs (1-2 m): <i>Cassia desolata</i>, <i>C. helmsii</i>, <i>C. nemophila</i>, <i>C. artemisioides</i>, <i>Eremophila granitica</i>, <i>E. fraseri</i>, <i>E. forrestii</i>, <i>Spartothamnella teucriflora</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>P. schwartzii</i>, <i>E. margarethae</i>, <i>Maireana planifolia</i>, <i>M. convexa</i>, <i>Solanum lasiophyllum</i>, <i>Sida calyxhymenia</i>, <i>Rhagodia eremaea</i>. Perennial grasses: <i>Monachather paradoxa</i>, <i>Eragrostis eriopoda</i>, <i>E. lanipes</i>, <i>Eriachne helmsii</i>.</p>	<p>2 inventory sites, 23 condition sites and traversed</p> <p>Vegetation type: Wanderrie Bank Grassy Shrubland. Palatable perennials include: <i>Monachather paradoxa</i>, <i>Eragrostis eriopoda</i>, <i>Eremophila latrobei</i>, <i>E. forrestii</i>, <i>Spartothamnella teucriflora</i>, <i>Ptilotus</i> spp., <i>Maireana</i> spp., <i>Sida calyxhymenia</i>, <i>Rhagodia eremaea</i>. Pastoral use limitations: None with controlled grazing; subject to invasion by <i>E. granitica</i> or <i>E. margarethae</i>. Vegetation condition %: VG/G 19, F 51, P/VP 30. Erosion incidence %: min 3. 139 obs.</p>
<p>Unit 3: Hardpan plains (80%)</p> <p>Extensive, flat surfaced, very gently inclined plains with slopes < 0.5% grading to almost flat in system centre, subject to sheet flow and flanking tributary drainages for many kilometres. Soil surfaces extensively crusted, with patchy cover of cryptogams (lichens, algae and mosses) parts lightly to moderately strewn with quartz or mixed gravels and pebbles. Soils are red hardpan clay loams over red-brown hardpan (occasionally granite), usually 20-50 cm deep; pH 5.5-7.0 with a neutral to acidic trend. Principal profile form: Um5.31.</p>	<p>Very scattered to moderately close (PFC < 30%) mixed height or tall shrublands dominated by <i>Acacia aneura</i>. Trees (to 6 m): <i>A. aneura</i>, <i>A. pruinocarpa</i>, <i>A. quadrimarginea</i>, <i>Grevillea striata</i>. Tall shrubs (> 2 m): <i>A. craspedocarpa</i>, <i>A. grasbyi</i>, <i>A. ramulosa</i>, <i>A. tetragonophylla</i>, <i>A. aff. quadrimarginea</i>, <i>A. rhodophloia</i>, <i>A. kempeana</i>, <i>Canthium latifolium</i>, <i>C. lineare</i>, <i>Hakea arida</i>, <i>H. recurva</i>. Mid shrubs (1-2 m): <i>Eremophila forrestii</i>, <i>E. fraseri</i>, <i>E. latrobei</i>, <i>E. spathulata</i>, <i>E. freelingii</i>, <i>Cassia desolata</i>, <i>C. sturtii</i>, <i>Calytrix</i> spp., <i>Mirbelia spinosa</i>, <i>Thryptomene</i> sp., <i>Spartothamnella teucriflora</i>, <i>Grevillea deflexa</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>P. roei</i>, <i>P. schwartzii</i>, <i>Acacia daviesoides</i>, <i>E. compacta</i>, <i>Maireana convexa</i>, <i>M. planifolia</i>, <i>M. triptera</i>, <i>M. villosa</i>, <i>Abutilon</i> sp., <i>Sida calyxhymenia</i>, <i>S. sp.</i>, <i>Solanum lasiophyllum</i>, <i>Rhagodia eremaea</i>, <i>Enchylaena tomentosa</i>, <i>Scaevola spinescens</i>. Perennial grasses (always sparse): <i>Eragrostis setifolia</i>, <i>E. eriopoda</i>, <i>Eriachne helmsii</i>, <i>Monachather paradoxa</i>, <i>Stipa</i> sp.</p>	<p>10 inventory sites, 184 condition sites and traversed</p> <p>Vegetation type: Hardpan Mulga Shrubland. Palatable perennials include: <i>Eremophila latrobei</i>, <i>E. compacta</i>, <i>E. forrestii</i>, <i>Ptilotus</i> spp., <i>Sida</i> spp., <i>Maireana convexa</i>, <i>M. planifolia</i>, <i>Spartothamnella teucriflora</i>, <i>Rhagodia eremaea</i>, <i>Canthium lineare</i>, <i>Enchylaena tomentosa</i>, <i>Cassia chatelainiana</i>, <i>Hibiscus burtonii</i>, <i>Grevillea deflexa</i>. Pastoral use limitations: Mildly susceptible to accelerated erosion where severely degraded mainly over areas near unit 5; also subject to water starvation where tracks intercept or divert sheet flows. Vegetation condition %: VG/G 21, F 40, P/VP 39. Erosion incidence %: min 7, mod 1. 1,643 obs.</p>

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 4: Mulga groves (4%)</p> <p>Groving formations prominent in areas receiving more concentrated sheet flow, up to 500 m long and 100 m wide; with dense vegetation; elsewhere, occurrence is scattered with groves being smaller, less distinct and barely discernible on the ground. Soils are red earths or hardpan clay loams < 1 m deep usually with more surface sand than intergrove areas; pH 5.5-6.0 with a neutral to acidic trend. Principal profile forms: Um5.31, Gn2.12.</p>	<p>Moderately close to closed (PFC 30 - > 50%) woodlands or tall shrublands dominated by <i>Acacia aneura</i>. Trees (to 8 m): <i>A. aneura</i>, <i>A. pruinocarpa</i>, <i>Canthium lineare</i>. Tall shrubs (> 2 m): <i>A. ramulosa</i>, <i>A. tetragonophylla</i>, <i>A. kempeana</i>, <i>C. latifolium</i>, <i>A. craspedocarpa</i>. Mid shrubs (1-2 m): <i>Eremophila forrestii</i>, <i>E. latrobei</i>, <i>E. spathulata</i>, <i>E. gilesii</i>, <i>E. punicea</i>, <i>Spartothamnella teucriflora</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>Scaevola spinescens</i>, <i>Rhagodia eremaea</i>, <i>Solanum lasiophyllum</i>, <i>Maireana planifolia</i>, <i>M. convexa</i>, <i>Sida calyxhymenia</i>, <i>S. sp.</i> Creepers: <i>Leichardtia australis</i>. Perennial grasses: <i>Monachather paradoxa</i>, <i>Eragrostis eriopoda</i>, <i>Eriachne helmsii</i>.</p>	<p>3 inventory sites, 3 condition sites and traversed</p> <p>Vegetation type: Mulga Grove Woodland.</p> <p>Palatable perennials include: <i>Eremophila forrestii</i>, <i>E. latrobei</i>, <i>Grevillea deflexa</i>, <i>Spartothamnella teucriflora</i>, <i>Ptilotus obovatus</i>, <i>Scaevola spinescens</i>, <i>Rhagodia eremaea</i>, <i>Maireana</i> spp., <i>Sida</i> spp., <i>Monachather paradoxa</i>, <i>Eragrostis eriopoda</i>.</p> <p>Pastoral use limitations: None with controlled grazing.</p>
<p>Unit 5: Drainage tracts (4%)</p> <p>Broad alluvial tracts (up to 750 m wide) receiving concentrated run-on, usually without channels in less organised tracts; larger or more discrete flow zones may have single or multiple channels incised into hardpan. Soils are mostly red hardpan loams > 50 cm over hardpan, slightly saline locally, pH 6.0-6.5 with a neutral to acidic trend. Principal profile form: Um5.31.</p>	<p>Moderately close (PFC 20-30%) tall shrublands dominated by <i>Acacia aneura</i> or <i>A. tetragonophylla</i>. Trees and tall shrubs (to 6 m): <i>A. aneura</i>, <i>A. craspedocarpa</i>, <i>A. pruinocarpa</i>, <i>A. tetragonophylla</i>, <i>Eremophila fraseri</i>, <i>Canthium lineare</i>. Mid shrubs (1-2 m): <i>E. forrestii</i>, <i>E. latrobei</i>, <i>E. georgei</i>, <i>Spartothamnella teucriflora</i>, <i>Cassia helmsii</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>P. schwartzii</i>, <i>Sida calyxhymenia</i>. <i>S. sp.</i>, <i>C. chatelainiana</i>, <i>Maireana villosa</i>, <i>M. planifolia</i>, <i>Rhagodia eremaea</i>, <i>Abutilon</i> sp., <i>Solanum lasiophyllum</i>.</p>	<p>1 inventory site, 2 condition sites and traversed</p> <p>Vegetation type: Hardpan Mulga Shrubland and Creekline Shrubland.</p> <p>Palatable perennials include: <i>Eremophila forrestii</i>, <i>E. latrobei</i>, <i>Spartothamnella teucriflora</i>, <i>Ptilotus</i> spp., <i>Sida</i> spp., <i>Maireana</i> spp., <i>Cassia chatelainiana</i>, <i>Rhagodia eremaea</i>.</p> <p>Pastoral use limitations: Moderately susceptible to accelerated erosion where degraded.</p> <p>Vegetation condition %: VG/G 5, F 24, P/VP 71.</p> <p>Erosion incidence %: min 29, mod 25, sev 1. 102 obs</p>

Yarrameedie land system (W) 519 km² (0.60% of survey area)

Land type: 3; Pastoral potential: low.

Undulating stony interfluvies, drainage floors and pediment (foothill) plains below major ranges of crystalline rocks (mainly Weld land system) supporting sparse mulga shrublands.

Geology: Archaean metamorphic rocks with Quaternary colluvium.

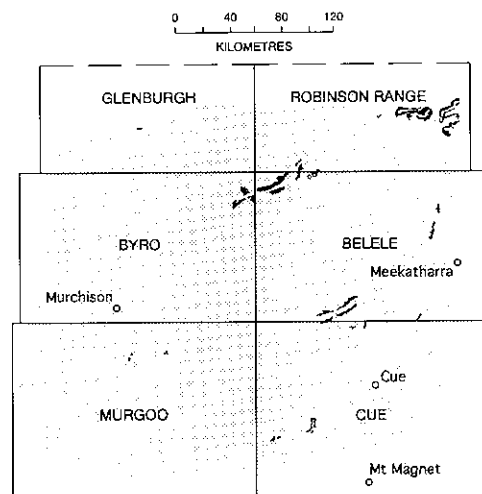
Geomorphology: Erosional surfaces; piedmont slopes and plains; mainly 2 to 4 km wide, parallel with major ranges, heavily mantled by mixed pebbles and gravels; higher parts consist of spurs and stony interfluvial slopes dissected by often fairly closely spaced parallel incised drainage lines leading to narrow drainage floors, spreading into minor alluvial tracts downslope; overall relief mainly 5 to 20 m.

Vegetation and pastoral use: Stony Mulga Mixed Shrubland and Creekline Shrubland; palatable perennials are naturally sparse on interfluvies and plains; overgrazing of more accessible parts has reduced pastoral value, particularly on alluvial fans and drainage tracts; major units support useful annual forbs and grasses in good seasons; units 3 and 4 show mild susceptibility to accelerated erosion when degraded.

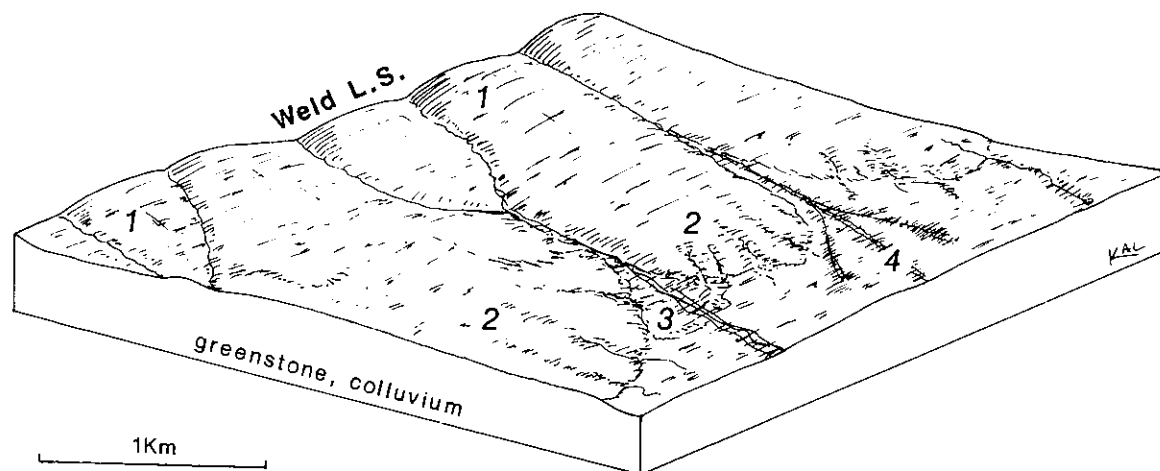
Estimated carrying capacity, good condition: 20 ha/dse.

Range condition summary (98 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
96	4	0	0	22	44	34



- Unit: 1. Footslopes and hill spurs.
 2. Stony plains and interfluvies.
 3. Alluvial fans.
 4. Drainage floors and creeklines.



Yarrameedie I.s.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 1: Footslopes and hill spurs (40%)</p> <p>Concave or convex inclines and piedmont tracts with slopes 1-3%, occasional low rounded crests to 10 m relief with total relief generally < 20 m. All surfaces densely to very densely strewn with ironstone, greenstone, gabbro or quartz pebbles. Soils are dark red earthy sands, shallow red earths or occasional duplexes, overlying various metamorphic parent materials < 50 cm deep; pH 5.0-7.0 with neutral to acidic reaction trends. Principal profile forms: Dr2.12, Uc5.21, Um5.51.</p>	<p>Very scattered to scattered (PFC < 20%) mixed <i>Acacia</i> shrublands. Trees and tall shrubs (2-6 m): <i>A. aneura</i>, <i>A. burkittii</i>, <i>A. aff. citrinoviridis</i>, <i>A. pruinocarpa</i>, <i>A. ramulosa</i>, <i>A. tetragonophylla</i>, <i>Canthium latifolia</i>, <i>Santalum spicatum</i>. Mid shrubs (1-2 m): <i>A. sp. MRS399</i>, <i>A. tetragonophylla</i>, <i>Cassia pruinosa</i>, <i>C. helmsii</i>, <i>C. nemophila</i>, <i>C. oligophylla</i>, <i>C. sturtii</i>, <i>Eremophila macmillaniana</i>, <i>E. cuneifolia</i>, <i>E. latrobei</i>, <i>E. georgei</i>, <i>E. oppositifolia</i>, <i>E. forrestii</i>, <i>Dodonaea pinifolia</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>P. rotundifolius</i>, <i>P. schwartzii</i>, <i>Thryptomene</i> sp., <i>E. compacta</i>, <i>Maireana georgei</i>, <i>M. planifolia</i>, <i>Solanum ashbyi</i>, <i>S. lasiophyllum</i>, <i>Scaevola spinescens</i>, <i>S. tomentosa</i>, <i>Sida calyxhymenia</i>, <i>S. sp.</i>, <i>S. chrysiopetala</i>. Perennial grasses: <i>Eragrostis lanipes</i>, <i>Eriachne mucronata</i>, <i>Neurachne</i> sp.</p>	<p>3 inventory sites and traversed</p> <p>Vegetation type: Stony Mulga Mixed Shrubland. Palatable perennials include: <i>Maireana</i> spp., <i>Ptilotus</i> spp., <i>Sida</i> spp., <i>Scaevola</i> spp., <i>Eremophila forrestii</i>, <i>E. latrobei</i>, <i>E. compacta</i>, <i>Tribulus platypterus</i>, <i>Eriachne mucronata</i>. Pastoral use limitations: None with controlled grazing. Vegetation condition %: VG/G 30, F 43, P/NP 27. 40 obs.</p>
<p>Unit 2: Stony plains and interfluvies (50%)</p> <p>Broad, gently sloping plains and slightly rounded interfluvies to 1 km wide with slopes < 1%, dissected by alluvial fans and associated drainage lines; lower plains are typically almost flat and carry moderately dense mantles of mixed pebbles and gravels, with small tracts of laterite, hardpan and low sandy banks. Soils are dark red or reddish-brown earthy sands to hardpan clay loams over various substrates (laterite, hardpan or metamorphic colluvium) < 50 cm deep; pH 5.5-7.0 with a mainly neutral reaction trend. Principal profile forms: Uc5.21, Um5.31.</p>	<p>Very scattered to scattered (PFC < 20%) mixed <i>Acacia</i> shrublands dominated by stunted <i>A. aneura</i>. Trees and tall shrubs (2-6 m): <i>A. aneura</i>, <i>A. pruinocarpa</i>, <i>A. quadrimarginea</i>, <i>A. tetragonophylla</i>, <i>Canthium latifolium</i>, <i>Hakea preissii</i>. Mid shrubs (1-2 m): <i>A. quadrimarginea</i>, <i>A. sp. P41</i>, <i>Thryptomene</i> sp., <i>Grevillea didymobotrya</i>, <i>Eremophila latrobei</i>, <i>E. forrestii</i>, <i>Cassia sturtii</i>. Low shrubs (< 1 m): <i>C. helmsii</i>, <i>E. spathulata</i>, <i>Ptilotus rotundifolius</i>, <i>P. obovatus</i>, <i>P. schwartzii</i>, <i>Solanum lasiophyllum</i>, <i>Maireana planifolia</i>. Perennial grasses: <i>Eragrostis lanipes</i>, <i>Eriachne helmsii</i>, <i>Monachather paradoxa</i>.</p>	<p>2 inventory sites, 8 condition sites and traversed</p> <p>Vegetation condition: Stony Mulga Mixed Shrubland. Palatable perennials include: <i>Eremophila forrestii</i>, <i>E. latrobei</i>, <i>Ptilotus</i> spp., <i>Maireana</i> spp., <i>Eragrostis lanipes</i>, <i>Monachather paradoxa</i>. Pastoral use limitations: Sparse perennials but a high annual pasture component following good seasons. Vegetation condition %: VG/G 16, F 37, P/NP 47. 38 obs.</p>
<p>Unit 3: Alluvial fans (5%)</p> <p>Gently sloping tracts of shallow sandy and gravelly surfaced alluvium diverging from narrow creeks as slope decreases; average grades are < 1%. Usually strewn with an ironstone, quartz or mixed gravel mantling. Soils are dark red earthy sands up to 1 m deep over various substrates. pH 6.5-7.0 with a neutral trend. Principal profile forms: Uc5.21, Um5.52.</p>	<p>Very scattered to scattered (PFC < 20%) mixed <i>Acacia</i> shrublands, with occasional groves of closer shrubland. Trees and tall shrublands (> 2 m): <i>A. aneura</i>, <i>A. ramulosa</i>, <i>A. cuthbertsonii</i>, <i>A. pruinocarpa</i>. Mid shrubs (1-2 m): <i>Cassia desolata</i>, <i>C. helmsii</i>, <i>Eremophila forrestii</i>, <i>E. aff. granitica</i>, <i>E. fraseri</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>C. aff. chatelainiana</i>, <i>C. helmsii</i>, <i>Solanum lasiophyllum</i>. Perennial grasses: <i>Eragrostis eriopoda</i>, <i>E. lanipes</i>, <i>Eriachne helmsii</i>, <i>Monachather paradoxa</i>.</p>	<p>2 inventory sites, 1 condition site and traversed</p> <p>Vegetation type: Stony Mulga Mixed Shrubland. Palatable perennials include: <i>Eremophila forrestii</i>, <i>Cassia aff. chatelainiana</i>, <i>Ptilotus obovatus</i>, <i>Eragrostis</i> spp., <i>Monachather paradoxa</i>. Pastoral use limitations: Mildly susceptible to accelerated erosion where degraded.</p>

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
<p>Unit 4: Drainage floors and creeklines (5%)</p> <p>Drainage lines originating as creeklines in neighbouring elevated systems such as Weld, Farmer and Peak Hill; usually < 30 m wide and parallel on upper slopes, broadening to > 100 m and coalescing lower in the topography. Generally with minor incised channels, but mainly becoming disintegrated at alluvial fans or above wash plain systems. Soils are variable from shallow clayey sands upslope to deeper (up to 1 m) sandy clay loams.</p>	<p>Scattered to moderately close (PFC 10-30%) tall shrublands dominated by <i>Acacia aneura</i>. Trees and tall shrubs (> 2 m): <i>A. aneura</i>, <i>A. craspedocarpa</i>, <i>A. tetragonophylla</i>, <i>A. cuthbertsonii</i>, <i>A. pruinocarpa</i>. Mid shrubs (1-2 m): <i>Cassia desolata</i>, <i>C. helmsii</i>, <i>Eremophila fraseri</i>, <i>E. linearis</i>. Low shrubs (< 1 m): <i>Ptilotus obovatus</i>, <i>C. helmsii</i>, <i>Sida</i> spp., <i>Rhagodia eremaea</i>, <i>Solanum lasiophyllum</i>. Perennial grass (sparse): <i>Chrysopogon fallax</i>.</p>	<p>Vegetation type: Creekline Shrubland. Palatable perennials include: <i>Ptilotus obovatus</i>, <i>Sida</i> spp., <i>Rhagodia eremaea</i>, <i>Monachather paradoxa</i>, <i>Chrysopogon fallax</i>. Pastoral use limitations: None with controlled grazing.</p>

Traversed

Yewin land system 316 km² (0.37% of survey area)

Land type: 16; Pastoral potential: high.

Mainly flat saline floodplains on the Greenough and Sanford Rivers supporting halophytic shrublands dominated by samphire, saltbush, snakewood and spiny snakewood.

Geology: Quaternary alluvium, aeolian sand and kopi, with minor Tertiary calcrete.

Geomorphology: Depositional surfaces; saline riverine plains mainly 3 to 6 km wide, flanked by wash plains, with minor calcrete rises and featuring isolated low platforms of kopi; major alluvial plains subject to near-annual flooding with many features of through and internal drainage: variable swampy drainage foci and occasional gilgaied floors; many small, anastomosing drainage tracts and claypans forming on active flood plains adjacent to major channels. Overall relief mostly < 5 m.

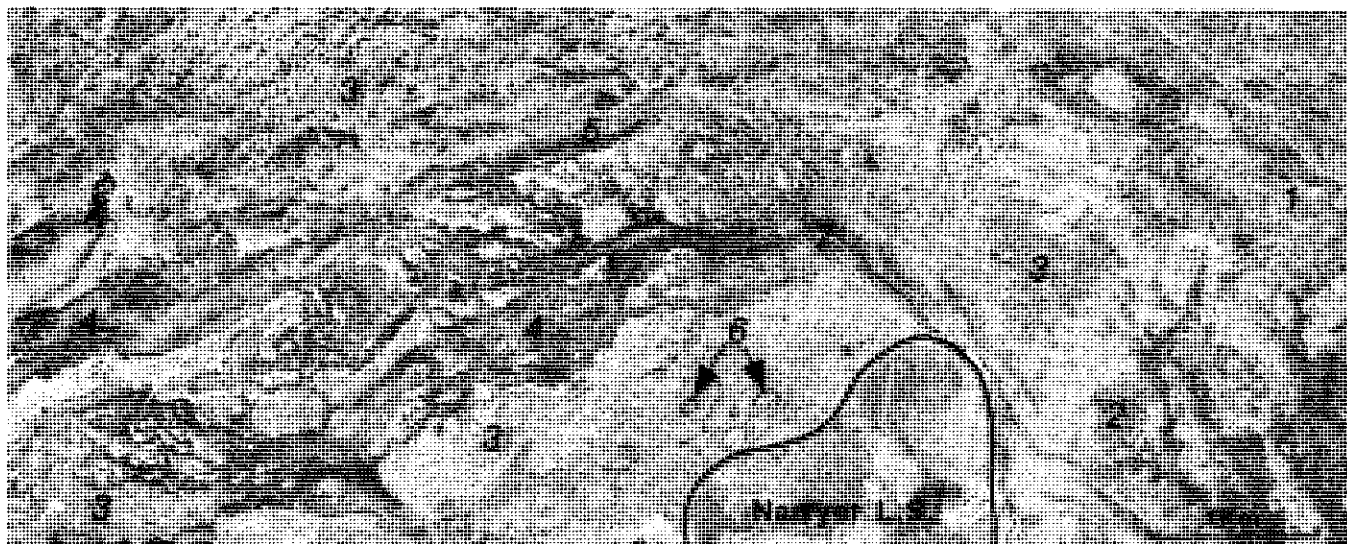
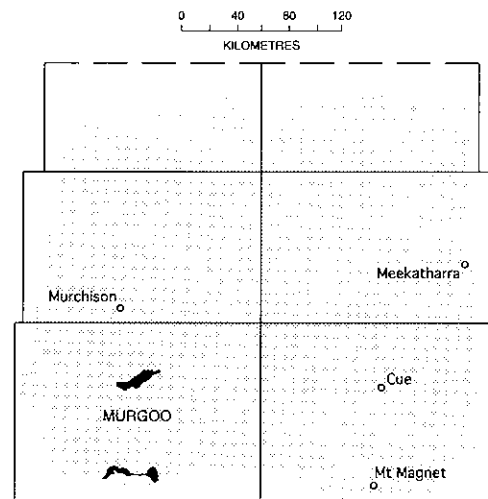
Vegetation and pastoral use: Extensive Bluebush and Saltbush Shrubland with very highly saline Samphire Shrubland; in good condition, this system has the capacity to sustain year-round grazing of stock, provided that fresh quality water is accessible. Alluvial plains (unit 3) in good condition support bladder saltbush and flood plains feature bluebush-saltbush-sage associations; both are susceptible (particularly unit 3) to increases in unpalatable tall shrubs and accelerated erosion when degraded.

Estimated carrying capacity, good condition: 7 ha/dse.

Range condition summary (70 traverse observations):

(a) Erosion status (%)				(b) Vegetation condition (%)		
Nil	Min.	Mod.	Sev.	Good	Fair	Poor
68	21	10	1	48	24	28

- Unit: 1. Calcrete platforms.
 2. Kopi banks.
 3. Alluvial plains.
 4. Flood plains.
 5. Saline alluvial plains.
 6. Swamps and claypans.
 7. Drainage tracts and channels.



Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 1: Calcrete platforms (2%) Minor tracts of elevated calcrete residuals up to 2 m high and extending to 2 km long and < 1 km wide; usually located towards margins of system; almost flat plains, lightly to moderately strewn with calcrete rubble. Soils are calcareous yellowish red earths < 1 m deep overlying calcareous pan; pH 9.0 with an alkaline trend. Principal profile form: Gc1.12.	Scattered (PFC 10-20%) tall shrublands dominated by <i>Acacia tysonii</i> and <i>Atriplex bunburyana</i> . Trees and tall shrubs (2-6 m): <i>Grevillea</i> aff. <i>stenobotrya</i> , <i>A. tysonii</i> , <i>A. burkittii</i> , <i>Pittosporum phylliraeoides</i> . Mid shrubs (1-2 m): <i>Cassia nemophila</i> , <i>C. spp.</i> , <i>Eremophila miniata</i> . Low shrubs (< 1 m): <i>Atriplex bunburyana</i> , <i>Olearia pimeleoides</i> , <i>Sclerolaena</i> spp.	1 inventory site and traversed Vegetation type: Saltbush Shrubland. Palatable perennials include: <i>Atriplex bunburyana</i> , <i>Maireana</i> spp., <i>Enchylaena tomentosa</i> , <i>Eragrostis</i> spp. Pastoral use limitations: Preferentially grazed unit, susceptible to vegetation degradation but not normally susceptible to accelerated erosion.
Unit 2: Kopi banks (1%) Occasional expanses of slightly elevated gypseous mounds (to 1 m high) between saline plains; often highly saline with areas of dense surface crusting over powdery kopi. Total profile depth is often greater than 1 m, mostly without true soil profile development; pH 9.5 with a strongly alkaline trend.	Very scattered (PFC < 10%) low halophyte shrublands dominated by <i>Lawrenia chrysoderma</i> and <i>Halosarcia</i> spp. Tall and mid shrubs (sparse > 1 m): <i>Acacia tysonii</i> , <i>A. victoriae</i> . Low shrubs (< 1 m): <i>L. chrysoderma</i> , <i>Halosarcia halocnemoides</i> , <i>H. pergranulata</i> , <i>Lycium australe</i> .	1 inventory site, 1 condition site and traversed Vegetation type: Samphire Shrubland. Palatable perennials include: <i>Lawrenia chrysoderma</i> , <i>Lycium australe</i> . Pastoral use limitations: High salinity content of perennial species.
Unit 3: Alluvial plains (50%) Extensive, flat plains flanking and slightly higher than major flood plains (units 4-7), slopes mostly negligible (< 0.3%) with little relief except for occasional low sandy banks up to 1 m high or wind-blown hummocks around plant bases on degraded parts. Soils are red duplex types, clayey coarse sand to sandy loam over sandy to medium clays, locally gypsiferous, < 1 m deep often overlying hardpan; pH 6.5-7.0 with a neutral to alkaline trend. Principal profile forms: Dr1.13, Dr1.53, Dr1.56, Dr2.52.	Scattered (PFC 10-20%) low shrublands dominated by <i>Atriplex vesicaria</i> or <i>Maireana pyramidata</i> . Trees and tall shrubs (2-8 m): <i>Acacia</i> sp. P41 'spiny snakewood', <i>A. victoriae</i> , <i>A. sclerosperma</i> , <i>A. xiphophylla</i> , <i>A. microcalyx</i> , <i>Hakea preissii</i> , <i>Pittosporum phylliraeoides</i> . Mid shrubs (1-2 m): <i>A. sp. P41</i> , <i>A. microcalyx</i> , <i>Cassia phyllodinea</i> . Low shrubs (< 1 m): <i>Atriplex vesicaria</i> , <i>A. bunburyana</i> , <i>Maireana amoena</i> , <i>M. atkinsiana</i> , <i>M. pyramidata</i> , <i>M. tomentosa</i> , <i>M. triptera</i> , <i>Enchylaena tomentosa</i> , <i>Rhagodia</i> sp., <i>Halosarcia indica</i> , <i>H. pergranulata</i> , <i>H. doleiformis</i> , <i>Frankenia</i> sp., <i>Gunniopsis quadrifida</i> , <i>Carpobrotus</i> aff. <i>virescens</i> , <i>Sida</i> sp., <i>Ptilotus obovatus</i> , <i>Solanum lasiophyllum</i> , <i>Scaevola spinescens</i> , <i>Eremophila maculata</i> , <i>Zygophyllum</i> sp.	4 inventory sites, 4 condition sites and traversed Vegetation type: Bluebush or Saltbush Shrubland. Highly productive perennial pastures providing excellent drought reserves with a significant annual component in good seasons. Palatable perennials include: <i>Atriplex</i> spp., <i>Maireana atkinsiana</i> , <i>M. pyramidata</i> , <i>Enchylaena tomentosa</i> , <i>Rhagodia</i> sp., <i>Ptilotus obovatus</i> , <i>Frankenia</i> spp., <i>Eremophila maculata</i> . Pastoral use limitations: Moderately to highly susceptible to accelerated erosion where perennial vegetation is degraded; less invaded by unpalatable shrubs than other equivalent units of Beringarra and Roderick land systems, but presumably still susceptible. Vegetation condition %: VG/G 41, F 32, P/P 27. Erosion incidence %: min 27, mod 12, sev 2. 41 obs.
Unit 4: Flood plains (20%) Active flood plains adjacent to major watercourses; slightly below unit 3; flat plains with widespread patterning of recently redistributing surface deposits. Soils are brown light clays, with or without sandy surfaces, to 1 m deep; pH 7.0-8.0 with neutral to alkaline reaction trends. Principal profile forms: Uf6.53, Uf6.71.	Very scattered to moderately close (PFC < 30%) low chenopod shrublands with a sparse mid shrub layer of <i>Acacia</i> spp. Tall and mid shrubs (> 1 m): <i>Acacia</i> sp. P41, <i>A. tetragonophylla</i> , <i>A. victoriae</i> , <i>A. microcalyx</i> , <i>Hakea arida</i> , <i>Cratystylis subspinescens</i> , <i>Eremophila oldfieldii</i> , <i>Melaleuca</i> sp. Low shrubs (< 1 m): <i>Atriplex amnicola</i> , <i>A. bunburyana</i> , <i>A. aff. paludosa</i> , <i>Halosarcia indica</i> , <i>Frankenia</i> sp., <i>C. subspinescens</i> , <i>Ptilotus divaricatus</i> , <i>Maireana pyramidata</i> , <i>M. triptera</i> . Perennial grass: <i>Stipa elegantissima</i> .	2 inventory sites, 2 condition sites and traversed Vegetation type: Saltbush or Mixed Halophyte Shrubland. Palatable perennials include: <i>Atriplex</i> spp., <i>Maireana</i> spp., <i>Cratystylis subspinescens</i> . Pastoral use limitations: Moderately susceptible to accelerated erosion where degraded.

Landform and soils	Vegetation : formations and major species	Comments and condition indicators
Unit 5: Saline alluvial plains (20%)		1 condition site and traversed
<p>Tracts of low-lying and strongly saline flat alluvium between unit 4 and 7; usually with only very sluggish through flow. Soils are similar to unit 3 but more saline and with salt or gypsum crystals in the upper profile and with a highly alkaline reaction trend; also beds of mud with crystalline gypsum in areas prone to prolonged waterlogging.</p>	<p>Very scattered (PFC < 10%) low shrublands dominated by <i>Halosarcia</i> spp. with fringing communities of <i>Eremophila pterocarpa</i>, <i>Melaleuca</i> spp., <i>Maireana atkinsiana</i>, <i>Frankenia</i> spp., <i>Atriplex</i> spp.</p>	<p>Vegetation type: Samphire Shrubland. Palatable perennials include: <i>Frankenia</i> spp. Pastoral use limitations: High salinity levels of predominant perennial species, seasonal flooding and waterlogging.</p>
Unit 6: Swamps and claypans (2%)		3 inventory sites and traversed
<p>a) Isolated, discrete swampy drainage foci < 250 m in diameter, located throughout system but more common on alluvial plains and flood plains (units 3 and 4). b) More extensive, irregular claypans up to 1 km long and 500 m wide with sluggish through drainage patterns and (locally) gilgai surfaces. Soils are yellowish red or brown variable to clay loams over light and medium clays; or unconsolidated juvenile coarse sandy clay loams; < 1 m deep; pH 6.0-9.5 with a variable trend. Principal profile form: Uf6.53 and alluvial soils.</p>	<p>a) Moderately close to close (PFC 20-50%) low shrublands dominated by <i>Atriplex amnicola</i> or <i>Halosarcia</i> spp. with dense fringes of <i>Hakea preissii</i> or <i>Melaleuca</i> sp. Trees and tall shrubs (> 1 m): <i>Acacia victoriae</i>, <i>A. sclerosperma</i>, <i>A. xiphophylla</i>, <i>A. tetragonophylla</i>, <i>A. microcalyx</i>, <i>A. ligulata</i>, <i>H. preissii</i>, <i>Pittosporum phylliraeoides</i>, <i>Eremophila laanii</i>, <i>E. longifolia</i>, <i>E. paniculata</i>. Low shrubs (< 1 m): <i>Atriplex amnicola</i>, <i>A. bunburyana</i>, <i>Scaevola spinescens</i>, <i>Halosarcia indica</i>, <i>H. doleiformis</i>, <i>Cratystylis subspinescens</i>. Perennial grasses: <i>Stipa elegantissima</i>, <i>Eragrostis dielsii</i>. b) Scattered (PFC 10-20%) woodland dominated by <i>Acacia aneura</i> or <i>Hakea preissii</i>. Trees (to 8 m): <i>A. aneura</i>, <i>Pittosporum phylliraeoides</i>. Tall shrubs (> 2 m): <i>Hakea preissii</i>, <i>A. tetragonophylla</i>, <i>Santalum spicatum</i>. Mid shrubs (1-2 m): <i>H. preissii</i>, <i>Melaleuca uncinata</i>, <i>Mirbelia spinosa</i>. Low shrubs (< 1 m): <i>Rhagodia eremaea</i>, <i>Enchylaena tomentosa</i>, <i>Chenopodium gaudichaudianum</i>, <i>Solanum orbiculatum</i>, <i>S. lasiophyllum</i>. Perennial grasses: <i>Eriachne benthamii</i>, <i>E. flaccida</i>, <i>Enteropogon acicularis</i>.</p>	<p>Vegetation type: Saltbush Shrubland. Palatable perennials include: <i>Atriplex</i> spp., <i>Cratystylis subspinescens</i>, <i>Enchylaena tomentosa</i>, <i>Scaevola spinescens</i>, <i>Stipa elegantissima</i>, <i>Eragrostis dielsii</i>, <i>Eriachne</i> spp., <i>Rhagodia eremaea</i>, <i>Chenopodium gaudichaudianum</i>. Pastoral use limitations: Seasonal waterlogging; otherwise none.</p>
Unit 7: Drainage tracts and channels (5%)		2 inventory sites and traversed
<p>Drainage tracts up to 1 km wide with channels of Greenough River up to 100 m wide and sharply incised into hardpan or calcrete and carrying bedloads of coarse sand, calcrete and rubble. Frequent meanders and associated deposition around ox bows; also channels dispersing river flows onto flood plains. Soils in drainage tracts and channel margins are brown or yellowish red duplexes or light clays overlying hardpan or calcrete up to 1 m deep; pH 7.0-8.0 with an alkaline trend. Principal profile forms: Dr2.5, Uf6.71 and alluvial soils.</p>	<p>Moderately close (PFC 30-50%) tall shrublands dominated by <i>Acacia tysonii</i>, <i>A. victoriae</i> or <i>Eremophila miniata</i>. Trees and tall shrubs (> 2 m): <i>A. tysonii</i>, <i>A. victoriae</i>, <i>A. xiphophylla</i>, <i>A. tetragonophylla</i>, <i>A. sclerosperma</i>, <i>Hakea preissii</i>, <i>E. miniata</i>, <i>Exocarpus aphyllus</i>. Mid shrubs (1-2 m): <i>A. sp. P41</i>, <i>A. tysonii</i>, <i>Cassia phyllodinea</i>, <i>Scaevola spinescens</i>. Low shrubs (< 1 m): <i>Atriplex amnicola</i>, <i>A. vesicaria</i>, <i>A. bunburyana</i>, <i>Rhagodia drummondii</i>, <i>R. eremaea</i>, <i>Enchylaena tomentosa</i>, <i>Ptilotus divaricatus</i>, <i>P. obovatus</i>, <i>Maireana pyramidata</i>, <i>Gunnipopsis quadrifidum</i>, <i>Halosarcia</i> spp., <i>Cratystylis subspinescens</i>, <i>Solanum orbiculatum</i>, <i>Zygophyllum</i> sp.</p>	<p>Vegetation type: Saltbush Shrubland. Palatable perennials include: <i>Atriplex</i> spp., <i>Scaevola spinescens</i>, <i>Rhagodia</i> spp., <i>Enchylaena tomentosa</i>, <i>Ptilotus</i> spp., <i>Maireana pyramidata</i>, <i>Cratystylis subspinescens</i>. Pastoral use limitations: Exposed and unconsolidated soils on channel margins and banks are susceptible to accelerated erosion.</p>

Landform development and soils

Introduction

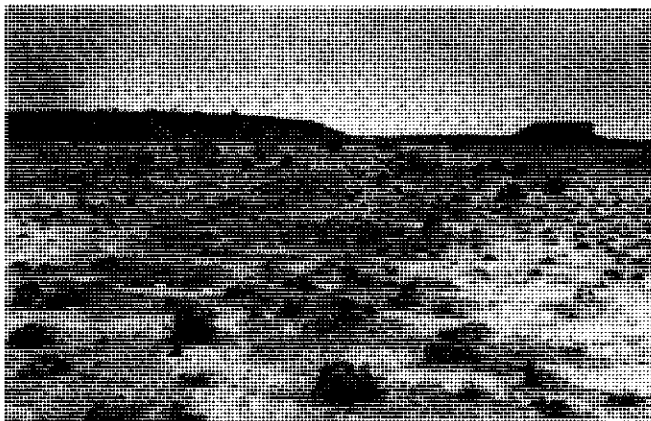
The soils of the Murchison have been mapped on a broad scale (1:2,000,000) by Bettenay *et al.* (1967). The soils of the north-east of the area were previously described for the 1:250,000 scale map sheet of Belele by Litchfield as part of a larger study of the lands of the Wiluna-Meekatharra area (Mabbutt *et al.* 1963).

Teakle (1936), Stephens (1962) and Bettenay and Churchward (1974) described one of the unique widespread features of this region, the red-brown siliceous hardpan (locally known as Murchison cement) underlying many soils, especially on broad wash plains. Other features such as the dominant red soil colour, a paucity of organic matter, the highly patterned distribution of nutrients within a small area and shallow depth are typical of soils in this and other parts of the arid zone of Australia.

Landform development

The survey area exhibits a mainly Quaternary landscape underlain by ancient igneous and metamorphic rocks first described in detail by Jutson (1934). Mabbutt (1963) hypothesised geological processes of uplift and dissection of an old plateau in Tertiary times, which was characterised by lateritic weathering and the subsequent formation of the present lower plains that Mabbutt called the 'New Plateau'. More recently, Ollier *et al.* (1988), suggest the landscape displays a recurring sequence of Old above New above Old Plateau, showing a saw-tooth cross-section of the land rather than one major undulating landscape feature. This suggests that weathered material was repeatedly deposited into valleys and the relief became inverted so that the alluvium remained as a duricrust capping. Both hypotheses suggest weathering and erosion were the dominant forces leading to the formation of the current landscape. The local existence of tiered remnants of Old Plateau surfaces was confirmed during this survey, lending support to the hypothesis of more than a single Old Plateau surface having been formed.

General stripping of the original landscape has intermittently exposed fresh country rocks of granite, gneiss and greenstone (metamorphosed volcanic rock) which form mainly low hills above colluvial slopes and peneplains. The heavily mantled colluvial pediments with more or less incised drainage lines drain onto broad flat 'wash' plains carrying sheet flow down extremely shallow gradients. The wash plains consist of alluvium partly derived from pallid zone materials of the older lateritic land surface and partly from weathered granite, gneiss and metamorphic rock. Shallow accumulations of surface sand and an extensive underlying hardpan are features of these wash plains. The sandy banks (known locally as wanderrie banks), may be oblong or reticulate and are



Erosional landforms at the margins of 'Old Plateau' surfaces - the distinctive breakaway faces, residuals and footslope plains of the upper units of the Sherwood land system.

normally stable and well vegetated. They may occur regularly or intermittently and are often arranged in water-modified patterns transverse to the direction of the sheet flow.

A siliceous red-brown hardpan occurs throughout much of the Murchison River catchment as an almost continuous cemented layer varying from a few centimetres to 30 m in depth. The pan usually lies below the soil at a depth of 70 cm or less with occasional minor outcropping and is commonly exposed along drainage channels.

Sheet drainage is terminated partly by infiltration and partly by discharge at or near major tributaries and channels of the Murchison, Sanford and Roderick Rivers (and more locally along the Wooramel and Greenough Rivers). The channels of the major tributaries may be up to 200 m wide but often are less than 100 m, while the associated flood plains are normally 3-10 km wide. These riverine areas are generally saline to some extent and often contain exposed calcreted valley fill existing as restricted raised plains dissected by sluggish drainage lines. Part of the survey area drains into salt lakes such as Lake Austin in the south-east, Lake Anneen in the north-east and the lakes on Muggon station in the west.



One example of the most widespread geological formations in the region: exposed red-brown hardpan overlying granite, Woogalong Brook, Jingemarra station.

Deeply dissected Permian sediments of sandstone and siltstone occur on the western margin of the survey area. This landscape is dominated by gently undulating stony plains below breakaways with remnant low hills and plateaux with up to 30 m relief. The upland plateaux are often capped with a duricrust of silcrete. The northern portion of the Permian landscape drains to the Wooramel River, while the southern portion is associated with a lacustrine system. This palaeodrainage links the present Wooramel River headwaters with the Murchison River (Denman *et al.* 1985). Drainage is very sluggish with many local foci which are often saline. The Permian and lacustrine systems are closely associated with extensive areas of aeolian sand sheet. The sand sheet occurs as flat or gently undulating plains with occasional linear dunes and no surface drainage. This is essentially an outlying section of the vast Victoria Sandplain (Condon 1967) which dominates the landscape further west.

Soils

The method of soil sampling used during the survey and the data collected are described in the 'Survey methods' section of the report. The techniques and standards used were those given in the Australian Soil and Land Survey Field Handbook (McDonald *et al.* 1984) and Northcote (1979). The data collected enabled Northcote's key to rank soils into Principal Profile Forms (PPF's).

Soil classification is a systematic arrangement of soils on the basis of similarities and differences in their morphological features. Soils are generally composed of three major layers designated A, B and C horizons. The A and B horizons are layers that have been modified by weathering and soil development. The C horizon is weathering parent material. Occasionally D horizons occur. These are not related to the soil forming processes of the overlying soil (e.g. red-brown hardpan). Northcote's key is based on observable soil profile features and uses alpha-numeric coding system to identify classes. The first division is based on texture variation within the soil profile. Soils are mostly classified as one of three types - uniform (U), gradational (G) or duplex (D).

Uniform soils show little, if any, change in soil texture throughout the profile. These soils are further classified as either coarse, medium or fine textures. A uniform coarse profile is typically a sand; a uniform medium profile a loam and a uniform fine profile is clay throughout.

Gradational soils show a gradual increase in clay content throughout the depth of the soil profile. Further classification is based on the presence or absence of calcium carbonate (lime).

Duplex soils show a sharp textural change between the A and B horizons such as a coarse texture (e.g. sand) overlying a fine texture (e.g. clay). Duplex soils are further classified on colour, surface characteristics, soil reaction trends and structure.

Soil profiles sharing similar characteristics have been combined to create soil groups. These soil groups are used for soil descriptions throughout the text.

Twelve major soil groups were identified in the survey area. Sorted primarily on soil profile development, the soil groups are, in part, similar to those of Stace *et al.* (1968). Soil phases of Great Soil Groups have been introduced to differentiate the soils according to their lithology or profile development. The soils range from poorly sorted river sands to well structured deep cracking clays.

Alluvial (juvenile) soils

These are weakly or undifferentiated soils formed in recent alluvium. They occur in or immediately adjacent to major and minor rivers or flow lines. These sediments may have many layers of coarse loose sand, clayey sand or silty sand. Layers containing river pebbles are visible on exposed creek banks. Depth is variable, but where it is less than 1 m, the soil is often underlain by rock or hardpan which, within drainage lines on occasions has a thin calcrete veneer. Fluvial sediments are often found on levee banks associated with the larger flow lines. They may be no more than poorly sorted coarse sands, depending on catchment size and lithology. Catchments with metamorphic lithology tend to produce finer sediments than granitic based catchments where quartz sand predominates. Alluvial soils are often called Juvenile soils, they occur in lake beds, drainage foci or other low lying areas receiving major run-on.

At drainage channels these soils are mostly weakly acidic to neutral (pH 6.0-7.5) and are non-saline. Saline varieties occur in areas of calcreted valleys, of the Mileura, Cunyu and Beringarra land systems. Soil colour varies from dark red (2.5YR 3/6) to strong brown (7.5YR 4/6).

These soils generally support vegetation on the stable levee banks and floodplains but only occasionally in the river channels, indicating the impact of intermittent river flows rather than a reflection on soil quality. These soils cannot be classified within the Northcote key.

Solonchaks

Solonchaks are highly saline. They occur in lake beds, on gypsiferous plains, in some drainage flats and at terminated drainages. Solonchaks are stone-free and very shallow (often less than 30 cm). Textures range from clayey sands to clay loams often overlying gypsum or cemented carbonates. Soil colour ranges from strong brown (7.5YR 4/6) to dark red (2.5YR 3/6). Some Solonchaks are characterised by a surface crusted with salt, showing polygonal cracking or exhibit a soft, loose, powdery surface horizon with visible salt crystals.

With high salinity and susceptibility to prolonged waterlogging, these soils support little or no vegetation. Away from lake beds, the less saline lake

margins support salt tolerant vegetation such as samphire and saltbush. The main Northcote's Principal Profile Forms are Dr1, Dr4 and Uf1.

Gypsiferous sediments have been incorporated into this soil group. They occur in gypsiferous muds on lake beds or are pure gypsum (calcium sulphate) dunes which are formed adjacent to some major lake beds. The dunes may be up to 5 m high. They have a crusted uneven surface which is white (10YR 8/2) to yellow (10YR 7/6). Vegetation is sparse. These soils cannot be keyed out sufficiently within the Northcote key.

Lithosols - skeletal phase

These soils are very shallow and overlie weathered parent rock. They are formed directly from surrounding rock on steep hill slopes, and on stripped surfaces. Soil properties vary according to the parent rock. Skeletal soils of the ranges and inaccessible hill slopes consisting of metamorphic rock are often very shallow (< 20 cm), occurring as small isolated pockets in between outcrops of parent rock. They have a fine sandy loam to clay loam texture and contain rock fragments throughout the profile. The soil reaction is always acidic (pH 5.0-6.5) and soil colour varies from dark red to strong brown (2.5YR 3/6 to 7.5YR 4/6) with minor local variations.

Skeletal soils on breakaways and granite are predominantly coarse quartz sand, the remnant compound of the parent material that most resists weathering. The coarse sand forms loose very shallow (< 10 cm) pockets supporting little vegetation. The sands are acidic (pH 5.0-6.0), dark red (2.5YR 3/6) and generally have little or no surface crusting.

The Northcote Principal Profile Form is mainly Uc1.43 and Um1.43 (sandy loams to clay loams).

Lithosols - stony phase

These soils are shallow and stony occurring on elevated and sloping positions within the landscape where soil accumulation is small such as on hill crests, ridges, stony interfluvies and upper undulating plains. The soils are shallow (rarely exceeding 30 cm), containing abundant coarse rock fragments throughout the profile and overlie acidic metamorphic rocks or occasional duricrusts of silcrete or ferruginous gravel. Soil surfaces have a mantle of rounded quartz and mixed metamorphic stones and boulders. Textures are usually fine sandy loam but may range from clayey sand to loam. Soil colour varies between dark red (2.5YR 3/6) and dark brown (7.5YR 3/4). The soil reaction is acidic to neutral (pH 5.5-7.0).

The main Northcote PPF's with some stony varieties are Uc1.43, Um1.41 and Um1.43.

Earthy sands

These are one of the most frequently occurring soil groups in the study area. They are characterised by a uniform texture profile of clayey sand to light sandy loam with a prominent quartz fraction. They are weakly coherent, especially when dry, contain little, if any, organic matter below the surface and are porous, with an earthy (when moist) to sandy fabric (when dry). They are transitional to siliceous sands. They are dark red (2.5YR 3/6) to red (2.5YR 4/8) and the soil reaction is weakly acidic to neutral (pH 5.5-7.0).

The earthy sands occur as sand banks or sand sheets. The sand banks are found as superficial deposits often running transverse to the direction of overland water flow. They are called wanderie banks, and are often about 50 m wide and 200 m long and usually over one metre deep overlying red-brown hardpan. As sand sheets and sandplains, the earthy sands are possibly deeply weathered ancient laterite profiles, with aeolian modification. On the south-west margin of the survey area the sand colour is yellowish red (5YR 5/6) occasionally overlying lateritic gravels, yet other features such as fabric and consistency remain the same.

The earthy sands are free draining and have a very low salt content (less than 0.02%) (Mabbutt *et al.* 1963). Analyses of two soil profiles suggest very low organic carbon (0.18%), phosphorus (2 ppm), total nitrogen (180 ppm) and potassium (110 ppm).

The main Northcote PPF is Uc5.21.

Morphological description of an earthy sand soil

Land system: Belele
Land unit: Sandy bank overlying hardpan
Principal profile form: Uc5.21

Horizon	Depth (cm)	Description
A/C	0-90	Dark red (2.5YR 3/6 moist) clayey sand; earthy fabric, massive structure, moderately weak consistency, 2-5% (2-5 mm) quartz coarse fragments, non-saline, non-calcareous, pH 7.0; abrupt boundary.
D	90+	Red-brown siliceous hardpan.

Siliceous sands - deep phase

These soils occur as large longitudinal dunes (surrounded by extensive sand sheets) or as large red sand dunes, often located around lake margins or large drainage foci. The textures are seldom heavier than a loamy or clayey sand throughout the very deep (over 3 m) profile. The soil reaction is acidic to neutral (pH 5.5-7.5). The dominant colour is dark reddish brown (2.5YR 3/4) to dark red (2.5YR 3/6), with yellower (5YR 4/6) forms occurring on the south-western margin of the area.

The salt content of these soils is very low (less than 0.02%), but where the dunes are adjacent to salt lakes the salt content may reach 0.1%.

The main Northcote PPF is Uc1.23 with some transitional types of Uc5.21.

Morphological description of a typical siliceous sand soil

Land system: Carnegie
Land unit: Lake margin sand dune
Principal profile form: Uc1.23

Horizon	Depth (cm)	Description
A/C	0-100	Red (2.5YR 4/8) to dark red (2.5YR 3/6) sand to clayey sand; single grained, sandy fabric, loose consistency, non-saline, non-calcareous, pH 6.0.

Siliceous sands - shallow granitic phase

These soils are shallow, coarse, gritty red sands, usually found immediately below or adjacent to outcropping granite and breakaways. The texture ranges from loamy coarse sand to coarse sandy loam overlying decomposing granite at a depth that is usually less than 40 cm. The soil reaction is acidic, occasionally neutral (pH 5.5-7.0). Colour ranges from dark red (2.5YR 3/6) to yellowish red (5YR 4/6) and occasionally strong brown (7.5YR 4/6). Partly weathered fragments of granite may be found on the surface and coarse fragments of quartz and partly decomposed granite occur throughout the profile.

The main Northcote PPFs of the shallow phase are Uc5.21, Uc5.11 and Uc1.43.

Morphological description of a shallow granitic siliceous sand.

Land system: Challenge
Land unit: Sandy surfaced plain
Principal profile form: Uc5.21

Horizon	Depth (cm)	Description
A	0-20	Reddish brown (5YR 4/4 moist) clayey coarse sand; sandy fabric, massive, moderately firm consistency, 5-10% quartz coarse fragments (2-5 mm), compacted surface, a surface mantle of 2-10% subrounded quartz (6-20 mm), non-saline, non-calcareous, pH 6.5; abrupt boundary to
B2	20-45	Yellowish red (5YR 4/6 moist) clayey coarse sand; sandy fabric, massive, moderately firm consistency, 2-5% quartz coarse fragments (2-5 mm), 2-5% rounded manganese coarse fragments (2-5 mm) non-saline, non-calcareous, pH 7.0; sharp boundary.
C	45+	Decomposing granite bedrock.

Siliceous sands - deep granitic phase

Immediately below some large granite outcrops, deep coarse sands support a dense band of vegetation. The soil surface is often covered by a dense organic layer derived mainly from leaf litter. Here the soil colour ranges from black (2.5YR 2/0) at the surface to yellow (10YR 8/6) in the lower soil profile, occasionally overlying decomposing granite. These soils are infrequent in the study area.

Gravelly sands and loams

These soils are formed in ferruginous gravel originating from lateritised greenstones or granites.

The shallow forms of this soil are found on low rises, and on stripped surfaces bordering sand plains or crests of the old plateau remnants. They are non-coherent sandy loams or fine sandy loams with fine ironstone lateritic gravels on the surface and throughout the soil profile. Soil depth is limited by cemented duricrust. Soil colour varies from dark red (2.5YR 3/6) to yellowish red (5YR 4/6) to strong brown (7.5YR 4/6). The depth of soil is mainly less than 40 cm, though some deeper forms showing greater soil development may occur.

The deep soils have a similar mantle of fine ironstone pebbles, may have a slightly heavier texture (fine sandy clay loam) and a greater increase in gravel content with depth. They are often over 1 m deep.

Many of these soils have an earthy fabric, are acidic (pH 5.0-6.5), non-saline and non-calcareous.

The main Northcote PPFs are Uc1.43, Uc5.11, Uc5.21, Um1.43 and Um5.51 with some soils containing more than 60% gravel which are keyed out with a KS prefix.

Morphological description of a deep gravelly sand

Land system: Violet
Land unit: Lateritic plain
Principal profile form: Uc5.21

Horizon	Depth (cm)	Description
Veneer	2	Red (2.5YR 4/6 moist) clayey medium sand; earthy fabric, massive, very weak consistency, surface mantle > 50% ferruginous gravels (2-6 mm), firm surface, non-saline, non-calcareous, pH 6.0; sharp boundary to
A1	0-10	Red (2.5YR 4/6 moist) clayey sand; earthy fabric, massive, weak consistency, < 2% ferruginous gravels (2-6 mm), non-saline, non-calcareous, pH 6.0; abrupt boundary to
B21	10-30	Red (2.5YR 4/6 moist) clayey sand; earthy fabric, massive, weak consistency, 5-10% ferruginous gravels (2-6 mm), non-saline, non-calcareous, pH 6.0; clear boundary to
B22	30-60	Red (2.5 YR 4/6 moist) clayey sand; earthy fabric, massive, weak consistency, 10-20% ferruginous gravels (5-10 mm), non-saline, non-calcareous, pH 6.0; abrupt.

Red and brown calcareous soils

These soils are shallow (< 50 cm), soft, highly calcareous sandy loams overlying calcrete and usually occur in valley fills within major drainage flows of river systems. Textures vary from fine sandy loam to light sandy clay loam. The soils are loose and powdery in the dry state and their consistency is still weak when moist. Calcrete rocks, carbonate fragments and soft segregations appear throughout the profile. The soil reaction is highly alkaline (pH > 9.0), colour ranges from red (2.5YR 4/8) to dark yellowish brown (10YR 4/6). The soil surface is firm and occasionally crusted although a more notable feature is the mantle of calcrete fragments and exposed calcrete rock. Analysis for N, P and K of the horizons of two non-saline profiles showed low to moderate nitrogen levels (210-320 ppm), low phosphorus (6-7 ppm) and moderate potassium concentrations (240-300 ppm). Total soluble salt contents are low (0.02-0.03%).

A shallow clayey phase has also been included in this soil group.

The main Northcote PPFs are Gc1.12, Uc1.13 and Uc1.33.

Morphological description of a red calcareous soil

Land system: Mileura
Land unit: Calcrete platform
Principal profile form: Gc1.12

Horizon	Depth (cm)	Description
A11	2	Dark reddish brown (5YR 3/4 moist); loamy sand; earthy fabric; massive; weak consistency; 0-2% calcareous coarse fragments (2-5 mm); saline; highly calcareous and alkaline (pH 9.5); abrupt boundary to
A12	2-10	Yellowish red (5YR 5/8 moist); loamy sand; earthy fabric; massive; weak consistency; 5-10% calcareous coarse fragments (2-5 mm); highly calcareous and alkaline (pH 9.5); clear boundary to
B22	10-45	Yellowish red (5YR 5/6 moist); light sandy clay loam; 10-20% calcareous coarse fragments, (2-10 mm); highly calcareous and alkaline (pH 9.5); clear boundary to
C	45+	Yellowish red (5YR 5/6 moist); sandy clay loam; 20-50% calcareous coarse fragments (10-20 mm); highly calcareous and alkaline (pH 9.5).

Red-brown hardpan soils

The hardpan soils represent the most extensive soil in the region. They have a sandy clay loam texture overlying a red to brown siliceous hardpan at variable depth. The hardpan is believed to have been formed during the Quaternary Period by leaching and eluviation of clay and silica through episodes of periodic saturation caused by flooding and sheet flow. Colluvium derived from laterite profiles has been cemented by silica compounds to form a hardpan, which does not normally soften when wet. It varies in thickness from 3 cm to 30 m.

The shallow phase (< 40 cm) of the hardpan soils are dark red (2.5YR 3/6), weakly acidic to neutral, non-calcareous and non-saline. There are few coarse fragments with minor accumulations of iron and manganese gravels at the base of the soil immediately above the hardpan. The textures range from light sandy clay loam to clay loam with little horizon differentiation. In deeper hardpan soils, horizon differentiation is more evident, with texture becoming finer with depth. Soils within mulga groves and some drainage foci may grade into red earths which are deep, red gradational soils. The surface is protected

mainly by patchy cryptogams and tiny rhizomes of winter growing forbs although some areas are extensively mantled by gravels or pebbles. Chemical analyses of six shallow hardpan soils showed low to moderate nitrogen (250-400 ppm), low organic carbon (0.12-0.42%) and low salt contents (top soil 0.01-0.03%, subsoil 0.01-0.7%).

The Northcote PPFs are Um5.31 and occasionally Gn2.12.

Morphological description of a shallow red-brown hardpan soil

Land system: Yandil
Land unit: Hardpan plain - intergrove
Principal profile form: Um5.31

Horizon	Depth (cm)	Description
A	0-30	Dark red (2.5YR 3/6 moist) sandy clay loam; earthy fabric, massive, moderately firm consistency, 0-2% quartz coarse fragments, hardsetting with extensive cryptogamic crusting, 2-5% fine ironstone gravel mantle, non-saline, non-calcareous, pH 6.5; abrupt boundary.
D	30+	Continuous cemented laminar red to dark red (2.5YR 4/6) siliceous hardpan with manganiferous inclusions.

Morphological description of a typical deep red-brown hardpan soil

Land system: Woodline
Land unit: Hardpan plain
Principal profile form: Um5.31

Horizon	Depth (cm)	Description
A1	0-30	Red (2.5YR 4/6) sandy clay loam; earthy fabric, massive, moderately firm consistency, hardsetting surface with extensive cryptogamic crusting, > 2% quartz coarse fragments, non-saline non-calcareous, pH 7.0; gradual boundary to
B2	30-80	Red (2.5YR 4/6) clay loam; earthy fabric, massive, firm consistency < 2% quartz coarse fragments, 2-10% ferromanganiferous coarse fragments, pH 7.5; abrupt boundary to
D	80+	Continuous strongly cemented laminar red to dark red (2.5YR 4/6) siliceous hardpan with manganiferous inclusions.

Calcareous red earths

Calcareous red earths are essentially deep red earths with carbonates in part of, or throughout the profile. Their textures range from sandy loam and sandy clay loam to light clay. The soils show a trend of increasing amounts of clay and carbonates with depth. The carbonates may appear as coarse fragments or as soft segregations within the massive earthy fabric. There are few (2-5%) carbonate nodules (2-5 mm) in the topsoil increasing in abundance to common (5-10%) in the subsoil. The soil reaction is neutral to mildly alkaline at the surface becoming strongly alkaline at depth.

These soils occur in and adjacent to major creek systems and on or adjacent to large calcrete platforms. Their colour varies from red (2.5YR 3/6) to yellowish red (5YR 4/6) at the surface and becomes reddish yellow (5YR 7/6) at depth (1 m).

The main Northcote PPFs are Gc1.12, Gc1.21 and Gc1.22 and Gc2.22.

Morphological description of a typical calcareous red earth

Land system: Mileura
Land unit: Grove
Principal profile form: Gc1.22

Horizon	Depth (cm)	Description
A1	0-10	Dark reddish brown (5YR 3/2) fine sandy loam; earthy, massive, moderately weak consistency, soft soil surface, highly calcareous, pH 9.0; abrupt boundary to
A3	10-55	Dark reddish brown (5YR 3/4) loam; earthy fabric, massive, moderately weak consistency, highly calcareous, pH 9.0; abrupt boundary to
B21k	55-100+	Yellowish red (5YR 5/8) clay loam; earthy fabric, massive, moderately weak consistency, 0-2% soft calcareous nodules, highly calcareous, pH 9.5; abrupt boundary or
B22ky	55-100+	Yellowish red (5YR 5/8) light clay; earthy fabric massive, moderately firm consistency, 0-2% soft calcareous nodules, highly calcareous, 5-10% very fine gypsum crystals, pH 9.5.

Red earths

The red earths are loamy soils commonly with clay content increasing with depth (gradational soils). This soil group is quite variable, ranging from shallow stony loams to deep alkaline clay loams.

The shallow phase of red earths occur mainly on stony plains, margins of hardpan plains, some hill footslopes and adjacent to drainage channels. The soils are shallow (less than 50 cm) and overly decomposing metamorphic rock or granite and occasionally siliceous hardpan. The textures range from loamy sand and sandy clay loam at the surface to clay loam in the subsoil. Some profiles show increasing clay content with depth while others are uniform throughout, apart from a minor clay accumulation immediately above bedrock. All of these soils have a porous, earthy fabric with few coarse fragments throughout the profile. The soil reaction is weakly acidic to neutral. A stony mantle of mixed metamorphic rocks and quartz fragments is common, and they usually have a firm to hardsetting surface. The soil surface is stable and protected by the stony mantle.

The main Northcote PPFs are Gn2.11, Gn2.12, Um5.41 and Um5.52.

The deep phase of red earths are often found at drainage foci, mulga groves and narrow drainage tracts. The soils are often over one metre deep and

Morphological description of a typical red earth

Land system: Nerramayne
Land unit: Narrow drainage line
Principal profile form: Gn2.12

Horizon	Depth (cm)	Description
A1	0-5	Dark red (2.5YR 3/6) loamy sand; earthy fabric, massive, moderately weak consistency, firm soil surface, 2-5% quartz coarse fragments (2-5 mm), non-saline, non-calcareous, pH 6.5; sharp boundary to
A3	5-30	Dark red (2.5YR 3/6) clayey sand; earthy fabric, massive, moderately weak consistency, 2-5% quartz coarse fragments (2-5 mm), pH 7.0; abrupt boundary to
B1	30-45	Red (2.5YR 4/6) sandy loam; earthy fabric, massive, moderately firm consistency, < 2% quartz coarse fragments (2-5 mm), pH 7.0; clear boundary to
B2	45-90	Red (2.5 YR 4/6) sandy clay loam; earthy fabric, massive, moderately firm consistency, < 2% quartz coarse fragments (2-5 mm), pH 7.5; abrupt boundary
D	90+	Continuous strongly cemented laminar red to dark red (2.5YR 4/6) vesicular siliceous hardpan with manganiferous inclusions.

show a gradual increase in clay content with depth. The texture ranges from sandy loam to loam at the surface and clay loam to clay in the subsoil. The soil reaction is neutral to weakly acidic. The soil surface is usually stone free, firm to hardsetting and commonly protected by a cryptogamic crust. There are few coarse fragments in the upper profile, but some (2-5%), fine ferromanganiferous nodules occur in the subsoil.

Soil colour for this soil group is predominantly red (2.5YR 3/6) to yellowish red (5YR 4/6), with some darker colours. Brownish soils (7.5YR 4/6) have a darker hue by increased organic matter. These soils have a very low salt content (less than 0.02%), although this may increase in areas near to saline plains.

Where water flow is less sluggish such as of flood plains, alluvial plains and wide drainage zones, the deep red earths occur in isolated pockets. Here they are more alkaline (pH > 8.5) in the subsoil. The main Northcote PPF's for this red earth (alkaline phase) is Gn2.13.

The main Northcote PPFs are Gn2.12 and Um5.22.

Duplex or texture contrast soils

These soils have a strong texture contrast between the major surface soil horizons with a sharp to clear boundary between the surface horizons (sandy or loamy) and the subsoil horizons (light clay). The major subsoil horizon is often referred to as a subsoil pan as it sets very hard on drying.

The genesis of duplex soils is uncertain. Their formation may include: deposition of coarser material upon a pre-existing clay material; loss of clay from lateral surface water flow; or the migration of clay particles into the subsoil.

Duplex soils occur in two areas of the landscape, in higher parts on footslopes, interfluvies and breakaways (generally developing shallow duplex phased soils) and on lower alluvial and depositional areas such as floodplains and lake margins (developing deeper soils).

Shallow phased duplex soils have total salt contents ranging from 0.01-0.07% in the topsoil to 0.7% in the subsoil. The range of organic carbon in the topsoil is 0.12-0.23%. Phosphorus and potassium levels range from 4-14 and 140-220 ppm respectively in the topsoil to 2-4 and 85-160 ppm in the subsoil. Nitrogen levels in the topsoil range from 160 to 240 ppm.

Deep phased duplex soils have total soluble salt contents ranging from 0.03-0.04% in the topsoil to 0.05-3.5%. Where the topsoil has eroded the remaining soil surface salt content is 0.13-0.3%. In a non-degraded topsoil the organic carbon content is around 0.03% while in a degraded soil the content may be as low as 0.009-0.017%.

Phosphorus and potassium levels range from 6-18 and 210-300 ppm respectively in the topsoil, with subsoil levels at 2-7 and 300 ppm.

Duplex soils developed in erosional landscapes have 10-20 cm of clayey sand to loams overlying light clay subsoils. Some of the shallow phases generally have a stone free cryptogamic surface crust. Hardsetting shallow soils often have a stony mantle (20-50%) of metamorphic rocks or quartz. Soil depth varies from 40 cm to 70 cm over bedrock or occasionally hardpan. Colours range between red (2.5YR 4/6) to dark red (2.5 YR 3/6) though variations of yellowish red (5YR 4/6) may occur. Soil reaction is mainly neutral (pH 6.5 to 7.5). Shallow brown duplex soils (although uncommon) are included within this group. These soils differ only in their colour (strong brown - 7.5YR 4.6) to the redder types. The main Northcote PPFs are Db0.56, Dr1.12, Dr1.13, Dr1.52, Dr1.53, Dr1.55, Dr1.56, Dr2.12, Dr2.52 and Dr2.53.

On alluvial plains and lake margins, the duplex soils are deeper, with hardsetting surfaces and few stony mantles. The surface horizons have 10 to 15 cm of clayey sand to sandy clay loams overlying light to heavy clay subsoils. Colours are dark red (2.5YR 4/6) at the surface and yellowish red (5YR 4/6) or strong brown (7.5YR 5/6) in the subsoil. The soil reaction is neutral to alkaline with carbonates increasing with depth. Gypsum layers are present in some subsoils and in lake beds.

Shallow varieties of hardsetting duplex soils overlying hardpan occur where the margins of alluvial tributary and riverine flood plains merge into wash plains; they also are included in this group. Colour variation in this group extends occasionally to the brown phase with the dominant colour being strong brown (7.5YR 4/6).

The main Northcote PPFs are Db1.13, Db1.33, Dr1.12, Dr1.13, Dr1.16, Dr1.23, Dr1.53, Dr1.55, Dr1.56, Dr1.73, Dr2.13, Dr2.33, Dr2.52 and Dr2.53.

Other phases of duplex soils occurred to a minor extent. Soft surfaced duplex soils with clayey sandy surfaces overlying light clay occur as isolated pockets.

Morphological description of a shallow duplex soil

Land system: Sherwood
Land unit: Breakaway lower footslope
Principal profile form: Dr1.52

Horizon	Depth (cm)	Description
A1	0-5	Dark red (2.5YR 3/6) clayey sand; earthy fabric, massive, crusted soil surface (3-5 mm) with some cryptogamic activity, 2-5% (2-5 mm) quartz coarse fragments, non-calcareous, pH 6.5; sharp boundary to
B2	5-25	Dark red (2.5YR 3/6) light clay; massive, non-calcareous, pH 7.0; sharp boundary to
D	25+	Decomposing granite.

Morphological description of a deep duplex soil

Land system: Beringarra
Land unit: Broad drainage zone
Principal profile form: Dr2.13

Horizon	Depth (cm)	Description
A	0-20	Dark reddish brown (5YR 3/4) sandy loam; earthy fabric, massive, moderately firm consistency, firm to hardsetting soil surface, < 2% (2-5 mm) quartz coarse fragments, non-calcareous, pH 6.5; sharp boundary to
B21	20-80	Reddish brown (5YR 4/4) light clay; smooth ped fabric, weak columnar structure, very firm consistency, < 2% calcareous nodules throughout, pH 9.0; clear boundary to
B22	80-100	Yellowish red (5YR 4/6) light clay; smooth ped fabric, weakly columnar structure, very firm consistency, 5-10% calcareous nodules, < 2% gypsum crystals, pH 9.5.

Occurrences of Great Soil Groups such as Non-Calcic Brown, Solonetz and Solodized Solonetz soils have been identified within the large duplex soil group. They occur sporadically throughout the survey area.

Red and brown clays

The common feature of this group is the dominance of the clay fraction throughout the profile. The clay fraction is mainly derived from weathered metamorphics (basalt and gabbro), sedimentary and other rock. Red and brown clays occur in areas such as flood plains and large drainage foci. Soil textures range from clay loams at the surface, to light and medium clays in the subsoils. The soils are deep (over 1 m), with shallower phases underlain by rock or hardpan which occur on the margins of floodplain and as pockets within broad alluvial plains. Clay soils on the floodplains of major tributaries often have a thin surface crust of silty loam indicating continuing deposition from recent flood events. The majority of the clay soils have an apedal or weakly pedal structure with smooth-faced peds. Soil reaction is neutral to strongly alkaline with carbonate content increasing with depth and the occasional occurrence of gypsum in the lower profile (pH range 7.0-9.5). Colour varies from dark red (2.5YR 3/6) to yellowish red (5YR 4/6) at the surface to yellowish red to dark yellowish brown (10YR 3/6) in the subsoil. These soils have total nitrogen levels of 0.031-0.035% and 0.12-0.28% organic carbon in the topsoil. Phosphorus and potassium levels range from 6-17 and over 300 ppm respectively in the topsoil, to 2-4 and 120-290 ppm in the subsoil. Total soluble salts may range from 0.01-0.8% in the

topsoil to 2.24% in the saline subsoils. Clay soils with a mottled subsoil occurred infrequently, as isolated pockets within saline plains. Calcareous clay soils occur occasionally in or adjacent to calcreted valley fill, with some shallow phases within saline plains or clay pans often underlain by gypsum.

Cracking clays (PPF:Ug) are a minor distinctive component of this group and occur only very locally in the study area. They are often called gilgai or crabhole soils exhibiting large open cracks at the soil surface when dry. The clays swell while absorbing moisture and shrink on drying. The soils may have a self-mulching or crumbly surface. These cracking clays are well structured, usually have an alkaline soil reaction trend and may contain nodules of soft carbonate. Their colour varies from dark red (2.5YR 3/6) to strong brown (7.5YR 4/8).

The main Northcote PPFs of the red and brown clay group are Uf6.12, Uf6.21, Uf6.31, Uf6.53, Uf6.71, Ug5.36 and Ug6.3.

Morphological description of a saline brown clay soil

Land system: Coolabulla
Land unit: Floodplain
Principal profile form: Uf6.12

Horizon	Depth (cm)	Description
A	0-5	Yellowish red (5YR 4/6) silty clay loam; earthy fabric, massive, moderately firm consistency, crusted soil surface, non-calcareous, pH 8.5; sharp boundary to
B21	5-50	Yellowish red (5YR 4/6) light clay; smooth ped fabric, strongly developed polyhedral structure, non-calcareous, pH 9.0; gradual boundary to
B22	50-100	Strong brown (7.5YR 4/6) light clay; smooth ped fabric, strongly developed polyhedral structure, 2-5% soft calcareous segregations, pH 9.0; sharp boundary to
D	100+	Calcrete.

Susceptibility to accelerated erosion

The table below summarises erosion hazards of the different soil groups in the survey area.

Table 14. Erosion hazards of soil groups

Soil group	Land units	Erosion susceptibility
Alluvial (juvenile) soils	River channels. Levee banks. Lake beds and sink zones.	Mobile river bed sediments. Usually stable under vegetation. Very low.
Solonchaks	Highly saline plains, lake beds and kopi dunes.	Very low.
Lithosols (skeletal phase)	Breakaway plateaux and hillslopes.	Low owing to protection by heavy stone mantle and rock outcrop. Moderate to high susceptibility to rilling and guttering (because of slope) if mantle disturbed.

The largest areas of soil erosion occur on plains with duplex soils adjacent to the river systems. This reflects the usage of natural waters, supplemented by permanent fresh water easily obtained from shallow wells, and an open range grazing system established at the beginning of pastoral settlement. The extent and severity of contemporary erosion reflects both the over-use to which areas have been subjected and features soil-related variations in erosion susceptibility.

The removal of perennial plant cover over the years by sometimes excessive grazing by domestic livestock under marginal rainfall conditions, exacerbated by the effects of drought and grazing pressure by kangaroos and feral animals, has been the underlying cause of the majority of soil erosion.

Only the hardiest perennials persist under excessive grazing. Palatable perennial shrubs and grasses are killed by continuous over-utilisation or if severe defoliation occurs during growth periods following dry years or prolonged droughts. Plants and plant litter increase rainfall infiltration, retain organic matter, nutrients and seed stores, reduce rates of overland water flow, reduce wind velocities at ground level, bind soil together and assist in retaining moisture and structure in the subsoil.

The soils most vulnerable under grazing have hard-setting or crusted surfaces, which, when continuously disturbed will eventually break down to fine particles that are easily eroded. Both water, through raindrop action and unimpeded or accelerated overland flow, and wind are responsible for removing loose or unprotected soil. Unchecked soil erosion removes the most valuable surface mulch or 2 cm, in which scarce nutrients and organic matter are concentrated. The widespread loss of major soil layers is shown by extensive scalds. Water erosion acting in conjunction with wind erosion removes surface soil and exposes the subsoil reducing soil fertility. This further reduces the chance of establishment and survival of seedlings even after adequate rainfall. A direct result of surface soil removal and subsoil exposure is reduced water infiltration into the bare soil surfaces. The lack of water penetration and high velocities of surface flow during floods are two of the major factors limiting successful re-establishment of plants on eroded sites in the area. Otherwise, the shallowness of many thin duplex soils overlying hardpan has meant that severely eroded areas have suffered almost complete loss of the soil profile. Such areas are likely to remain desertified irrespective of changes to management or land use.

Table 14. Erosion hazards of soil groups—continued

Soil group	Land units	Erosion susceptibility
Lithosols (stony phase)	Low hills, stony low rises and lower slopes.	Low owing to protection by heavy stone mantle. High susceptibility to guttering and gullyng (because of slope) if mantle disturbed.
Earthy sands (deep phase)	Sandy banks. Red and yellow sandplain.	Low to mild where vegetation is severely degraded. Low where vegetated but susceptible to deep gullyng along inappropriately maintained tracks and roads.
Earthy sands (shallow calcareous phase)	Broad and narrow drainage zones and adjacent levee banks.	Low to moderate under existing vegetation.
Siliceous sands (deep phase)	Red and yellow sand dunes.	Low.
Siliceous sands (shallow granitic phase)	Sandy surfaced plains adjacent to granite outcrops. Breakaway plateaux and granite outcrops. Red and yellow sandplain.	Stable under existing vegetation otherwise moderately susceptible to water erosion. Low where vegetated but susceptible to deep gullyng along inappropriately maintained tracks and roads.
Gravelly sands (and loams)	Lateritic plains, low hills or rises.	Low owing to ferruginous gravels on the surface and throughout the profile.
Red and brown calcareous soils	Calcrete platforms and non saline drainage tracts. Saline drainage tracts.	Low to moderate because of calcrete outcrop and often heavy mantle. Low to moderate where adjacent to duplex soils.
Red-brown hardpan soils	Hardpan plains and fringing units of drainage tracts and duplex soils. Mulga groves and thickly wooded areas.	Locally susceptible to sheet erosion where vegetation is severely degraded and/or unprotected by a stony surfaces mantle. Low, but susceptible by accretion at edges where surrounding plain is eroding.
Red earths (shallow phase)	Stony plains, lower footslopes, margins of hardpan plains and drainage tracts.	Low where protected by a stony mantle, otherwise low to moderate depending on hydrology and slope where vegetation is degraded.
Red earths (deep phase including calcareous red earths and alkaline red earth)	Mulga groves and some drainage foci. Occasional flood plains, alluvial plains and wide drainage tracts.	Low under existing vegetation otherwise subject to minor wind erosion. Low to moderate - subject to sheet water and wind erosion where vegetation is degraded.
Duplex soils Crusted duplex (shallow phase)	Hill or breakaway stony footslopes. Hill or breakaway non-stony footslopes and some hardpan margins.	Moderate to high where perennial cover by low shrubs is reduced. Breakdown of surface crust leads to sheet, rill or minor gully erosion. High or very high whenever perennial cover of low shrubs is significantly reduced. Breakdown of surface algal crust leads to microterracing, scalding, sheet or rill erosion, with gutters and gullies on lower slopes.
Crusted duplex (deep phase)	Alluvial plains, floodplains, saline plains, drainage foci and some hardpan margins.	Moderate to high - subject to wind and water erosion after initial breakdown of soil surface algal crust.
Hardsetting duplex (shallow phase)	Hill or breakaway footslopes, alluvial plains, stony plains, and saline plains over rock or hardpan.	Very high, especially after initial soil surface decline where vegetation is degraded. Subject to water and wind erosion; major scalding and complete loss of topsoil common.
Hardsetting duplex (deep phase)	Broad drainage tracts, floodplains, alluvial plains, saline plains and lake frontages.	High, after initial soil surface decline where vegetation is degraded. Subject to water and wind erosion, scalding and guttering common.
Soft surfaced duplex (deep phase)	Occasional broad drainage tracts, saline stony and stone free plains.	High or very high, (soft nature of soil surface layers). Subject to wind and water erosion - scalding common.
Red and brown clays (deep phase including calcareous red earths and alkaline red earth)	Alluvial plains, flood plains and saline plains.	Mild to moderate - subject to sheet water and wind erosion where vegetation is severely degraded - scalding common.
Red and brown clays (shallow phase - often over hardpan)	Hardpan plains and fringing drainage units. Drainage foci.	Moderate to high - subject to sheet water and wind erosion unless well vegetated - scalding common. Low to moderate under existing vegetation otherwise mild susceptibility to water erosion.
Cracking clays	Gilgai plains and isolated pockets within alluvial and flood plains.	Very low to moderate under existing vegetation.

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Vegetation

The main features of vegetation in the eastern parts of the area have been described by Mabbutt *et al.* (1963) and at a very broad scale by Beard (1976). As a result of the present survey, a much more detailed picture of the area emerges.

The account presented here concentrates on the major vegetation communities found in the area, and their structure, composition, variation and long-term condition status at the time of the survey. These factors relate to very variable cumulative impacts from past use and management. Implications for future pastoral usage and the potential for degraded vegetation to be rehabilitated through appropriate management are addressed.

As a result of collections made during the survey, R.J. Cranfield has compiled a comprehensive list of species of both the vascular and non-vascular plants known from the area (Cranfield 1990). This list is reproduced, with minor revisions and additions in Appendix 2. A shorter list of common perennial species and their broad patterns of occurrence in relation to the mapped land systems and land types of the 1:250,000 map series is given in Appendix 3.

Regional overview

Beard (1976) identified the whole of the Murchison River catchment, in its stricter hydrological sense, as a single Upper Murchison Sub-region of the Austin Botanical District in the Eremaean Botanical Province. The area covered by the present survey includes all but the north-eastern extremity of this Sub-region,

plus the Byro Sub-region in the north-west, parts of the Wiluna, Barlee and Yalgoo Sub-regions in the east, south-east and south-west respectively, and a tiny area of the South-Western Botanical Province in the far south-west (Figure 35).

The flora and communities of the Byro Sub-region resemble those of the Carnarvon Basin more than those of the Upper Murchison Sub-region. This appears to be correlated with the geomorphic change from the underlying Archaean rocks on which catchment lands of the Murchison River catchment are mainly based, to the Permian and Quaternary surfaces of the Byro Plains, the Muggon lakes area and the eastern edge of the Victoria (Shark Bay) Sand Plain.

The only abrupt transition in the whole area is the demarcation between the arid zone vegetation of the Upper Murchison sub-region and the South-Western Botanical Province in the south-western corner of the survey area. The boundary between the Eurardy land system and others to its north and east probably best delineates the semi-arid zone from the arid zone at its roughly 250 mm isohyetal limits. Otherwise, the climatic trends across the area are very gradual and do not produce anything more than gradual patterns of change and clines across the Upper Murchison sub-region.

General vegetation characteristics in the Upper Murchison Sub-region

Arid shrublands make up the vast majority of vegetation types encountered. Most landscapes are dominated by mixed shrublands, with few or no trees or perennial grasses, with shrubs apparently randomly scattered or loosely aggregated, and with large

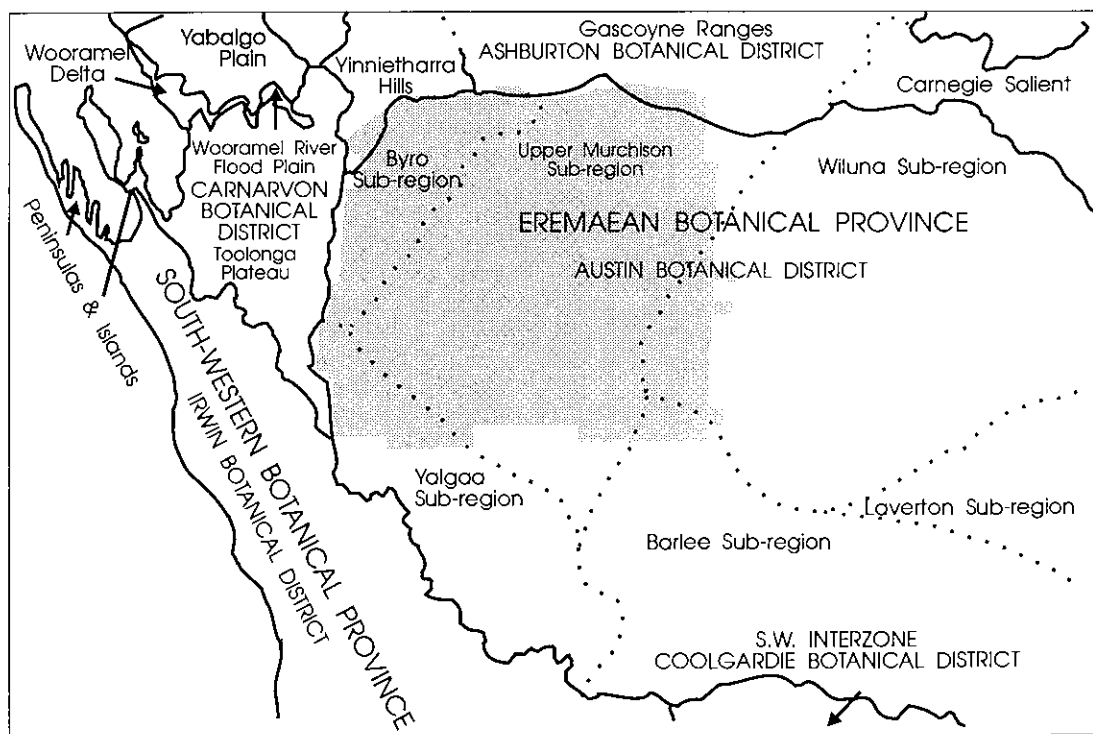


Figure 35. Natural regions of the Murchison area, after Beard (1976).

Survey area

amounts of bare ground and shallow red soils exposed between the shrubs. Only over areas with either sand or clay soils are perennial grasses locally common, and then generally only as an understorey to shrubland or open woodland.

Areas of primary salinity exist, mainly adjacent to the lakes and rivers, but also below lateritic breakaways and deeply weathered rock outcrops. Here vegetation is also dominated by shrublands, but on such areas adjacent *Acacia*-dominated associations give way to low (steppe) shrublands dominated by *Chenopodiaceae* and other halophytes. It was these shrublands, with their proximity to more local grassy areas growing on river limestones (calcretes) and also on claypans, sandy washes and plains below granites, that originally attracted the pioneers of the pastoral industry to the area.

Vegetation has been cleared only around the settlements and mine sites, apart from small areas of sand plains in the far south-west which were chained at various times with the goal of increasing grasses for pastoral production.

Spatial aspects of vegetation

A feature of the vegetation, which is common to much of the shrublands of the southern arid zone, is the generally small scale of landscape patterning evident for the various vegetation types.

With few exceptions, the major vegetation types are usually encountered at the scale of the land unit rather than the land system or any larger mapping unit. In other words, most examples of any particular vegetation type exist over areas of a few hectares to hundreds of hectares, or as topographically restricted zones no more than hundreds of metres wide before being replaced by an adjacent, different vegetation type. Reference to the descriptions of individual land systems illustrates this general scale of environmental patterning. Often, the vegetation sequence repeats across the landscape, and long line transects in any direction will progress through repeated sequences of two or more major types across each land system.

Arguably, the most extensively uniform of the vegetation types are those encountered on the sand plains, where any controlling development of surface drainage is rudimentary or apparently absent.

Patterns of seasonal growth by annual and ephemeral species

The perennial long-lived, drought-resistant communities are augmented by a diverse ephemeral flora of fast-growing, drought-evading, short-lived species. While they are popularly known as 'annuals', their long-term occurrence in any one location is less than annual. Their occurrence is determined primarily by the incidence of effective rainfall. During dry seasons, many species in an area exist only as seeds, sometimes for years at a time.

Winter growth of the ground herbage layer is made up by a wide variety of *Asteraceae*, *Amaranthaceae*, *Chenopodiaceae* and many other less dominant families (see Cranfield 1990). In late summer, however, when effective rainfall is less reliable (see 'Climate' section), the herbage response is dominated by *Poaceae* (annual grasses) and *Chenopodiaceae* (mainly annual saltbushes and bindiis).

Both types of seasonality are required for long-term maintenance and regeneration of the perennial communities. In general, summer rainfall stimulates rapid growth and flowering of perennial grasses, and the flowering of many shrubs and trees (particularly *Acacia* spp.; Davies 1976). Most germination of perennials also occurs after summer or autumn rains. Winter responses by perennial shrubs are slower, and generally feature considerable foliar growth before flowering and seeding. Perennial grasses respond only slowly after winter rain, as temperatures rise in early spring, whereas responses to summer rain are characteristically rapid.

Small-scale patterning and patchiness is a conspicuous feature of herbage response in all but the most uniform of land surface types. This is primarily a result of intense micro-topographic variation and redistribution of key surface features (soil crusting, nutrients, roughness elements, moisture, temperature and seed reserves), which are in turn related to the small-scale patterning found in the distribution of perennial plants (Mott 1973, Mott and McComb 1974, Hacker 1986).

Within each community, woody perennials serve to concentrate fauna, organic matter and soil nutrients and are vital protectors of the soil surface against erosive forces. During each period of growth there is recurrent competition between the ephemeral and perennial flora for moisture and nutrients. This has been clearly demonstrated in mulga environments elsewhere (Beale 1973). The most prolific growths of winter annuals such as everlasting (*Helipterum* and *Helichrysum* spp.), blue crow's foot (*Erodium cygnorum*) and billy buttons (*Craspedia* spp.) tend to occur on sites with depleted levels of mulga or other tall shrub cover, but with intact soil surfaces (through cryptogamic crusts, stony mantles etc. on the less erodible soil types).

Such effects are sometimes noticeable along fencelines where different stocking regimes have affected vegetation unequally. Once accelerated erosion of the first surface millimetres of topsoil has begun, for any reason, the growth potential of each affected patch of soil is severely reduced.

Classification of vegetation types

As described under 'Methods', 23 major, mostly widespread, recurrent association types have been identified (Table 15) and are described below. Table 60, presented at the end of this section, summarises the characteristics of the major vegetation types.

Quantitative data are presented for 14 of the 23 vegetation types, in order to identify condition states and changes or effects related to pastoral use of the particular vegetation. No attempt is made to include and review the very large number of minor associations and formations that are known from the whole area. Basic information on variants in the vegetation associations is obtainable from the inventory and condition sites summaries listed in Appendix 5. The emphasis below is on the commonest types of land and presents land managers with information on their recognition. This is an essential first step in assessing varying degrees of need for regeneration and management, towards desirable states of perennial productivity, diversity and subsequent sustainability.

The system of classification and naming of vegetation types used here was derived from multivariate analysis of biophysical data collected at inventory sites sampled during reconnaissance survey (Foran *et al.* 1986). Initially, all site data obtained during the reconnaissance survey were converted into binary format and subjected to agglomerative classification using the information statistic (Grunow and Lance 1969) via the Taxon P4 software package (Ross *et al.* 1983). Eight initial major groups of sites were subsequently expanded into the full 23 major vegetation types dealt with below.

The 23 types are grouped below according to their total structural-botanical compositions combined with predominant soil types. This reflects one finding from the Taxon classification, in that more satisfactory groupings of sites were obtained when fundamental soil attributes were incorporated into the analysis of perennial plant species. Representative photographs of each vegetation type are included in this chapter.

Isolation of type 12, Calcrete Shrubby Grassland into a group of its own reflects the finding that such sites' associations were the most distinctly different among all those sampled from the major types in the area. This finding is consistent with results obtained for equivalent vegetation in central Australia (Foran *et al.* 1986).

Vegetation type 1: Hardpan Mulga Shrubland

Hardpan Mulga Shrubland is the most widespread and extensive of all vegetation types in the Murchison River catchment. It is the major vegetation of all the broad 'wash' plains (which carry sheet flow after major rainfall) which are underlain by red-brown hardpan. These wash plains comprise the seven land systems of **land type 14**, as well as being a major part of all land systems in **land type 13** (wash plains and sandy banks on hardpan) and a unit of many other systems in **land types 3, 4, 7, 15 and 16**.

Nearly all of the Hardpan Mulga Shrubland in the survey area lies above relatively shallow groundwater supplies of a high quality. Recognition of this availability of stock water coupled with its generally moderate pastoral potential and very flat terrain for stock and pastoralists, has meant that most areas of this vegetation have been grazed more or less perpetually for well over half a century. Studies of what was previously known of the grazing ecology of mulga shrublands in Western Australia have been reviewed by Morrissey (1984).

In this report, Hardpan Mulga Shrubland is dealt with as a separate type from Granitic (and other baserock) Mulga Shrubland which is not subject to

Table 15. Major vegetation types, Murchison River catchment

ACACIA-DOMINATED SHRUBLANDS ON NON-SALINE LOAMY SOILS		
1.	Hardpan Mulga Shrubland	(HPMS)
2.	Mulga Grove Woodland	(MGRW)
3.	Creekline Shrubland	(CRLS)
4.	Creekline Grassy Shrubland	(CRGS)
5.	Rocky Hill Mixed Shrubland	(RHMS)
6.	Stony Mulga Mixed Shrubland	(SMMS)
7.	Granitic Mulga Shrubland	(GMUS)
8.	Lateritic Acacia Shrubland	(LACS)
MIXED PERENNIAL GRASSLAND-SHRUBLAND-WOODLANDS ON CLAYEY SOILS		
9.	Non-Calcareous Shrubby Grassland	(NCSG)
10.	Alluvial Tussock Grassland	(ATUG)
11.	Riverine Mixed Shrubland	(RIMS)
SHRUBBY PERENNIAL GRASSLANDS ON CALCAREOUS SOILS		
12.	Calcrete Shrubby Grassland	(CSHG)
SHRUBLANDS ON SALINE SOILS		
13.	Mulga Chenopod Shrubland	(MCHS)
14.	Stony Snakewood Shrubland	(SSWS)
15.	Saltbush Shrubland	(SALS)
16.	Bluebush Shrubland	(BLUS)
17.	Mixed Halophytic Shrubland (frankenja, sage, mulla-mulla etc.)	(MXHS)
18.	Samphire Shrubland	(SAMS)
SHRUBLANDS AND GRASSY SHRUBLANDS ON SANDY SOILS		
19.	Wanderrie Bank Grassy Shrubland	(WBGS)
20.	Sandplain Wanderrie Grassy Shrubland	(SWGS)
21.	Sandplain Acacia Shrubland	(SAAS)
22.	Sand Dune Shrubland	(SDUS)
23.	Sandplain Mallee-Acacia-Spinifex Shrubland	(SMAS)

sheet flow and alluvial processes in the same way. These two major types are often floristically similar, but are evidently controlled or influenced by somewhat different ecological processes. Plains supporting Hardpan Mulga Shrubland are subject to sustained sheet flows for hours or days after major rainfall events. Their soils are formed by biological action and shallow weathering of silicified alluvium *in situ*, whereas Granitic Mulga Shrubland grows on shallow soils developed from decaying parent rocks and on sites which depend more on incident rainfall and its redistribution in the micro-topography.

The vast majority of soils which support Hardpan Mulga Shrubland are the loamy red hardpan soils (q.v.), 15 to 50 cm deep (often deeper on the Woodline land system) over red-brown hardpan. In practice it is very difficult to determine the soil depth of an individual site, because within-site variation of ± 10 cm is normal. Most soils classify as uniform medium textured Um5 (Northcote), but a minority show sufficient profile development, with a more clayey B horizon, to qualify as gradational neutral types (Gn2).

Soil surfaces are extensively (but not continuously) crusted by patchy cryptogamic plants (algae and lichens) and alluvial surface deposits, together with semi-perennial rhizomes of various Asteraceae. The patterns of cracks, fissures and mixed roughness elements in these crusts constitute natural seed niches and nutrient recycling patches which stabilise the soils and facilitate rainfall infiltration and vegetation regeneration of the whole association.

General characteristics



Vegetation type 1: Hardpan Mulga Shrubland: Yanganoo land system, Nallan station.

Hardpan Mulga Shrubland is typically dominated by an association of various overstorey *Acacia* species including mulga, with non-halophytic perennial shrubs and herbs to comprise a mixed structural community of low trees, tall shrubs, mid shrubs and low shrubs. The cover relativities of the various woody strata vary a great deal, and structural dominance by any of the four woody strata is common. Spatial variation in the distribution of woody cover is normal, with some degree of loose groving - intergroving being evident at most sites. The

groved aggregations of tall shrubs and low trees are typically made up by combinations of species which differ from the dominants growing on the more open intergrove areas, where higher densities of some of the low shrubs occur. Perennial grasses occur irregularly and are of only minor significance on this vegetation type. Woollybutt and broad-leaved wanderrie are the main species; they occur only on sandy-surfaced soil accretions, which can be found at all scales from tiny patches at the base of individual shrubs to well-developed wanderrie banks (mainly on land type 13; see Wanderrie Bank Grassy Shrubland).

Over 70% of all sites sampled supported a total perennial cover of between 10 and 25% projected foliar cover (PFC) (Figure 37). The commonest dominant species within each main stratum are listed in Table 16. Sites on the land systems of the northern parts of the area (e.g. Yandil, Flood, Cole, Frederick) have lower average levels of shrub cover than those in the south (e.g. Tindalarra, Woodline).

A wide variety of palatable shrubs and perennial herbs occur in this vegetation type, with many species having very wide distributions within and beyond the boundaries of the survey area. To a large extent these palatable perennials (Table 17), which are of great importance to pastoral production, are 'generalist' species. They appear to have some capacity to replace each other in space and time according to the climatic and management events experienced at the site and throughout surrounding areas. While the dynamics of their populations are not well understood, several key species often possess populations made up by a low density of mature, long-lived individuals occupying protected, fertile niches and providing most of the source of both edible biomass and seed production. Alongside these 'parent' plants are more labile populations of young, recently established plants which are more vulnerable to mortality as a result of overgrazing or seasonal adversity, or both in combination.

Gradational associations

Hardpan Mulga Shrubland typically occupies large areas of the central parts of the catchment topography, between the rises below the ranges of hills and the river flood plains. As a consequence of rather broad environmental gradients, intermediate associations with several other vegetation types occur.

The more pronounced groves, with their small areas of close or closed canopies tend towards a distinct vegetation type (Mulga Grove Woodland). In higher areas, where the underlying hardpan becomes thin and tends to disappear and give way to underlying colluvium and weathered rocks, gradations occur with Granitic Mulga Shrubland, Stony Mulga Mixed Shrubland and Mulga Chenopod or Stony Snakewood Shrubland. Within the areas generally dominated by Hardpan Mulga Shrubland, small sandy-surfaced groves and minor sandy banks show association characteristics mixed with Wanderrie Bank Grassy Shrubland. Where hardpan wash plains meet the upper reaches of river tributaries and lacustrine flood

Table 16. Commonest dominant species at Hardpan Mulga Shrubland sites

Low trees	Tall shrubs	Mid shrubs	Low shrubs
<i>Acacia aneura</i>	<i>A. aneura</i>	<i>Eremophila fraseri</i>	<i>Ptilotus obovatus</i>
<i>A. pruinocarpa</i>	<i>A. ramulosa</i>	<i>A. tetragonophylla</i>	<i>E. forrestii</i>
	<i>A. grasbyi</i>	<i>Cassia desolata/sturtii</i>	<i>E. fraseri</i>
	<i>A. tetragonophylla</i>	<i>E. forrestii</i>	<i>Solanum lasiophyllum</i>
	<i>A. craspedocarpa</i>	<i>A. ramulosa</i>	<i>Sida calyxhymeria</i>
		<i>C. helmsii</i>	<i>C. helmsii</i>
		<i>A. grasbyi</i>	<i>E. punicea</i>
		<i>A. craspedocarpa</i>	<i>Maireana convexa</i>
		<i>C. phyllodinea</i>	<i>P. schwartzii</i>

plains, transitions occur with several types found on alluvial landforms. Among these is Riverine Mixed Shrubland which, like Hardpan Mulga Shrubland, is extensively underlain by hardpan.

Grazing impact and the condition of perennial vegetation

No. of condition sites investigated: 476

Site methodology: D

Site variables analysed: dominant species in association; projected foliar cover (PFC); plant density; species richness; palatable species density; palatable species richness; perennial diversity (Shannon-Weiner); palatable species diversity (Shannon-Weiner); species evenness (equability); distance from stock water point; paddock quadrant; and erosion status.

Table 17. Commonest palatable woody perennial species at Hardpan Mulga Shrubland sites

<i>Maireana planifolia</i>	flat leaved bluebush
<i>M. convexa</i>	mulga bluebush
<i>M. villosa</i>	
<i>Rhagodia eremaea</i>	rhagodia, tall saltbush
<i>Ptilotus obovatus</i>	cotton bush
<i>Eremophila latrobei</i>	warty fuchsia bush
<i>E. forrestii</i>	Wilcox bush
<i>E. compacta</i>	compact poverty bush
<i>E. aff. compacta</i>	
<i>Sida calyxhymeria</i>	tall sida
<i>Grevillea deflexa</i>	red grevillea
<i>Canthium lineare</i>	
<i>Santalum spicatum</i>	sandalwood
<i>Spartothamnella teucriflora</i>	mulga broombush
<i>Hibiscus gardneri</i>	

Results: condition of perennial vegetation: 4 classes

Class 1

Total density of woody perennials $\geq 200/1000 \text{ m}^2$
 Species richness of woody perennials $\geq 10/1000 \text{ m}^2$
 Density of palatable woody perennials $\geq 150/1000 \text{ m}^2$
 Species richness of palatable perennials $\geq 4/1000 \text{ m}^2$

Class 2

Not as class 1
 Density of palatable woody perennials $\geq 50/1000 \text{ m}^2$
 Species richness of palatable woody perennials $\geq 3/1000 \text{ m}^2$
 Species richness of woody perennials $\geq 7/1000 \text{ m}^2$

Class 3

Not as classes 1 or 2
 Density of palatable woody perennials $\geq 5/1000 \text{ m}^2$

Class 4

Other sites, with very degraded vegetation not as classes 1, 2 or 3.

Table 18. Site classification summary (n = 476) Hardpan Mulga Shrubland sites

Class	No.	%	Cumulative %
1	38	8	8
2	139	29	37
3	223	47	84
4	76	16	100

Table 19. Erosion status: incidence of accelerated erosion, Hardpan Mulga Shrubland sites

Class	No. of eroding sites	%	Mean intensity rating
1	0	0.0	0.0
2	0	0.0	0.0
3	11	4.9	1.8
4	7	9.2	2.0

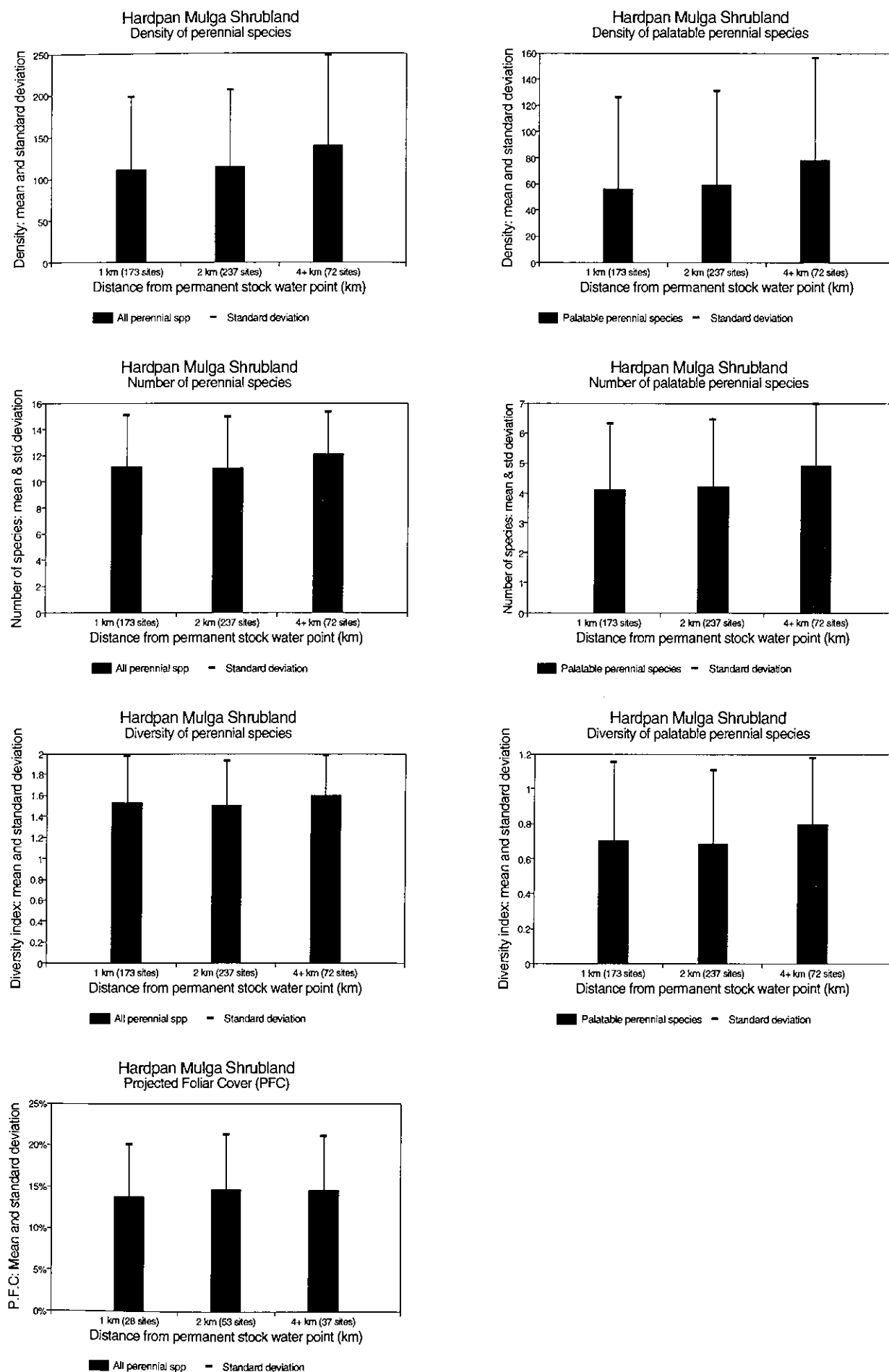


Figure 36. Vegetation attributes and the effect of site distance from stock water point for Hardpan Mulga Shrubland 0.1 ha condition sites (n = 482).

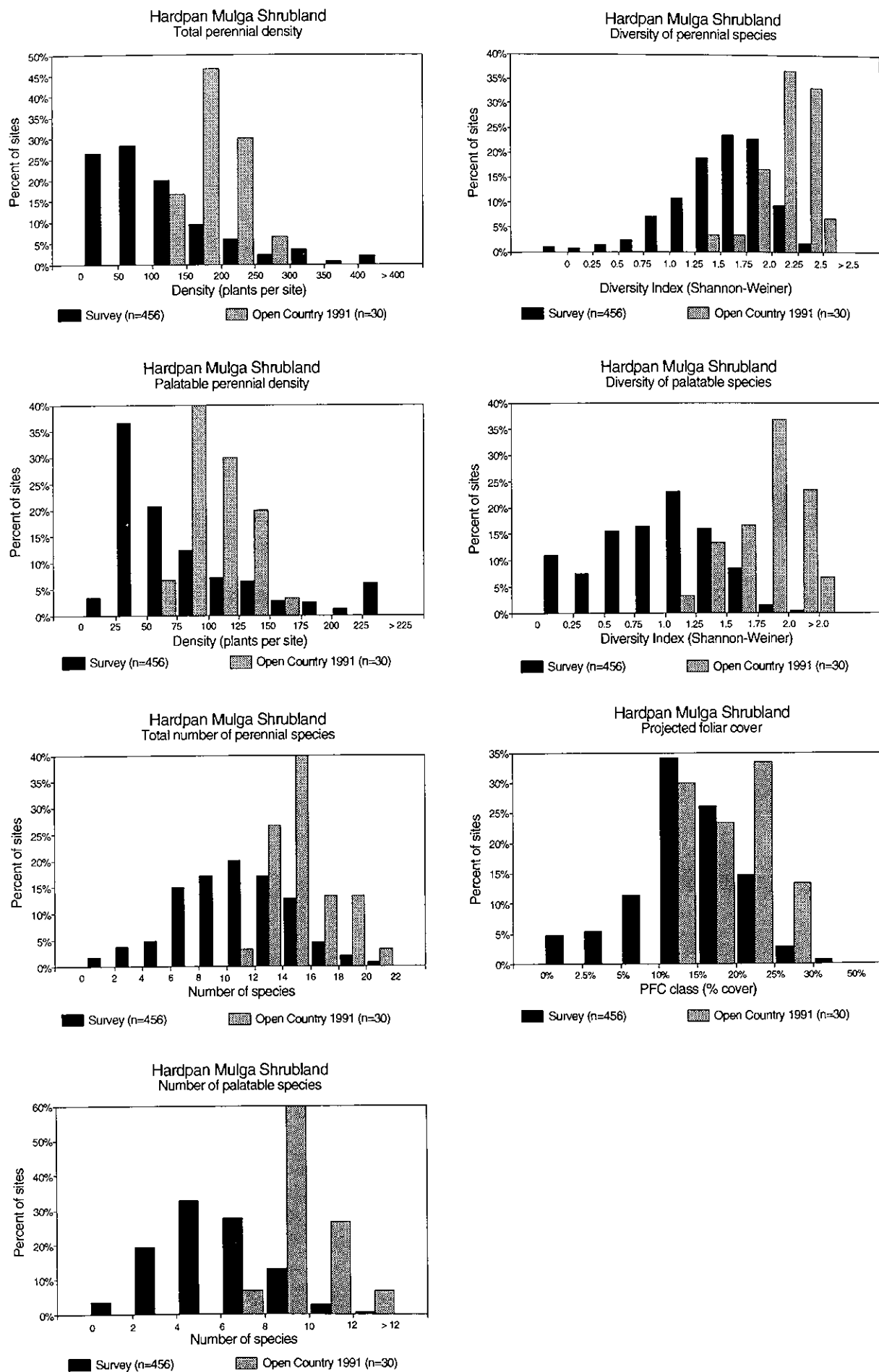


Figure 37. Frequency histograms for key vegetation characteristics of Hardpan Mulga Shrubland over the whole survey area and from an ungrazed benchmark area (Boolardy station 'Open Country') sampled in 1991; data from 1000 m² condition sites.

Table 20. Comparison of woody perennial composition of 1000 m² Hardpan Mulga Shrubland sites from grazed (whole survey) and ungrazed (Boolardy Open Country) areas

Variable	Grazed area (whole survey)			Ungrazed sites (Open Country)		
Density of woody perennials	116	±	94.2	186	±	39.8
Density of palatable woody perennials	60.5	±	72.7	83.3	±	23.9
Species of woody perennials	11.2	±	4.0	15.8	±	2.3
Species of palatable woody perennials	4.3	±	2.2	8.2	±	1.4
Diversity index (all species)	1.52	±	0.44	2.17	±	0.26
Diversity index (palatable species)	0.71	±	0.43	3.24	±	0.66

Erosion status: incidence of accelerated erosion

Accelerated soil erosion was not encountered at sites in classes 1 and 2, and was uncommon on sites with the poorer vegetation characteristics in classes 3 and 4.

General conclusions and remarks

Extensive sampling of Hardpan Mulga Shrubland sites and analysis of variables in relation to site distance from stock water (see Figure 36) revealed that the best indicators of condition are the total density of perennial plants, species richness (i.e. the number of species per unit area), and the density, diversity and species richness of palatable perennials. The total cover of shrubs and trees (PFC) was a poor indicator, being insensitive to major variations encountered in the composition and density of woody perennials. Sites 1 km from water did not differ in their total PFC from those sampled at greater distances, while the density of palatable perennials at 1 to 2 km from water was 25% less than at 4 km or more. Repeated observations during traverses strongly suggested that compensatory increases in individual shrub size often accounted for the lack of detectable diminution in total cover on sites with low plant density and poor species richness. It was only on severely degraded sites, and otherwise within about 800 m of watering points, that any general loss of cover and alteration of soil surfaces became evident.

Most of the shrub size increase occurs in turpentine bush (*Eremophila fraseri*) and curara (*Acacia tetragonophylla*), although a variety of other species (mainly inedible *Eremophila* spp.) are involved.

Evidence from an unstocked (benchmark) area

Thirty Hardpan Mulga Shrubland sites sampled in Open Country Paddock (on Boolardy station) in 1991 provide a set of 'benchmark' data for this vegetation type (Figure 37). These sites showed several significant differences from those of the survey area as a whole. The findings provide confirmation that Hardpan Mulga Shrubland vegetation elsewhere in the area has been extensively changed through long-term grazing pressure. The key characteristics indicated as being significantly changed by grazing are similar to those indicated by distance from stock watering points (see above). Sites on Open Country, an area which has remained virtually free of stock, showed significantly greater perennial density, perennial species richness, density and richness of palatable species and

Shannon-Weiner diversity index (Table 20). These differences were apparent from the unstocked 'control' area even during very adverse seasonal conditions (at Boolardy) compared with seasonal conditions prevailing during the period of the main survey.

Vegetation type 2: Mulga Grove Woodland

Mulga Grove Woodland occurs mainly in small, abruptly demarcated units of 0.2-2 ha where either grove-intergrove patterning is highly developed on sheet wash land systems such as Cole, Frederick and Yandil, or where irregular internal drainage occurs as discrete elliptical foci on broad and usually well-mantled, pebbly plains. Such drainage foci and their groves of relatively dense vegetation occur as minor units on most systems from land types 1-10 and 12-14.

Characteristically, Mulga Grove Woodland grows on relatively deep, loamy to clayey soils (mostly Um5 or Uf6) which are sharply demarcated with the boundaries of the vegetation they support.

General characteristics



Vegetation type 2: Mulga Grove Woodland: Horseshoe land system, Mt Padbury station.

Mulga Grove Woodland is generally a close to closed low woodland (PFC 30 to > 50%) with the low tree stratum being the cover dominant over the tall shrub stratum and the mid-shrub stratum. Low shrubs usually comprise only a minor cover component. Perennial grasses are either scarce or absent throughout the area.

While most Mulga Grove Woodland formation appear to be long-established, naturally self-perpetuating associations, some undoubtedly have their origins within historic times as almost even-aged woody regeneration on depositional cells of eroding alluvial land. Such groves are easily identified by their irregular aerial photopatterns and eroded surrounding units, as well as by their distinctively depauperate species composition.

More normal, regular Mulga Grove Woodland associations otherwise have distinctive composition variants related to specific geomorphological sites. One very distinctive variant is that of broad-leaved miniritchie (*Acacia rhodophloia*) and kite leaf poison (*Gastrolobium laytonii*) below granite domes of granitic land systems in **land types 1 and 4**. Otherwise, Mulga Grove Woodland associations are most widespread, contain high species richness and appear to be most productive for pastoral use on plains of greenstone-derived colluvium and alluvium, as found within land systems of **land types 2, 7 and 14**. Here, mulga and gidgee are normally the dominant trees growing over a mixed understorey of *Eremophila* species with various palatable shrubs of low to mid-height.

Gradational associations

Mulga Grove Woodlands show some overlap with Wanderrie Bank Grassy Shrublands on poorly developed groves which feature accumulations of redistributed sand. These are particularly common on degraded areas of land systems of **land type 13**, in the north of the survey area.

Grazing impact and the condition of perennial vegetation

In most areas grazed by sheep, Mulga Grove Woodland units appear to be resilient under grazing. To some extent, they may have benefited from additional run-off and mobilised soil particles, organic matter and nutrients released from adjacent degraded mulga communities (mainly Hardpan Mulga Shrubland and Granitic Mulga Shrubland), some of which is redeposited locally in Mulga Grove Woodland 'sinks'. Regeneration niches among dense

tangles of woody vegetation are common, and provide protection for seedlings against grazing during their vulnerable establishment phases. More mature palatable perennials frequently have foliage canopies or sprays out of reach to sheep. Mulga Grove Woodland is generally less susceptible to obvious degradation than the vegetation types around them.

The more important palatable perennials are rhagodia, ruby saltbush, flat-leaved bluebush, warty fuchsia bush, cotton bush, *Canthium* species, Wilcox bush and *Sida* species. Degraded sites are susceptible to increases by some unpalatable species, particularly *Eremophila spectabilis*, *E. pantonii* and flannel bush, but these remain understorey components in virtually every instance. Where present, perennial grasses are evidently susceptible to grazing impact.

Mulga Grove Woodland sites are sometimes susceptible to accelerated erosion at their margins where denudation of upstream slopes and plains has occurred.

Vegetation type 3: Creekline Shrubland

Creekline Shrubland develops along the innumerable channelled drainage lines encountered throughout the Murchison. Most drainage lines show considerable downstream development and reach a stage of one or more channels incised into hardpan (or hardpan veneers on rock) flanked by a zone or plain through which the creekline flows. While the majority of creeklines end where they disperse water onto broad wash plains, some major lines continue to the river tributaries and their flat plains with little net contribution to wash flow.

Davies (1976) indicated how the consequences of concentrated run-on and subsequent moisture storage benefited the biological productivity of drainage lines in this region. More often than not, the composition of the creekline community is not dissimilar from that of the adjacent run-off surfaces, but the association tends to be more species rich per unit area, with more concentrated and lasting seasonal productivity as a consequence of the superior moisture status available within the unit.

Table 21. Commonest dominant species at Mulga Grove Woodland sites

Low trees	Tall shrubs	Mid and low shrubs	Perennial grasses
<i>Acacia aneura</i>	<i>A. aneura</i>	<i>Eremophila georgei</i>	<i>Monachather paradoxa</i>
<i>A. pruinocarpa</i>	<i>A. craspedocarpa</i>	<i>E. forrestii</i>	<i>Enteropogon acicularis</i>
<i>A. rhodophloia</i>	<i>A. tetragonophylla</i>	<i>E. spectabilis</i>	<i>Eriachne pulchella</i>
<i>A. aff. citrinoviridis</i>	<i>A. ramulosa</i>	<i>Solanum lasiophyllum</i>	<i>Chrysopogon fallax</i>
<i>Canthium latifolium</i>	<i>Eremophila georgei</i>	<i>E. latrobei</i>	
<i>A. distans</i>	<i>E. fraseri</i>	<i>Cassia helmsii</i>	
	<i>E. macmillaniana</i>	<i>Ptilotus obovatus</i>	
	<i>Gastrolobium laytonii</i>	<i>E. willsii</i>	
	<i>A. kempeana</i>	<i>E. pantonii</i>	
	<i>Calycopeplus ephedroides</i>	<i>A. daviesioides</i>	
	<i>Rulingia kempeana</i>		

Table 22. Commonest dominant species at Creekline Shrubland sites

Low trees	Tall shrubs	Mid shrubs	Low shrubs
<i>Acacia aneura</i>	<i>A. aneura</i>	<i>Eremophila fraseri</i>	<i>Solanum lasiophyllum</i>
<i>A. rhodophloia</i>	<i>A. craspedocarpa</i>	<i>Cassia helmsii</i>	<i>Ptilotus obovatus</i>
<i>A. cyperophylla</i>	<i>A. cuthbertsonii</i>	<i>C. nemophila</i>	<i>Abutilon</i> spp.
<i>A. burkittii</i>	<i>A. tetragonophylla</i>	<i>C. desolata</i>	<i>Cassia helmsii</i>
<i>A. acuminata</i>	<i>A. xiphophylla</i>	<i>C. artemisioides</i>	<i>Eremophila pumicea</i>
<i>A. citrinoviridis</i>	<i>Eremophila fraseri</i>	<i>E. platycalyx</i>	
<i>Eucalyptus coolabah</i>		<i>Rhagodia eremaea</i>	
<i>Casuarina obesa</i>		<i>Acacia kempeana</i>	
		<i>E. lineare</i>	
		<i>E. forrestii</i>	
		<i>Pimelea microcephala</i>	

General characteristics



Vegetation type 3: Creekline Shrubland: Koonmarra land system, Mount Gould station.

Creekline Shrubland is usually dominated by shrubs of mid and tall height, with a more or less developed narrow streamline community dominated by trees. There is often a well-marked vegetation zonation profile from the stream bed to the adjacent plain. The strength of this zonation is influenced by the degree of creekline development (i.e. small or large) and its associated depths of soil, slopes, and the size of the interfluvial shedding water to the drainage. These factors make area-based or transect-based quantitative condition assessment at any point along the creekline virtually impossible.

In most instances, total shrub and tree cover of Creekline Shrubland is higher than that of the adjacent slopes or plains, and generally 15 to 50% PFC, including more or less unvegetated channels.

Most sites are dominated by tall and mid-level shrubs, with lesser amounts of low shrub and tree cover. Perennial grasses are scarce or absent (see Creekline Grassy Shrubland), and, like tree cover, are more prominent in the north of the area.

Gradational associations

Creekline Shrubland intergrades with Creekline Grassy Shrublands, which tend to occur lower in the landscape where clayey alluvium has been patchily deposited.

Grazing impact and the condition of perennial vegetation

Creekline Shrublands frequently appear to be mildly to moderately degraded, in terms of the loss of palatable shrubs. Significant damage to the overstorey trees and tall shrubs is much less frequent. Accelerated erosion of the channels and major flow lines is common; often it is not clear to what extent this results from increased run-off arising from losses in ground cover on interfluvial areas adjacent to the drainage lines or, more locally, the banks of the channels.

Vegetation type 4: Creekline Grassy Shrubland

Creekline Grassy Shrubland is mainly found on major drainage lines and along associated channels through upland areas of **land types 1, 2** and their wash-drained systems in **land types 13 and 14**. Elsewhere, a more saline variant is common along some channels carried by alluvial systems of **land types 15 and 16**. Creekline Grassy Shrubland generally occurs lower in the drainage sequences where there are discontinuous deposits of clayey alluvium, and is more common in the northern half of the survey area.

Like Creekline Shrublands most Creekline Grassy Shrubland sites show marked vegetation zonations running more or less parallel with the channels.

Creekline Grassy Shrubland is usually characterised by a mosaic of very narrow zones of close tall shrubland or low woodland, fringing the channels, with clayey banks, levees and flood-outs on which patchy shrublands grow, with understorey grasses and

General characteristics



Vegetation type 4: Creekline Grassy Shrubland; Jundee land system, Karbar station.

sedges very unevenly distributed. Small-scale examination usually reveals that vegetation patchiness is strongly correlated with patchiness in the depth and distribution of soil type and soil surface characteristics.

Dominant woody species are similar to those listed under Creekline Shrubland, on some sites with the addition of salt-tolerant creekline species such as sheoak (*Casuarina obesa*) and river saltbush (*Atriplex amnicola*).

Table 23. Commonest perennial grasses and sedges at Creekline Grassy Shrubland sites

<i>Eriachne flaccida</i>	claypan grass
<i>Chrysopogon fallax</i>	ribbon grass
<i>Themeda australis</i>	kangaroo grass
<i>Eriachne benthamii</i>	
<i>Eleocharis pallens</i>	pale spike rush
<i>Juncus aridicola</i>	sedge
<i>Cyperus squarrosus</i>	curry sedge
<i>Stipa elegantissima</i>	feather speargrass
<i>Eulalia fulva</i>	silky browntop
<i>Enteropogon acicularis</i>	curly windmill grass

The species richness and density of palatable shrubs is similar to that of Creekline Shrubland; the perennial grass cover and content is very variable between sites.

Gradational associations

Creekline Grassy Shrubland intergrades and overlaps with Creekline Shrubland, particularly in higher areas, and with Non-Calcareous Shrubby Grassland on flood-outs and less incised concentrated drainages of the alluvial landscapes of land types 14, 15 and 16.

Grazing impact and the condition of perennial vegetation

Long-term monitoring of particular sites and reference areas would be required to distinguish patterns of change and potential from natural

variations between sites. Assessment of any acceleration of streamline erosion processes is, likewise, very difficult to determine, although the usual relationships between erosion minimisation through soil cover and the density and distribution of perennial grasses, sedges, herbs and shrubs can be expected to apply.

Generally speaking, Creekline Grassy Shrubland associations are probably widely if not ubiquitously degraded to various extents under high levels of grazing pressure from kangaroos, stock and feral animals. Even so, many creekline systems remain highly productive for pastoral purposes and function as drought refuges for grazing animals generally.

Vegetation type 5: Rocky Hill Mixed Shrubland

Rocky Hill Mixed Shrubland is very widespread and dominant over the rock-strewn higher units of systems of land type 1 and elsewhere on the upland units of systems of land types 2, 3 and 4. The vegetation type includes a wide variety of associations, the common features of which are either a lack of well-marked stratification or a predominance of mid-height shrubs, a lack of halophytic species, presence of species restricted to upland units (including perennial grasses) and an ability to thrive on mainly acidic skeletal soils (lithosols).

General characteristics



Vegetation type 5: Rocky Hill Mixed Shrubland: Weld land system, Dalgara station.

In approximately 50% of cases, the tall shrub stratum dominates the association; in the majority of other cases, the mid shrub stratum is dominant. Less frequently, either the low tree stratum or the low shrub stratum dominates, the former most often on ridges and dykes, the latter on high, windswept rounded summits and upper slopes. Total cover levels are between 10 and 25% (i.e. scattered to moderately close) in over 80% of sites examined. Perennial grasses are invariably scarce or absent, but where present are distinctive, with lemon scented grass (*Cymbopogon ambiguus*), mountain wanderrie (*Eriachne mucronata*) and greybeard grass (*Amphipogon strictus*).

Table 24. Shrubs and trees largely limited to Rocky Hill Mixed Shrubland sites

Species	Name
<i>Acacia grasbyi</i>	'tree form' miniritchie
<i>A. aff. citrinoviridis</i>	
<i>A. MRS No. 399</i>	
<i>Eremophila glutinosa</i>	
<i>Solanum ashbyae</i>	greater flannel bush
<i>Tribulus platypterus</i>	
<i>Spyridium sp. MRS 174</i>	
<i>Sarjojustica kempeana</i>	rock fern
<i>Cheilanthes austrotenuifolia</i>	

Commonest among very variable dominant species are mulga (*Acacia aneura*), grey turpentine bush (*Eremophila macmillaniana*) and cotton bush (*Ptilotus obovatus*).

Gradational associations

On lower slopes and spurs, Rocky Hill Mixed Shrublands show gradational changes and associations intermediate with Stony Mulga Mixed Shrubland and Granitic Mulga Shrubland. There are some floristic features in common with Lateritic Acacia Shrubland (e.g. abundance of *Eremophila latrobei* ssp. *glabra*, *Calytrix* sp., *Eriostemon brucei* and *Acacia linophylla*).

Grazing impact and condition of perennial vegetation

With most areas of this vegetation type rarely visited by domestic stock, and impact by feral goats and red kangaroos being limited by terrain (not favoured by red kangaroos), and a paucity of permanent stock watering points in such hilly areas, grazing impacts have rarely been of more than very local significance. Among the more sensitive indicators of grazing pressure are *Tribulus platypterus*, *Eriostemon brucei* and *Eremophila latrobei*, with *Eriachne mucronata* being preferentially grazed almost everywhere. The entire vegetation type, in combination with the landform, is mostly avoided by domestic stock wherever low lands and their vegetation are available. Grazing impact is often only evident on valley floors, along creek-lines and on lower slopes. The very depauperate, minimally developed soil profiles further dictate that plant mineral nutrition will be generally poor to very poor, with lower than average palatability and nutritional content to be expected of all the major browse species.

Erosion status: incidence of accelerated erosion

Accelerated erosion occurs only very locally, along creek-lines and drainage floors.

General conclusions and remarks

Seasonally, there is a limited and patchy response of annual grasses and forbs.

Rocky Hill Mixed Shrubland normally offers little general prospect for pastoral use and management. Where grazed, such areas tend to attract stock to very small pockets of country in the valleys and lowlands which mainly produce annual pasture in favourable seasons.

Vegetation type 6: Stony Mulga Mixed Shrubland

Stony Mulga Mixed Shrubland is found over large areas of the northern half of the survey area, particularly on the quartz-strewn plains of **land type 3**, where it is the predominant vegetation type on the Koonmarra and Mindura land systems. SMMS also occurs on major interfluvial units of systems of **land type 4**, especially on the Glenburgh and Robinson Range map sheets. To a lesser extent it is also encountered on lower units of some systems from **land types 1 and 2**.

Stony Mulga Mixed Shrubland and Hardpan Mulga Shrubland have many floristic similarities, but SMMS usually appears distinctively different as a consequence of its more scattered shrub cover and frequent dominance by *Eremophila* and *Acacia* species which are not typically members of Hardpan Mulga Shrubland associations, notably grey poverty bush (*Eremophila spathulata*), grey turpentine bush (*E. macmillaniana*), limestone fuchsia (*E. freelingii*) and Murchison willow (*Acacia demissa*). In the shrub layer, one or more species of perennial *Ptilotus* is usually conspicuous.

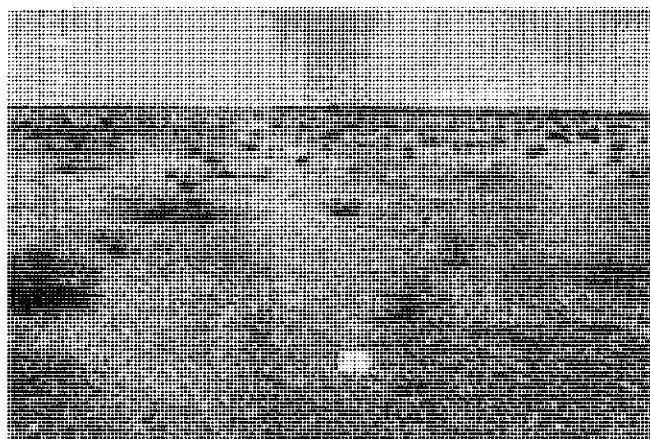
Typically, units supporting Stony Mulga Mixed Shrubland are gently convex to almost flat interfluvial slopes and plains based on Archaean gneissic and granitic rocks. The plains themselves are usually mantled by quartz cobbles and pebbles derived from dykes and other outcrops at the higher points of the landscape. The shallow loamy soils (Um5.51) encountered over such plains become progressively underlain by a hardpan layer as the interfluvial plains approach the wash plains found below them.

Table 25. Commonest dominant species at Stony Mulga Mixed Shrubland sites

Low trees	Tall shrubs	Mid shrubs	Low shrubs
<i>Acacia aneura</i> <i>A. pruinocarpa</i>	<i>A. aneura</i> <i>A. aff. quadrimarginea</i> <i>A. grasbyi</i>	<i>Eremophila macmillaniana</i> <i>E. spathulata</i> <i>A. aneura</i> <i>E. fraseri</i> <i>Cassia sturtii</i> <i>E. freelingii</i>	<i>E. spathulata</i> <i>Solanum lasiophyllum</i> <i>Ptilotus rotundifolius</i> <i>E. fraseri</i> <i>Cassia helmsii</i> <i>Ptilotus obovatus</i> <i>P. schwartzii</i>

Hydrologically, Stony Mulga Mixed Shrubland units shed run-off to narrow drainage lines. They are thus distinct from Hardpan Mulga Shrubland units lower in the landscape which receive run-on as sheet flow from the dispersal of water from higher drainage lines.

General characteristics



Vegetation type 6: Stony Mulga Mixed Shrubland: Narryer land system, Byro station.

Stony Mulga Mixed Shrubland is typically a mixed mid and low shrubland, with far fewer tall shrubs or trees than Hardpan Mulga Shrubland. Over 70% of all sites sampled supported total perennial cover of between 5 and 15% PFC (Figure 38). This open appearance, of mixed silvery and green shrubs set against the white quartz ground of the very gently undulating landscape is distinctive of much of this 'hard' mulga country in the upper Murchison. Relative proportions of total cover vary, particularly in the tall shrub and low tree strata: tall shrubs are rarely dominant and low trees are only present at about 50% of sites. Perennial grasses are normally absent or rare (unless some minor sandy unit is present) regardless of condition status.

A wide variety of palatable shrubs and perennial herbs occurs (Table 26). These are mainly non-halophytic species but include several of the less salt-tolerant bluebush species. Their distribution at individual sites is often somewhat patchy and local. For this reason, and the fact that palatable perennials often grow at only low densities (and in association with clumps of tall shrubs and decaying 'mulga log mounds') large transect areas are required to gauge their general level of abundance over any particular plain or slope.

Ungrazed or little grazed areas far (> 5 km) from stock watering more often supported three-winged bluebush (*M. triptera*) among other *Maireana* species. Although not usually considered to be a preferred palatable species, particular on alluvial surfaces, fenceline effects observed during the survey confirmed that three-winged bluebush has been widely eliminated and generally reduced by grazing in this vegetation type. Whether or not it was formerly ubiquitous, or of more patchy rather than general distribution is not known. At the time of the survey it was absent from the majority of sites.

Table 26. Main palatable woody perennial species at Stony Mulga Mixed Shrubland sites

<i>Ptilotus schwartzii</i>	horse mulla-mulla
<i>P. obovatus</i>	cotton bush
<i>P. rotundifolius</i>	showy mulla-mulla
<i>Eremophila compacta</i>	compact poverty bush
<i>E. latrobei</i>	warty fuchsia bush
<i>Maireana triptera</i>	three-winged bluebush
<i>M. thesioides</i>	lax bluebush
<i>M. convexa</i>	mulga bluebush
<i>M. georgei</i>	golden bluebush
<i>M. melanocoma</i>	pussy bluebush
<i>Rhagodia eremaea</i>	rhagodia, tall saltbush
<i>Grevillea deflexa</i>	red grevillea

Gradational associations

Stony Mulga Mixed Shrubland normally intergrades with several other main vegetation types. Geographically, it is mainly replaced by Granitic Mulga Shrubland south and west of a zone from the north-west corner of the Byro sheet to the south-east corner of the Belele sheet. At the land unit level, it merges with Rocky Hill Mixed Shrubland on the slopes of hills and on the higher rises and outcrops of the stony plains it dominates. While the relict areas of undisturbed perennials resemble Mulga Chenopod Shrubland in their composition of the low shrub layer, other differences in upper storey composition, soil type and landscape position indicate that typical Stony Mulga Mixed Shrubland sites are not merely degraded Mulga Chenopod Shrubland.

Across their lower extent, where stony plains meet hardpan plains, there is normally a transition zone with Hardpan Mulga Shrubland which follows the contour and extends downslope for several hundred metres.

Grazing impact and the condition of perennial vegetation

Number of condition sites investigated:	166
Site methodology:	C
Site variables analysed:	dominant species in association; projected foliar cover (PFC); plant density; species richness; palatable species density; palatable species richness; perennial diversity (Shannon-Weiner); palatable species diversity (Shannon-Weiner); species evenness (equitability); distance from stock water point; paddock quadrant; erosion status.

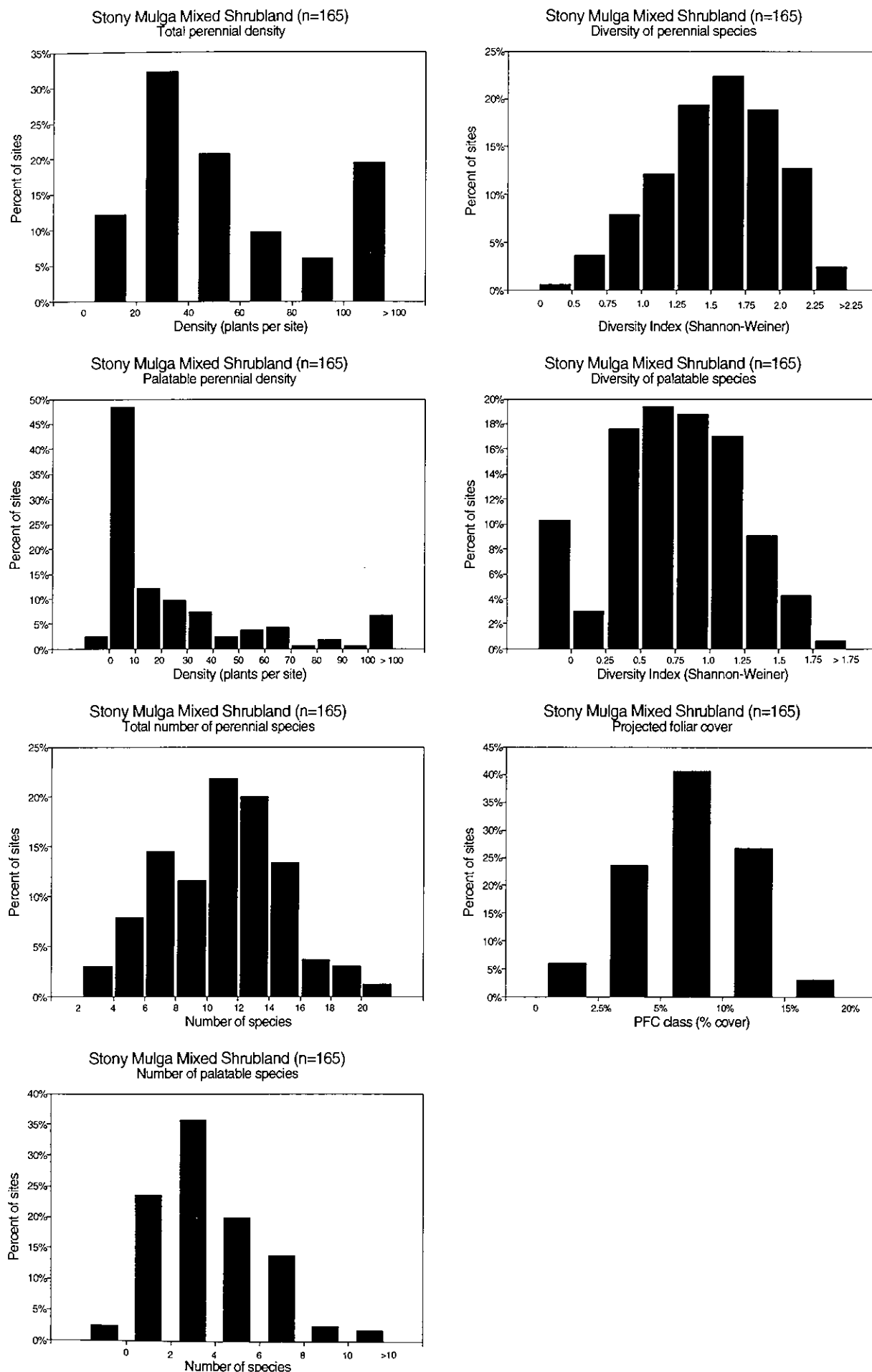


Figure 38. Frequency histograms for key vegetation characteristics of Stony Mulga Mixed Shrubland over the whole survey area; data from 2000 m² condition sites.

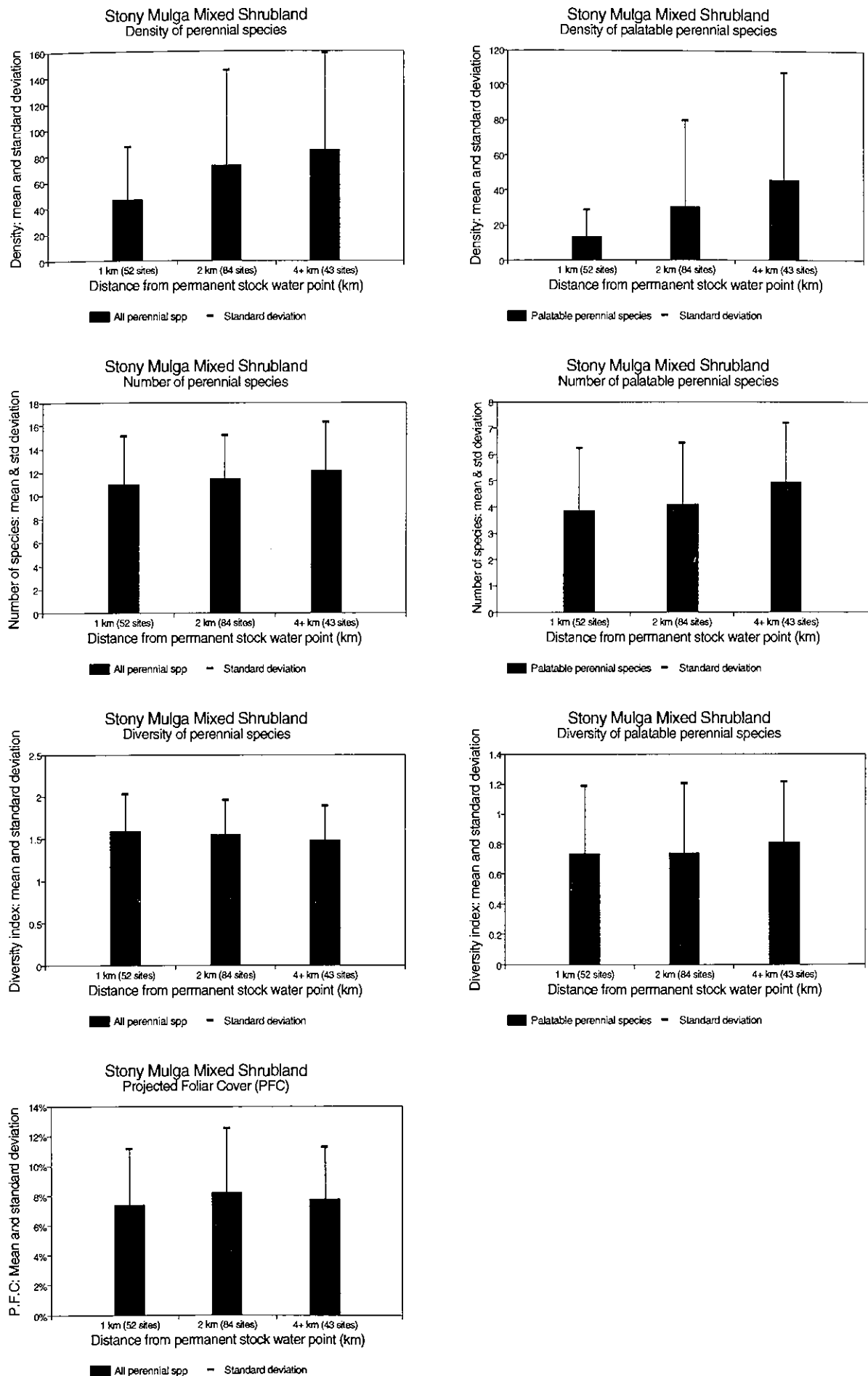


Figure 39. Vegetation attributes and the effect of site distance from the nearest stock water point for Stony Mulga Mixed Shrubland sites.

Results: condition of perennial vegetation: 4 classes

Class 1

Density of palatable woody perennials > 100/2000 m²

Species richness of palatable woody perennials
≥ 7/2000 m²

Class 2

Not as class 1

Density of palatable woody perennials > 25/2000 m²

Species richness of palatable woody perennials
≥ 4/2000 m²

Class 3

Not as class 1 or 2

Density of palatable woody perennials > 5/2000 m²

Species richness of palatable woody perennials
≥ 2/2000 m²

Class 4

Not as classes 1, 2 or 3

**Table 27. Site classification summary (n = 166)
Stony Mulga Mixed Shrubland sites**

Class	No.	%	Cumulative %
1	17	10	10
2	59	36	46
3	61	37	83
4	29	17	100

Erosion status: incidence of accelerated erosion

This vegetation type is not normally susceptible to accelerated erosion, even when severely degraded to near denudation. Only one site exhibited (minor) accelerated erosion in the entire survey.

General conclusions and remarks

The survey revealed marked patterns of reduced populations of total perennials and much reduced populations and species of palatable perennials at sites closer (1 and 2 km) to watering points (Figure 39). Sites with greatly reduced palatable perennial plants (classes 3 and 4) often exhibit compensatory increases in the cover of unpalatable *Eremophila* species as well as a general loss of *Acacia* species from the mid and upper storeys.

The causes of death of mulga and other tall shrubs (in evidence from standing dead wood) may not be attributable to any one cause. In general, regeneration of mulga from seedlings has as yet been poorer in Stony Mulga Mixed Shrubland than most of the other vegetation types in the survey area.

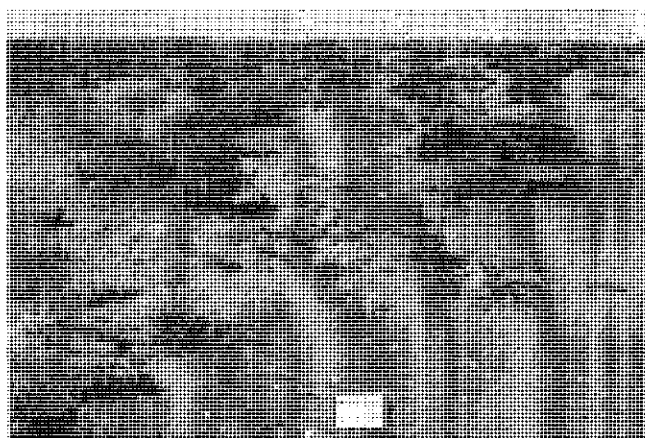
Stony Mulga Mixed Shrubland supports abundant annuals and ephemerals after effective rains. Perennial degradation may have increased the local susceptibility of these associations to fire when critical levels of herbage response not normally reached in the undegraded state occur.

Analysis of the site data suggests that densities of Stony Mulga Mixed Shrubland palatable perennials averaged significantly lower in the north-east quadrant of paddocks than elsewhere. This observation suggests that adverse grazing pressure which has resulted in the death, or lack of regeneration, of palatable shrubs has been particularly focussed on the north-eastern sectors of paddocks. Possibly, north-easterly winds have predominated and influenced grazing pressure during drought conditions or at times when shrub populations have been vulnerable on these landscapes.

Vegetation type 7: Granitic (and other baserock) Mulga Shrubland

Granitic (and other baserock) Mulga Shrubland occurs widely on rock-based plains and interfluvies of the 'hard mulga' country generally found adjacent to and slightly above the hardpan plains which receive their run-off as sheet drainage. A variety of underlying rocks and their colluvium are involved, with granites and other igneous rocks being by far the most widespread, although sedimentary rocks also feature in some areas. Major areas of Granitic Mulga Shrubland vegetation are found in **land type 4**, for which it is the most extensive vegetation type, particularly in the southern half of the area. To a lesser extent it occurs on equivalent units of **land types 2, 5 and 7** and irregularly elsewhere on other land types. Regardless of lithological types, the soils characteristic of Granitic Mulga Shrubland sites are shallow sandy loams with neutral reaction trends; they have developed over weathering parent rocks, which outcrop to some extent.

General characteristics



Vegetation type 7: Granitic Mulga Shrubland: Challenge land system, Boolardy station.

Table 28. Commonest dominant species at Granitic (and other base rock) Mulga Shrubland sites

Low trees	Tall shrubs	Mid shrubs	Low shrubs
<i>Acacia aneura</i>	<i>A. aneura</i>	<i>A. tetragonophylla</i>	<i>Ptilotus obovatus</i>
	<i>A. grasbyi</i>	<i>A. craspedocarpa</i>	<i>Solanum lasiophyllum</i>
	<i>A. cuthbertsonii</i>	<i>Cassia phyllodinea</i>	<i>E. punicea</i>
	<i>A. xiphophylla</i>	<i>A. ramulosa</i>	<i>C. helmsii</i>
	<i>A. victoriae</i>	<i>Eremophila fraseri</i>	<i>P. schwartzii</i>
	<i>A. quadrimarginea</i>	<i>Hakea arida</i>	<i>E. exilifolia</i>
	<i>A. burkittii</i>	<i>A. quadrimarginea</i>	<i>Sida calyxhymenia</i>
	<i>A. craspedocarpa</i>	<i>E. platycalyx</i>	<i>E. aff. mackinlayi</i>
		<i>E. exilifolia</i>	<i>Maireana convexa</i>
		<i>Cassia helmsii</i>	<i>M. triptera</i>

About 70% of sites are dominated by the tall shrub stratum, the remainder being dominated by either mid or low shrubs, or both lower strata co-dominantly. Over 30% of sites support a tree storey, which is dominated by tree-form mulgas in nearly all instances. Mulga (*Acacia aneura*) dominates the tall shrub layer at approximately 40% of sites, while minieritchie (*A. grasbyi*), snakewood (*A. xiphophylla*), fine leaf jam (*A. burkittii*), prickly acacia (*A. victoriae*), *A. cuthbertsonii* or Murchison willow (*A. demissa*) are dominant elsewhere. The total perennial cover is between 5 and 20% PFC in 80% of cases (Figure 40).

Among the low and mid shrubs, cotton bush (*Ptilotus obovatus*) and banana leaf cassia (*Cassia phyllodinea*) are the commonest dominants (Table 28).

As with Hardpan Mulga Shrubland, perennial grasses are not normally present.

Total perennial cover levels for Granitic Mulga Shrubland have the same central tendency (10-15%) as Hardpan Mulga Shrubland sites, but the normal range of variation (variance) is less and no grove-intergrove patterning is evident.

Non-halophytic species make up the vast majority of the palatable perennial shrubs and herbs which constitute the browse potential of this vegetation. The range of palatable species is similar to that encountered at Hardpan Mulga Shrubland sites, with some significant differences, such as the general absence of flat leaved bluebush (*Maireana planifolia*), mulga broombush (*Spartothamnella teucriflora*), red grevillea (*Grevillea deflexa*), *Hibiscus gardneri* and Wilcox bush (*Eremophila forrestii*) from most sites, and the inclusion of ruby saltbush (*Enchylaena tomentosa*), three-winged, golden and lax bluebushes (*Maireana triptera*, *M. georgei* and *M. thesioides*) on many sites.

It is interesting that, irrespective of differences in underlying geology, landform, surface hydrology and perennial species composition, the following general community attributes of the two types Granitic Mulga Shrubland and Hardpan Mulga Shrubland showed no significant differences (for 1000 m² sites over the survey areas as a whole):

- total density of perennials;
- density of palatable perennials;
- species richness and diversity of perennials;
- and species richness and diversity of palatable perennials.

Gradational associations

Granitic Mulga Shrubland intergrades with Stony Mulga Mixed Shrubland in some northern parts of the area, where some interfluvial plains (particularly of the Sherwood land system) based on granites and gneiss resemble a blend of the two types. Their similar landscape aspects, and surface mantles of pebbles and gravels add to the resemblance, although Granitic Mulga Shrubland sites are normally associated with lighter hued, pinkish, sandier soil surfaces carrying finer quartz grits than the more clayey, crusted, pebbled or cobbled surfaces of Stony Mulga Mixed Shrubland sites.

At the highest parts of the interfluvial plains, Granitic Mulga Shrubland normally has a transition zone to Rocky Hill Mixed Shrubland, for example around the boundary between Challenge and Norie land systems. At the lower end of the topography, there are normally only abrupt transitions to Creekline Shrubland or Creekline Grassy Shrubland, while there is a much broader transition zone where the interfluves flatten out and become veneered with hardpan at the upper limits of the 'wash' plains (land types 13 and 14) and the Hardpan Mulga Shrubland.

Grazing impact and the condition of perennial vegetation

No. of condition sites investigated:	117
Site methodology:	D
Site variables analysed:	dominant species in association; projected foliar cover (PFC); plant density; species richness; palatable species density; palatable species richness; perennial diversity (Shannon-Weiner); palatable species diversity (Shannon-Weiner); species evenness (equitability); distance from stock water point; paddock quadrant; erosion status.

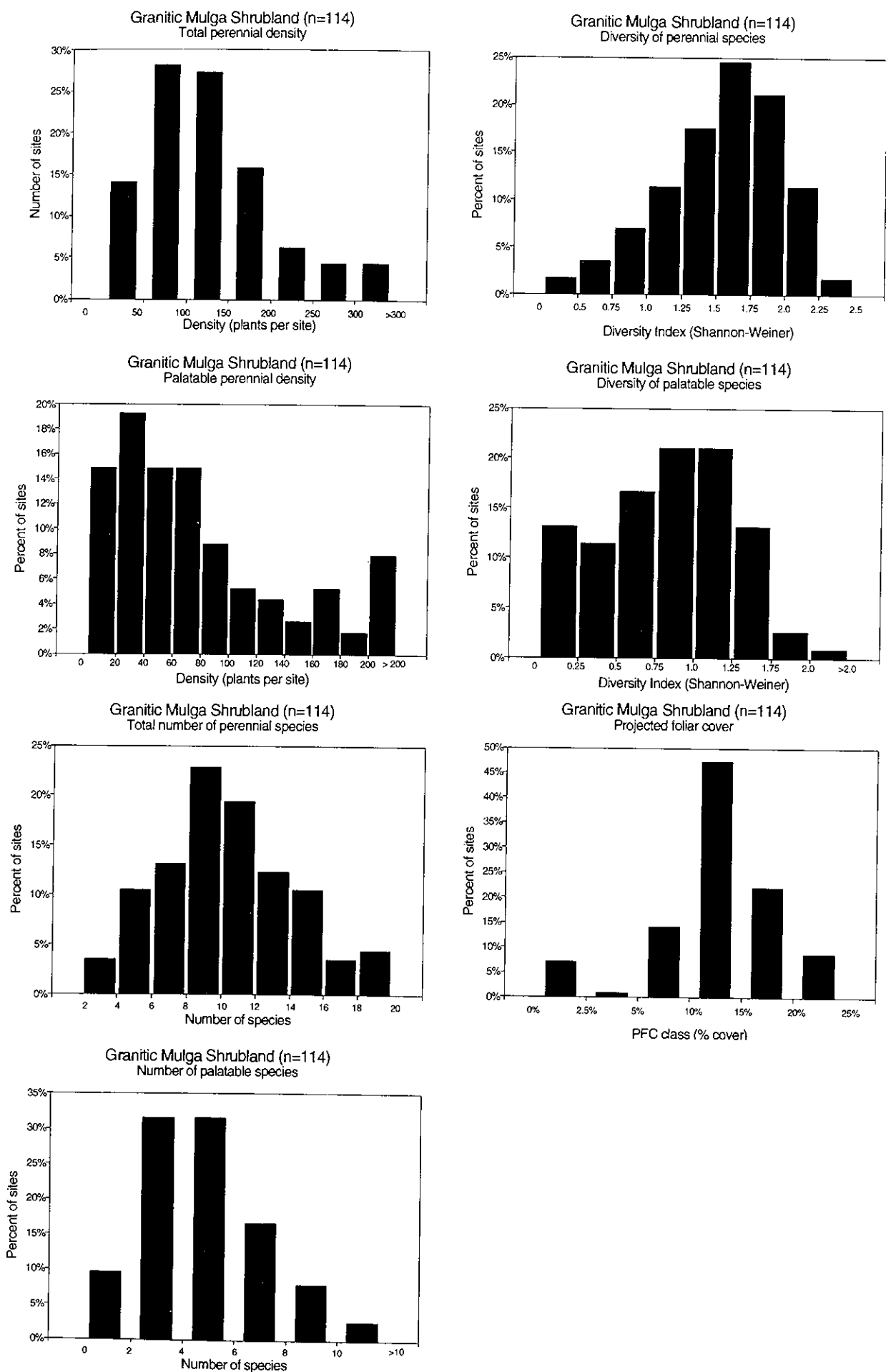


Figure 40. Frequency histograms for key vegetation characteristics of Granitic Mulga Shrubland over the whole survey area; data from 1000 m² condition sites.

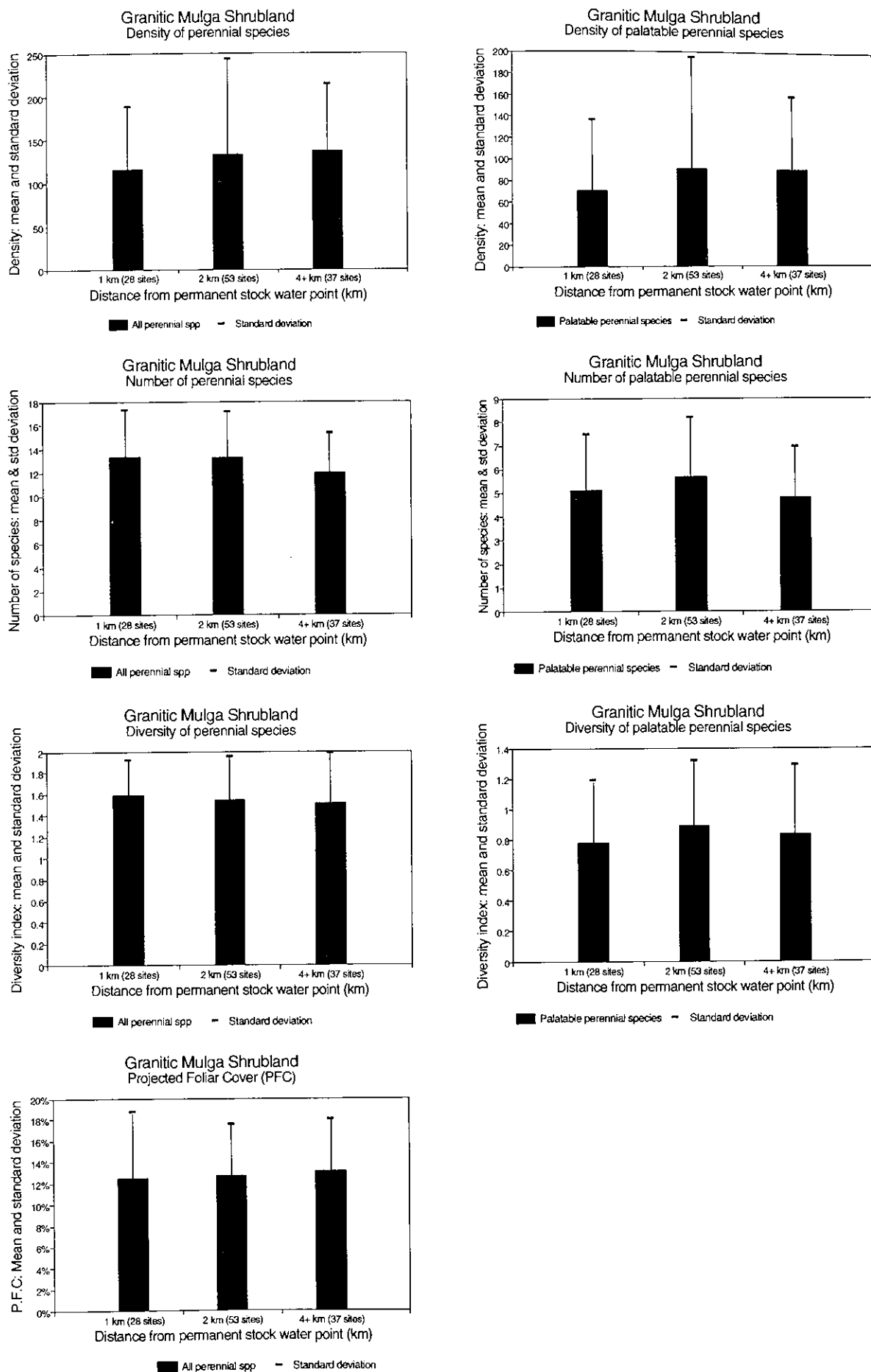


Figure 41. Vegetation attributes and the effect of site distance from the nearest stock water point for Granitic Mulga Shrubland sites.

Table 29. Main palatable woody perennial species at Granitic (and other base rock) Mulga Shrubland sites

<i>Ptilotus obovatus</i>	cotton bush
<i>Maireana convexa</i>	mulga bluebush
<i>Rhagodia eremaea</i>	rhagodia, tall saltbush
<i>Eremophila compacta</i>	compact poverty bush
<i>E. aff. mackinlayi</i>	
<i>E. muelleriana</i>	round leaved eremophila
<i>Ptilotus schwartzii</i>	horse mulla-mulla
<i>Maireana thesioides</i>	lax bluebush
<i>Sida calyxhymenia</i>	tall sida
<i>M. georgei</i>	golden bluebush
<i>M. sp. nov.</i>	
<i>M. villosa</i>	
<i>Enchylaena tomentosa</i>	ruby saltbush

Results: condition of perennial vegetation: 4 classes

Class 1

Density of palatable woody perennials $> 85/1000 \text{ m}^2$

Species richness of palatable woody perennials $\geq 4/1000 \text{ m}^2$

Class 2

Not as class 1.

Density of palatable woody perennials $\geq 50/1000 \text{ m}^2$

Class 3

Not as classes 1 or 2.

Density of palatable woody perennials $\geq 20/1000 \text{ m}^2$

Total density of woody perennials $\geq 30/1000 \text{ m}^2$

Class 4

Not as classes 1, 2 and 3.

Table 30. Site classification summary (n = 117) Granitic Mulga Shrubland sites

Class	No.	%	Cumulative %
1	32	27	27
2	39	33	60
3	28	24	84
4	18	16	100

Erosion status: incidence of accelerated erosion

Granitic Mulga Shrubland is not normally susceptible to accelerated erosion. Minor erosion was observed at one site only.

General conclusions and remarks

Extensive sampling of Granitic Mulga Shrubland sites indicated that the best indicators of long-term grazing impact (and thus condition states) are the total number and density of woody perennials and the

density of palatable perennial species. Both characteristics showed populations, on average, increasing with distance from stock watering points (Figure 41). Other key characteristics, such as perennial cover, species richness and diversity of all woody perennials, and of the palatable species, showed no significant differences in relation to distance from water (see Hardpan Mulga Shrubland).

Severely degraded Granitic Mulga Shrubland sites appear to be rare. This type is evidently more resistant to denudation than Hardpan Mulga Shrubland sites, and the tendency for sites to show increases in the size and cover of curara (*Acacia tetragonophylla*) and turpentine bush (*Eremophila fraseri*) is far less. The different surface hydrology of Granitic Mulga Shrubland interfluvial units renders the type almost unaffected by roads and tracks which cause water starvation-induced degradation within Hardpan Mulga Shrubland areas.

Vegetation type 8: Lateritic Acacia Shrubland

Lateritic Acacia Shrubland is a relatively localised type which occurs mainly on the gently sloping gravelly plains of the broad alluvial fans and stripped lateritic surfaces found on land type 7, particularly widely on Violet and Waguin land systems. Lateritic Acacia Shrubland associations are variable, but usually feature dominance by bowgada (*Acacia ramulosa*) and a loosely clumped or weakly groved pattern of tall shrub cover. The understorey vegetation consists of a mixture of medium and low shrubs plus occasional perennial wanderrie grasses. Lateritic Acacia Shrubland grows on sandy loam soil often showing abundant lateritic gravels, both on the surface and through the profile, which overlies laterite, hardpan or weathered granite.

General characteristics



Vegetation type 8: Lateritic Acacia Shrubland, Waguin land system, Jingemarra station.

Lateritic Acacia Shrubland is mainly observed as a scattered to moderately close (PFC 10 to 30%) tall shrubland dominated by bowgada or mulga (*A. aneura*) with some *A. quadrimarginea*. Among the

Table 31. Commonest species at Lateritic Acacia Shrubland sites

Tall shrubs and low trees	Mid shrubs	Low shrubs	Perennial grasses
<i>Acacia ramulosa</i>	<i>A. ramulosa</i>	<i>Eremophila compacta</i>	<i>Monachather paradoxa</i>
<i>A. aneura</i>	<i>A. aneura</i>	<i>Ptilotus schwartzii</i>	<i>Eragrostis eriopoda</i>
<i>A. quadrimarquina</i>	<i>Eremophila forrestii</i>	<i>Sida rohlenae</i>	<i>E. lanipes</i>
<i>Canthium lineare</i>	<i>Cassia nemophila</i>	<i>Solanum lasiophyllum</i>	
<i>C. latifolium</i>	<i>Rhagodia eremaea</i>	<i>Borya nitida</i>	
<i>A. tetragonophylla</i>	<i>Thryptomene maisonneuii</i>	<i>Maireana villosa</i>	
<i>A. pruinocarpa</i>		<i>M. convexa</i>	

variable understorey are some distinctive combinations of species, such as *Thryptomene* spp., horse mulla-mulla (*Ptilotus schwartzii*), *Canthium* spp. and, on areas with thin soil, *Borya nitida*. Sandy accumulations often support wanderrie grasses, mainly *Monachather paradoxa*, a combination of poverty bushes (*Eremophila*) spp. and various small bluebushes (*Maireana* spp.) under the bowgada canopies.

Gradational associations

Lateritic Acacia Shrublands normally show gradations with Sandplain Wanderrie Grassy Shrubland, Sandplain Acacia Shrubland, Hardpan Mulga Shrubland and Granitic Mulga Shrubland. At the upper extremities of the toposequence it meets the (undescribed) low shrubland of the breakaway plateaux and laterite crests.

Grazing impact and the condition of perennial vegetation

This vegetation type is rarely observed in a conspicuously degraded state and does not appear to be preferentially grazed in most circumstances. Lower wash plains and adjacent stony, more saline plains on weathered rock are both normally found nearby in the same paddock.

Palatable perennials are often largely confined to the shelter of tall shrub canopies, with the notable exception of horse mulla-mulla, which may be a useful and responsive indicator of grazing impact. The other main species grazed are bluebushes (*M. convexa*, *M. villosa*, *M. thesioides*) and other species such as tall saltbush, tall sida, warty fuchsia bush and cotton bush.

Lateritic Acacia Shrubland sites are not normally subject to accelerated erosion.

Vegetation type 9: Non-Calcareous Shrubby Grassland

Non-Calcareous Shrubby Grassland occurs mainly on units of the alluvial land systems of **land types 15** and **16**. Non-Calcareous Shrubby Grassland is found on broad, mostly unchannelled drainage lines with red and brown clayey soils (either Northcote Uf or Gn) and also, in a distinctive 'black mulga' association, as a grassy low woodland on non-saline flood plains of the Beringarra land system, where this vegetation type grows on deep clay soils (Uf6.12).

Non-Calcareous Shrubby Grassland appears to be mainly highly productive for pastoral purposes but is nowhere a major component of vegetation on an area basis.

General characteristics



Vegetation type 9: Non-Calcareous Shrubby Grassland: Yandil land system, Belele station.

On unchannelled drainage lines, Non-Calcareous Shrubby Grassland is generally encountered as an association of clumped shrubs and low trees, with a patchy understorey of perennial grasses. On non-saline flood plains elsewhere, Non-Calcareous Shrubby Grassland is more closely wooded (PFC 30 to 50%) by black mulga (*Acacia distans*), in addition to the tall shrub component, and the perennial grass component is more often dominated by the highly palatable *Eriachne* aff. *benthamii* rather than by claypan grass (*Eriachne flaccida*).

Gradational associations

On flood plains at slightly higher levels in the riverine landscape, Non-Calcareous Shrubby Grassland intergrades with Riverine Mixed Shrubland. Otherwise, many sites on low-lying flood-outs within the broad type are dominated by perennial grass and tree cover, and thus qualify as Alluvial Tussock Grassland.

Grassy shrubland sites along major drainage lines through the wash plains of **land types 13** and **14** locally resemble Non-Calcareous Shrubby Grassland sites in both structure and composition, but are normally considered to be part of the normal range of variation for Creekline Grassy Shrubland.

Table 32. Commonest dominant species at Non-Calcareous Shrubby Grassland sites

Low trees	Tall shrubs	Mid and low shrubs	Perennial grasses
<i>Acacia distans</i>	<i>A. tetragonophylla</i>	<i>Cassia helmsii</i>	<i>Eriachne flaccida</i>
<i>A. aneura</i>	<i>A. aneura</i>	<i>E. laanii</i>	<i>E. aff. benthamii</i>
<i>Eucalyptus coolabah</i>	<i>Scaevola spinescens</i>	<i>Solanum horridum</i>	
<i>Grevillea striata</i>	<i>Eremophila laanii</i>	<i>S. lasiophyllum</i>	
	<i>A. wiseana</i>	<i>E. fraseri</i>	
		<i>Rhagodia eremaea</i>	

Grazing impact and the condition of perennial vegetation

Both perennial grasses and palatable shrubs (particularly mulla-mullas (*Ptilotus obovatus*, *P. divaricatus* and *P. lazarides*), tall saltbush (*Rhagodia eremaea*) and flat-leaved bluebush *Maireana planifolia*) are susceptible to overgrazing. Many sites have few palatable perennials, with the perennial grasses severely reduced. Grazing by uncontrolled populations of kangaroos may have a major influence on the lack of recovery shown by some sites, which have no associated problems of erosion but may well be chronically deficient in mature, seeding plants and young plants of palatable species and seed stores generally. Sites on the gradational soils of the drainage lines are susceptible to scalding and the formation of incipient claypans on degraded areas receiving water-borne deposits.

Otherwise, degraded sites tend to support very large shrubs and variable tree cover, with an understorey mainly reduced to annual herbage.

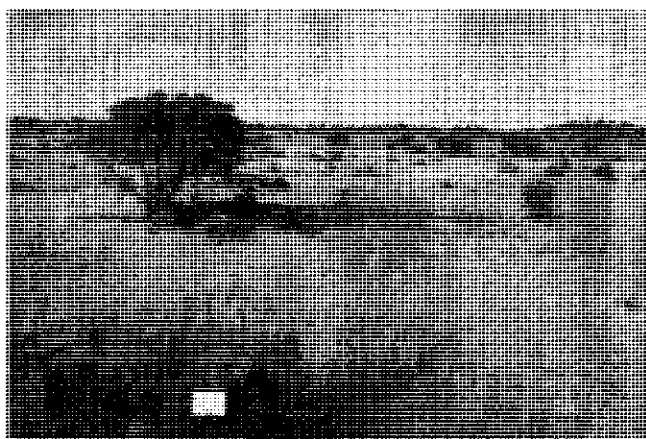
Vegetation type 10: Alluvial Tussock Grassland

In terms of grazing capacity per unit area, Alluvial Tussock Grassland is undoubtedly the most productive vegetation type in the area. The only significant areas exist on parts of the broad flood plains of the Beringarra land system (**land type 16**) in the north and centre of the region. However, its consideration as a major type of vegetation is justified mainly by records from the Merbla land system (**land type 18**) where Alluvial Tussock Grassland is found mixed with Saltbush and Bluebush Shrubland over the major units of this very localised land system. It is also found on the Wooleen land system (**land type 19**) where it covers large parts of the lake bed units.

Otherwise, Alluvial Tussock Grassland grows on usually small and isolated claypans and swampy drainage foci with clay soils which are found on several systems of the alluvial **land types 14, 15 and 16**, and also to a very minor extent on the internal drainages of greenstone areas in **land types 2 and 5**. Such perennial grassland is thus normally confined to small, isolated run-on sites with deep clay soils (massive to self-mulching and cracking types, Northcote Uf6 and Ug6).

Alluvial Tussock Grassland sites are mainly open grasslands, with only rather sparse basal cover (usually < 1%, more rarely up to 3 to 4%) with some

General characteristics



Vegetation type 10: Alluvial Tussock Grassland: Trillbar land system, Karbar station.

cover by trees and shrubs, particularly around the margins of pans and ephemeral swamps.

Dominant perennial grasses are neverfail (*Eragrostis setifolia*) and claypan grass (*Eriachne flaccida*); also, salt water couch (*Sporobolus virginicus*) is the dominant (usually with lovegrass, *Eragrostis dielsii*) on brackish lakebeds of the Wooleen land system.

Among the woody vegetation, many sites support scattered to isolated trees (*Eucalyptus coolabah*, *Grevillea striata*, *Pittosporum phylliraeoides*) and clumps or fringes of tall shrubs, mainly curara (*Acacia tetragonophylla*) and *Eremophila* spp., with or without lower shrubs such as sage (*Cratystylis subspinescens*), currant bush (*Scaevola spinescens*), river saltbush (*Atriplex amnicola*), rhagodia (*Rhagodia eremaea*) and fuchsia bush (*Eremophila maculata*).

Gradational associations

As mentioned previously, Alluvial Tussock Grassland exists in an apparently stable association with Bluebush Shrubland on major units of the Merbla land system. Otherwise, it is found mainly on lake beds and minor alluvial units of many different systems. Such drainage foci are usually distinct and discrete, with sharp boundaries to surrounding vegetation types, although minor flood-outs along major and tributary drainage courses resemble a full range of intermediate (shrubbier) states to Non-Calcareous Shrubby Grassland. Such units are common on systems such as Beringarra, Cunyu and Yandil.

Grazing impact and the condition of perennial vegetation

Such vegetation appears to be resilient even under concentrated grazing pressure. Undoubtedly, prolonged periods of inundation which follow major rains serve to protect perennial plants during part of their growth periods, through inaccessibility to stock. Even so, many sites appear to have become degraded through concentrations of grazing pressure by stock, feral and native animals. Patchiness or thinning of the grass tussock cover, perhaps as a consequence of a lack of recruitment by young plants, is frequently observed. On some sites, even-aged recruitment by unpalatable shrubs such as crinkled cassia (*Cassia helmsii*) has occurred.

Highly palatable species, particularly *Eriachne benthamii* and neverfail grass (*Eragrostis setifolia*) are probably the best indicators of vegetation condition. Although claypan grass (*Eriachne flaccida*) provides useful forage for livestock it is not regarded as being as highly palatable as the other grass species.

Condition of perennial vegetation

Insufficient sites were investigated to make any assessment of the area. A suggested condition classification is as follows:

Site methodology: E

Results: condition of perennial vegetation: 3 classes

Class 1

Palatable perennial grass(es) dominant among perennial grasses. Perennial grass cover dominant over shrubs.

Class 2

Palatable perennial grass(es) dominant among perennial grasses. Shrub cover exceeds perennial grass cover.

Class 3

Not class 1 or 2.

General conclusions and remarks

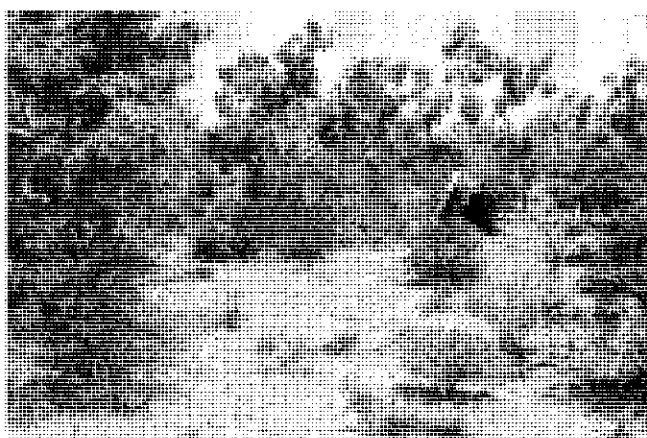
Some sites with degraded perennial grasses appear to have undergone secondary increases by unpalatable shrubs such as needle bush (*Hakea preissii*) and harlequin fuchsia bush (*Eremophila linearis*).

This vegetation type is not normally susceptible to accelerated erosion.

Vegetation type 11: Riverine Mixed Shrubland

Riverine Mixed Shrubland occurs on non-saline to slightly saline flood plains and unchannelled flow zones of the major rivers, on heavier clay loam or clayey soils of moderate depth, which are usually underlain by either cemented alluvium or red-brown hardpan. This is another structurally variable vegetation type, but one which is basically tall and mid-height shrubland with a tree storey and many forage shrubs. Riverine Mixed Shrubland mostly occurs on land systems of **land types 15** and **16**, particularly on Beringarra and Mileura land systems. Although no empirical information is available, Riverine Mixed Shrubland can be assumed to have high pastoral value from its botanical composition and favoured moisture status, being in close proximity to river channels and their underlying alluvium and associated shallow aquifers.

General characteristics



Vegetation type 11: Riverine Mixed Shrubland: Beringarra land system, Meeberrie station.

Riverine Mixed Shrubland associations are composed partly by species typical of Hardpan Mulga Shrubland (found higher and adjacent in the landscape) and others found widely among more saline shrublands (such as Bluebush and Mixed Halophyte Shrubland) with others which are generally confined to Riverine Mixed Shrubland and Non-Calcareous Shrubby Grassland types.

Most sites are dominated by tall or mid-shrubs, although on others the low shrub stratum is the major component of the cover. About 90% of sites support some tree cover, while perennial grasses are always scarce or absent. Usually, a combination of scattered

Table 33 Commonest dominant species at Riverine Mixed Shrubland sites

Low trees	Tall shrubs	Mid shrubs	Low shrubs
<i>Eucalyptus coolabah</i> <i>Grevillea striata</i> <i>Acacia distans</i>	<i>A. tetragonophylla</i> <i>A. victoriae</i> <i>A. sclerosperma</i> <i>A. aneura</i> <i>Eremophila laanii</i>	<i>A. victoriae</i> <i>A. tetragonophylla</i> <i>Scaevola spinescens</i> <i>Cassia desolata</i> <i>Rhagodia eremaea</i> <i>Stylobasium spatulatum</i>	<i>Ptilotus obovatus</i> <i>Eremophila maculata</i> <i>Cassia desolata</i> <i>Solanum lasiophyllum</i> <i>P. lazarides</i>

overstorey coolabahs (*Eucalyptus coolabah*), and beefwood (*Grevillea striata*) trees with a mixture of shrubs featuring curara (*Acacia tetragonophylla*), and prickly acacia (*A. victoriae*), (rather than much mulga, *A. aneura*) with cotton bush (*Ptilotus obovatus*), fuchsia (*Eremophila maculata*), currant bush (*Scaevola spinescens*), occasional sage (*Cratystylis subspinescens*) and river saltbush (*Atriplex amnicola*), make up a landscape which is distinctively recognisable as 'river country'.

Total perennial cover levels for Riverine Mixed Shrubland are mainly 10 to 20% but locally lower where severely degraded.

The range of palatable perennials is very broad, with much local variation. Cottonbush and fuchsia are the most abundant, with others including sage, river saltbush, frankenia (*Frankenia* spp.), currant bush, mulla-mullas (*Ptilotus lazardes*, *P. divaricatus* and *P. polakii*), rhagodia (*Rhagodia eremaea*), *Maireana* sp. nov. and spiny bluebush *M. aphylla*.

Gradational associations

Riverine Mixed Shrubland intergrades with Hardpan Mulga Shrubland along the line where wash plain systems (**land types 13 and 14**) drain sheet flow onto the river plains (**land types 15 and 16**). On the ground, this normally represents a zone up to 500 m wide, parallel with each arm of the river. Riverine Mixed Shrubland also intergrades with the more saline, mainly duplex plains of Saltbush, Bluebush and Mixed Halophytic Shrubland at transition zones lower in the alluvial catenas.

Otherwise, Non-Calcareous Shrubby Grassland associations, such as the 'black mulga' (*A. distans*) country of the Beringarra land system, are a similar grassier type growing only on deep non-saline clay soils.

Grazing impact and the condition of perennial vegetation

No. of condition sites investigated:	16
Site methodology:	B
Site variables analysed:	dominant species in association; projected foliar cover (PFC); species composition index (SCI); ratio of palatable to unpalatable species (RPU); erosion status; and distance from permanent water.

Results: condition of perennial vegetation: 3 classes

Class 1

A palatable species is the dominant or co-dominant cover perennial.

Class 2

Dominant cover perennial is not an unpalatable species with invasive tendencies. Palatable species are present on site.

Class 3

Dominant cover perennial is an unpalatable species with invasive tendencies.

Table 34. Site classification summary (n = 16) Riverine Mixed Shrubland sites

Class	No.	%	Cumulative %
1	4	25	25
2	5	31	56
3	7	44	100

General conclusions and remarks

The shrub strata of Riverine Mixed Shrubland in good condition are usually dominated or co-dominated by one or more palatable shrub species. Only sites which had evidently been subject to overgrazing showed the apparently secondary increases by unpalatable species, such as prickly acacia (*Acacia victoriae*), silver poverty bush (*Eremophila pterocarpa*), needle bush (*Hakea preissii*), or variable cassia (*Cassia sturtii*). Only at such sites is the occurrence of accelerated erosion common. Eroded sites show no difference in the range of total tree and shrub cover (PFC), indicating that once initiated, erosion is able to proceed and is not necessarily mitigated by increases in the density and cover of unpalatable invasive shrubs. This finding is common to several major vegetation types in the area (see Bluebush Shrubland, Saltbush Shrubland).

Vegetation type 12: Calcrete Shrubby Grassland

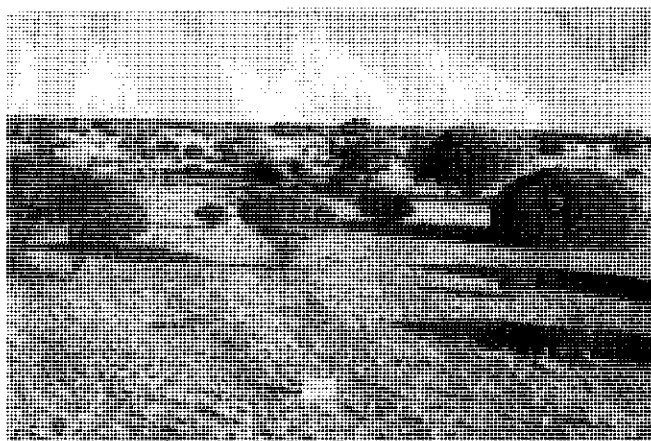
Calcrete Shrubby Grassland is a distinctive association of perennial grasses and a wide variety of shrubs that is confined to calcrete platforms on the alluvial landforms of **land type 15** and, to a lesser extent, **land type 16**.

Floristically, Calcrete Shrubby Grassland is very different from other vegetation types with only poorly developed between-type transitions. Such distinctiveness can be attributed to its special soil types, which are thin sands or gradational calcareous soils. Developed on calcrete, they are strongly alkaline in soil reaction trend.

While the broadscale occurrence of the type is limited to the vicinity of the major river plains and tributaries of the salt lakes, Calcrete Shrubby Grassland provides preferred grazing land for stock

and other herbivores. Almost every area of this type has received 80-110 years of concentrated grazing pressure because of the close proximity of wells and bores sunk into nearby alluvium. Of all the vegetation types, it is probably the most difficult to describe the likely original cover and botanical composition, except to surmise that the perennial grass component was much greater, in terms of both biomass and cover, than it is anywhere today. No satisfactory reference sites or grazing exclosures exist in the area.

General characteristics



Vegetation type 12: Calcrete Shrubby Grassland: Cunyu land system, Nallan station.

Calcrete Shrubby Grassland, in its normal degraded states appears as a shrubland of mixed and very variable stratification, with scattered trees, tall, mid and low shrubs, with some perennial grass present but grazed very hard at most sites. Total cover by woody perennials is also very variable, up to about 25%. Among the more distinctive shrubs and trees are beefwood (*Grevillea striata*), limestone wattle (*Acacia sclerosperma*), umbrella wattle (*A. ligulata*), poplar (*Codonocarpus cotinifolius*), desert cassia (*Cassia nemophila*), pink seeded bluebush (*Maireana trichoptera*), ragged leaf scaevola (*Scaevola tomentosa*) and, in the vicinity of gypsiferous alluvium and some salinity, limestone poverty bush (*Eremophila miniata*).

The herbaceous layer is composed of a combination of perennial grasses, mainly *Enneapogon caeruleus* or *E. nigricans*, and *Eragrostis pergracilis*, together with semi-perennial and annual grasses (mainly *Stipa scabra* with shorter-lived *Eragrostis* and wind grass, *Aristida contorta*) and facultative perennial herbs including bindiis (*Sclerolaena* spp.), and cannon balls (*Dissocarpus paradoxus*).

The extent of perennial grass cover is rarely more than patchy and sometimes locally absent. Grazing pressures are usually very high, including grazing by rabbits whose warrens are widely distributed through the calcrete platforms. Perennial grass butts are most often seen in an almost completely defoliated state. A close scrutiny of the soil surface is often required to determine whether or not there are living rhizomes on the soil surface. The major palatable species (*Enneapogon* sp. and *Eragrostis pergracilis*) are usually found together in mixed patches.

Table 36. Commonest palatable perennial species at Calcrete Shrubby Grassland sites

Shrubs	
<i>Maireana trichoptera</i>	pink seeded bluebush
<i>Enchylaena tomentosa</i>	ruby saltbush
<i>Ptilotus obovatus</i>	cotton bush
<i>Scaevola tomentosa</i>	ragged leaf scaevola
<i>S. spinescens</i>	currant bush
<i>Rhagodia eremaea</i>	rhagodia, tall saltbush
<i>Maireana pyramidata</i>	sago bush
Grasses	
<i>Eragrostis pergracilis</i>	
<i>Enneapogon</i> spp.	

Gradational associations

On saline sites, Calcrete Shrubby Grassland becomes mixed with Bluebush, Saltbush Shrubland or, in the far east of the area, with a woodland overstorey of *Eucalyptus striatocalyx*. Otherwise, Calcrete Shrubby Grassland generally exists as areas which are as extensive as each calcrete platform with very little zonation or gradational zones of transition to other types.

Highly saline depressions within broad platforms often support Samphire or Mixed Halophytic Shrubland units within the larger area.

Several shrubby species appear to have invasive tendencies and can recruit as even-aged stands on degraded sites. These species include *Cassia nemophila*, *C. helmsii*, *Dissocarpus paradoxus* and, at least on the Wooramel River, mulga (*A. aneura*).

Grazing impact and the condition of perennial vegetation

No. of condition sites investigated:	11
Site methodology:	E

Table 35. Commonest dominant species at Calcrete Shrubby Grassland sites

Low trees and tall shrubs	Mid-shrubs	Low shrubs	Perennial grasses
<i>Acacia aneura</i>	<i>Cassia nemophila</i>	<i>C. nemophila</i>	<i>Enneapogon</i> spp.
<i>A. sclerosperma</i>	<i>A. sclerosperma</i>	<i>Ptilotus obovatus</i>	<i>Eragrostis pergracilis</i>
<i>A. grasbyi</i>	<i>C. desolata/sturtii</i>	<i>Maireana trichoptera</i>	<i>Stipa scabra</i>
<i>Eremophila miniata</i>		<i>C. desolata</i>	

Site variables analysed: dominant species in association;
projected foliar cover (PFC);
stratum dominance;
perennial grass cover;
palatable and unpalatable shrub species occurrence.

Results: condition of perennial vegetation: 5 classes (1 not sampled)

Class 1

Cover by palatable perennial grass(es) dominant over shrub cover strata (not sampled).

Class 2

Palatable perennial grass(es) dominant among perennial grasses present, but perennial grass cover is not the dominant cover stratum.

Class 3

Unpalatable (invasive) shrub species dominant among shrub strata, but some cover by palatable perennial grass(es) still present.

Class 4

Shrub strata not dominated by unpalatable (invasive) species but palatable perennial grass(es) rare or absent.

Class 5

Shrub strata dominated by unpalatable (invasive) species and palatable perennial grass(es) rare or absent.

Table 37. Site classification summary (n = 11) Calcrete Shrubby Grassland sites

Class	No.
1	0
2	6
3	3
4	1
5	1

Erosion status: incidence of accelerated erosion.

Two sites exhibited minor accelerated erosion.

General conclusions and remarks

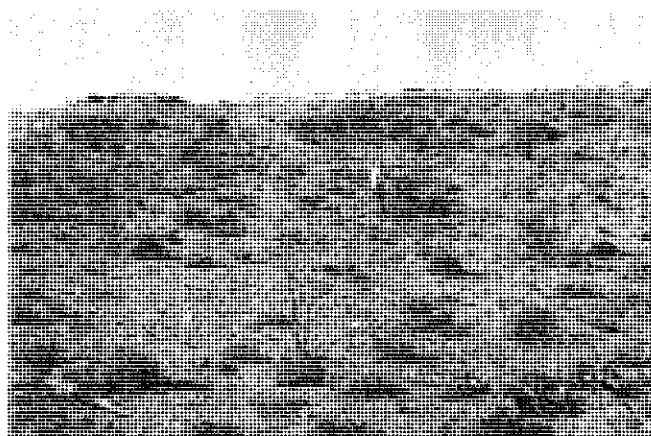
The survey results, together with other observations and data from similar associations in central Australia, suggest that Calcrete Shrubby Grassland associations have generally been greatly altered by grazing pressures, which include preferential grazing by rabbits and kangaroos. The key outcome has been a major decline in the cover and biomass of the key perennial grasses and increases in the unpalatable shrub species under shifts in competitive balance towards such species. In the original condition, shrub cover would have been suppressed by competition from perennial grasses.

Almost all Calcrete Shrubby Grassland sites remain moderately to highly productive, despite shrub increases. Reducing total levels of herbivory by total control of all grazing animals (including rabbits) would be required to redress the degraded states now ubiquitous in the area.

Vegetation type 13: Mulga Chenopod Shrubland

Mulga Chenopod Shrubland occurs widely but rather irregularly on stony interfluvial plains of a wide variety of land systems, but mainly those of **land types 3, 4, 5 and 6**. Sites remaining in good condition are relatively easy to identify by the combination of stony mantling of the soil surface, tall shrub and/or tree strata dominated by mulga over a low shrub stratum dominated by chenopodiaceous species, with only a minor mid-shrub storey. When degraded, such assemblages can resemble similarly degraded states in Granitic Mulga, Stony Snakewood and Stony Mulga Mixed Shrubland types. Soils vary from hard-setting red duplex types through gradational profiles to uniform medium textured classifications, usually with clay loam to sandy clay B horizons and total soil depth only 15 to 40 cm over parent rock. The soil reaction trend is generally neutral to alkaline, and some evidence of primary salinity is present (from the parent material) in the form of patches of halophytes growing on shallow depressions or other run-on areas.

General characteristics



Vegetation type 13: Mulga Chenopod Shrubland: Boulder land system, Curbur station.

About 60% of sites are dominated by the low shrub stratum. In most other cases the tall shrubs and low trees are dominant in terms of cover. Mulga (*A. aneura*) is invariably the dominant low tree and often also the dominant tall shrub form; in other cases snakewood (*A. xiphophylla*), prickly acacia (*A. victoriae*) or needle bush (*Hakea preissii*) are the dominant tall shrub species. The total perennial cover is mainly between 7.5 and 20% PFC.

Among the low shrubs, three-winged bluebush (*Maireana triptera*), was the commonest dominant species, followed by golden bluebush (*M. georgei*) and cotton bush (*Ptilotus obovatus*).

In good seasons, Mulga Chenopod Shrubland grows annual and ephemeral herbage of a high quality for grazing stock. Short-lived chenopods, particularly bindiis and copperburrs (*Sclerolaena* spp.) are major components of the annual response, particularly when germinating summer rains are followed by winter growth periods.

Gradational associations

Mulga Chenopod Shrubland shows a full range of transitional states with Bluebush Shrubland (on adjacent run-on sites), Stony Snakewood Shrubland (typically exhibiting dominance by *A. xiphophylla* and stronger aggregation of understorey low shrubs) and Granitic Mulga Shrubland (fewer halophytes, more diverse tall shrubs and typically situated on grit-surfaced plains derived from granite). Some areas of Mulga Chenopod Shrubland in unusually good condition are very similar in structure and composition to Bluebush Shrublands, but when in poorer condition they are dominated by mid-height *Eremophila* and *Acacia* species.

A lack of extensive occurrence of this vegetation type anywhere in the area tends to suggest that it is mainly made up by associations and soil types that are to some extent transition states or intermediates between other major vegetation types.

Grazing impact and the condition of perennial vegetation

No. of condition sites investigated:	22
Site methodology:	B and C
Site variables analysed:	dominant species in association; projected foliar cover (PFC); species composition index (SCI); ratio of palatable species to unpalatable species (RPU); erosion status.

Results: condition of perennial vegetation: 4 classes

Class 1

A key palatable species is dominant, or second dominant in the low shrub stratum; one of:

Maireana georgei
M. melanocoma
M. pyramidata
M. integra
M. convexa
Ptilotus beardii
Rhagodia eremaea

Class 2

Low shrub cover dominated by *Maireana triptera*.

Class 3

Key palatable species present but not dominant among low shrub cover, which is dominated by species other than key unpalatable species (below).

Class 4

Low / mid shrub cover dominated by key unpalatable species:

Eremophila pterocarpa
Hakea preissii
Acacia victoriae

or

All key palatable species rare to absent.

Erosion status: incidence of accelerated erosion

None of the condition sites sampled displayed accelerated erosion, and it appears that this vegetation type is not normally susceptible, except locally in cases of severe degradation. On some land systems, notably Gabanintha and Wiluna, local redistribution of topsoils with subsequent water erosion caused by mining exploration and alluvial mining operations is widespread. This is probably commoner than pastoral impacts as a cause of accelerated erosion of degraded Mulga Chenopod Shrubland.

General conclusions and remarks

Most sites dominated by three-winged bluebush have probably been degraded to the extent of more palatable perennials having been lost and replaced by a competitive advantage of this less palatable but sometimes edible species. For this reason, sites dominated by three-winged bluebush have been distinguished from sites dominated by other more palatable chenopodiaceous species (i.e. class 2 cf class 1).

Where all or most of the palatable low shrubs have been lost from the understorey, some sites exhibit understorey dominance by invasive unpalatable species while others simply show lack of understorey perennials. In this way it appears that increases by unpalatable understorey species are secondary events which may or may not occur (or have occurred) at any particular site. Mulga Chenopod Shrubland does not normally succumb to shrub 'invasion', in the conventional sense of supporting a greater amount of cover by unpalatable invasive species than the former cover by a palatable species and the original overstorey (mulga).

**Table 38. Site classification summary (n = 22)
Mulga Chenopod Shrubland sites**

Class	No.	%	Cumulative %
1	6	27	27
2	8	36	63
3	3	14	77
4	2	9	86
unclassified	3	14	100

While the mulga component of this vegetation tends to occur in apparently even-aged stands and is clearly subject to long-term cycles of mass establishment and death, the mulga upper storey has not generally suffered the widespread mass mortality of mulga around 1940, which is still evident over Stony Mulga Mixed Shrubland and parts of Hardpan Mulga Shrubland on land systems of **land types 13 and 14**. The evidently long-term nature of the natural cycling of the mulga contrasts with the flourishing and subsequent senescence of *Maireana triptera* in the understorey over a period of only a few years. Many stands of dead and dying three-winged bluebush were encountered in 1985-86; mass germinations of seedlings were observed among dead parent plants during 1986-88.

Vegetation type 14: Stony Snakewood Shrubland

Stony Snakewood Shrubland is widespread (and locally dominant) in parts of the north of the area, on land systems of the hills and plains of **land types 2 and 5**, and more locally on many other systems, particularly those of **land types 3 and 4**. It occurs on interfluvial slopes and plains receiving concentrated run-on, but characteristically only on areas where soils are slightly saline, often alkaline and sometimes calcareous. Shallow red duplex types, more locally clays, with pebbly or gravelly mantles, developed over weathered rocks, are the commonest of the soil types association with Stony Snakewood Shrubland. Saline stony rises near salt lakes or river systems are also typically sites supporting this vegetation type.

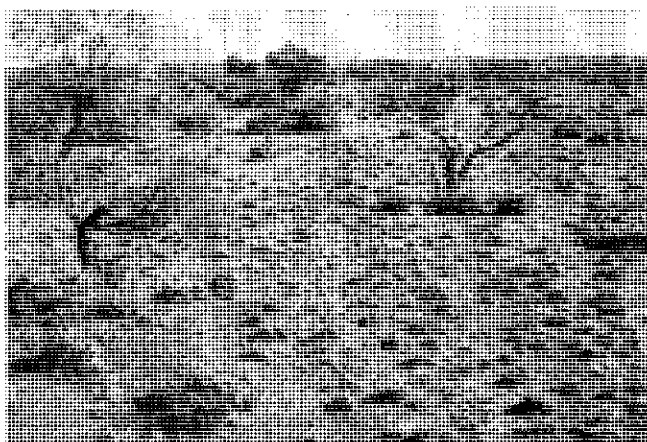
Snakewood (*Acacia xiphophylla*), as the name suggests, is the dominant tall shrub on about 80% of sites, with wait-a-while (*A. cuspidifolia*) the next commonest dominant. Value for pastoral production lies in a combination of both moderate seasonal pasture responsiveness (producing herbs and annual grasses) and moderate densities of palatable perennials when in good condition. Typically, the spatial distribution of palatable perennials is very uneven, with considerable aggregation around or directly below the tall shrub canopies. Geographically, snakewood-*Maireana* associations are mainly found east and south-east of the Murchison River, rather than snakewood-*Atriplex* associations found more commonly west and north of the area.

General characteristics

Snakewood and wait-a-while, together with some mulga (*A. aneura*) and (often) prickly acacia (*A. victoriae*) and needle bush (*Hakea preissii*), are the major tall shrubs on most sites. The mid-shrub stratum may be of *Cassia* or *Eremophila* species and is usually

only a minor cover component (except on degraded sites). The low shrub stratum is far more developed, and exceeds the cover component of tall shrubs on about 40% of all sites. It is composed of a mixture of chenopodiaceous species (mainly *Maireana triptera*, *M. pyramidata*, *M. georgei*, *M. melanocoma*, *M. glomerifolia*, *M. tomentosa*, *Enchylaena tomentosa* and *Rhagodia eremaea*) with others such as *Ptilotus beardii*, *P. obovatus*, *Cassia desolata*, *C. phyllodinea*, *Eremophila platycalyx*, *E. pterocarpa*, *Scaevola spinescens* and *Solanum lasiophyllum*. Total perennial cover is generally 10 to 20% unless degraded.

While unpalatable increaser species such as silver poverty bush (*Eremophila pterocarpa*), needle bush and prickly acacia are often present, there is little evidence of any potential to increase to the point that might constitute shrub infestation or invasion.



Vegetation type 14: Stony Snakewood Shrubland: Horseshoe land system, vacant Crown land.

Gradational associations

Stony Snakewood Shrubland intergrades with Bluebush and Mulga Chenopod shrublands; to a lesser extent with Saltbush Shrubland (mainly in the far west) and with non-saline mulga shrublands generally.

Circumstantial evidence suggests that there may be long-term cyclic changes in the balance between upper storey and understorey, in that both the snakewood and some of the bluebushes (particularly *M. triptera*) are subject to growth as even-aged stands, through rare events involving massive or general deaths of whole populations. Clearly, such events have the capacity to change the appearance and composition of the association.

Grazing impact and the condition of perennial vegetation

No. of condition sites investigated:	13
Site methodology:	A

Site variables analysed:

- projected foliar cover (PFC);
- dominant species in association;
- frequency of species per understorey aggregation;
- density of species per understorey aggregation;
- presence of palatable species in inter-shrub areas;
- erosion status.

Results: condition of perennial vegetation: 4 classes

Class 1

A key palatable species dominates or co-dominates in the low shrub stratum:

<i>M. georgei</i>	<i>Enchylaena tomentosa</i>
<i>M. melanocoma</i>	<i>Cassia hamersleyensis</i>
<i>M. pyramidata</i>	<i>Ptilotus beardii</i>
<i>M. platycarpa</i>	<i>P. schwartzii</i>
<i>M. convexa</i>	
<i>Rhagodia eremaea</i>	

Class 2

Low shrub cover dominated by *M. triptera*.

Class 3

Low shrub cover dominated by other species, but not unpalatable species with invasive tendencies.

Class 4

Low shrub cover dominated by unpalatable shrub species with invasive tendencies (*Eremophila pterocarpa*, *Hakea preissii*, *Acacia victoriae* or *Cassia phyllodinea*).

or

All key palatable species rare to absent (frequency ≤ 0.1 per tall shrub canopy).

Table 39. Site classification summary (n = 15) Stony Snakewood Shrublands sites

Class	No.	%	Cumulative %
1	6	40	40
2	4	27	67
3	3	20	87
4	2	13	100

Erosion status: incidence of accelerated erosion

In general, Stony Snakewood Shrubland grows on sites which have well-mantled soils which are not susceptible to accelerated erosion.

General conclusions and remarks

The best indicators of sites in good condition are the persistence of key palatable species (see above) as dominant or co-dominant understorey elements, occurring both in the aggregations under tall shrub canopies and in the inter-shrub areas.

There are no perennial grasses either generally or specifically associated with this vegetation type in the survey area. The large proportion of sites remaining in the higher condition classes is probably attributable to past levels of grazing usage often not being excessive in the stony hilly land systems, as well as some sampling bias in the small number of sites reported here.

Vegetation type 15: Saltbush Shrubland

Saltbush Shrubland is a broad group of chenopodiaceous shrublands dominated by *Atriplex* species. It is a major vegetation type in land types 16 and 17 and a minor component of land types 4, 5 and 12.

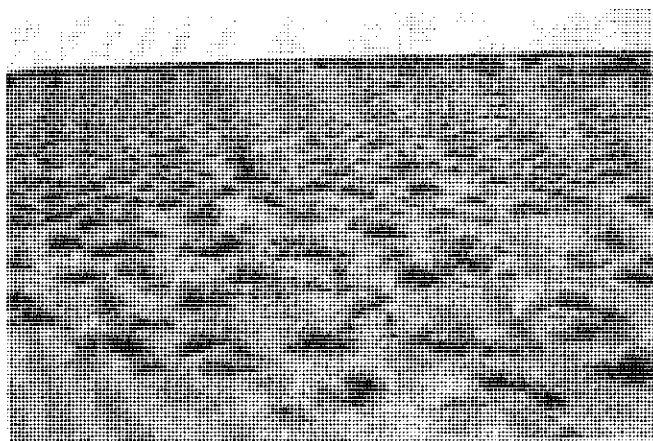
Of all the vegetation types in the region, Saltbush Shrubland is perhaps the most easily recognised, when in its characteristic undegraded form of a shrub 'steppe' of low to medium height, with distinctive silvery colouring and unusually uniform structure and composition. Its importance to pastoral management and production in the region was recognised by the earliest pioneer pastoralists, who were initially attracted to the extensive saltbush plains flanking the major watercourses of the upper Murchison for much of its length. For information from Australian studies of the grazing ecology of saltbush see Graetz and Wilson (1984), Graetz (1986) and Wilson (1991).

Like Bluebush Shrubland, Saltbush Shrubland is highly productive for domestic stock in pastoral situations wherever the permanent water supply is not saline. In the Murchison, Saltbush Shrubland is mainly found along the river flood plains and around the saline lakes. To a lesser extent it is found on saline footslopes and plains below breakaways edging 'Old Plateau' land surfaces, and more locally below outcrops of deeply weathered rocks shedding saline, relatively nutrient-rich soil-making minerals. The soil types which support Saltbush Shrubland are mainly shallow duplex types or deeper fine-textured soils (massive clays and gradational types).

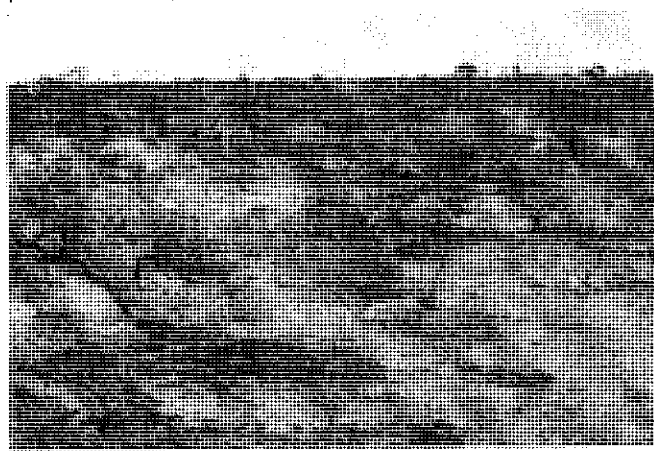
Table 40. Commonest dominant shrub species at Saltbush Shrubland sites

Species	% of sites
<i>Atriplex vesicaria</i>	bladder saltbush 21
<i>A. amnicola</i>	river saltbush 17
<i>A. bunburyana</i>	silver saltbush 13
<i>A. sp.</i>	4
<i>Acacia victoriae</i>	prickly acacia 17
<i>Cassia desolata/sturtii</i>	cassia 8
<i>Eremophila pterocarpa</i>	silver poverty bush 8
others	12

General characteristics



Vegetation type 15: Saltbush Shrubland: Beringarra land system, unit 2 (alluvial plains) in good condition (upper) and in poor condition (lower).



Of 60 condition sites sampled in Saltbush Shrubland, the dominant cover species were bladder saltbush (*A. vesicaria*), river saltbush (*A. amnicola*), and silver saltbush (*A. bunburyana*) (Table 40).

Most Saltbush Shrublands still dominated by *Atriplex* spp. are predominantly low to mid-height shrublands with 5 to 20% total perennial PFC (Figure 42). Characteristically, degraded communities on duplex soils tend to be replaced by predominantly mid to tall shrubland of unpalatable species, with a more patchy cover interspersed by scalds or other types of more or less bare, eroded surfaces.

Associations on clay soils invariably include a denser but still scattered overstorey of trees and tall shrubs. Only the Merbla land system typically supports a well-mixed saltbush-bluebush-perennial grassland association; perennial grasses are otherwise normally sparse within Saltbush Shrubland, except on some units e.g. breakaway footslopes in good condition, where *Eragrostis dielsii* cover often perenniates on the crusted red duplex soils if grazing pressure allows.

In good seasons, Saltbush Shrubland grows annual and ephemeral herbage of a high quality for grazing stock. The composition of such herbage varies greatly, but in general after winter rains is dominated by short-lived Asteraceae (everlastings, billy buttons etc.), Chenopodiaceae (bindiis, copper burrs, annual saltbushes and bluebushes) and Amaranthaceae (annual mulla-mullas). Summer rainfall growth

produces mostly bindiis and Poaceae (lovegrasses, wind grass etc.). Relationships between perennial vegetation condition and herbage response have not been quantified, but the ubiquitous susceptibility of duplex soil surfaces to accelerated erosion in Saltbush Shrublands throughout the area suggests that loss of perennial condition will often be accompanied by reductions in the herbage response.

Like Bluebush Shrubland, Saltbush Shrubland has become widely degraded. Many land units formerly dominated by perennial *Atriplex* associations have lost their cover of saltbushes and become seriously eroded as a consequence. Other areas have become 'invaded' by unpalatable deep-rooted shrub species better able to germinate and survive on degraded, disturbed and actively eroding soil surfaces.

Gradational associations

Most individual sites show some degree of mixture with perennial *Maireana* species, and the full range of intermediate states and transitions to Bluebush Shrublands can be found. The degree to which Saltbush and Bluebush shrublands can replace each other in time and space on texture contrast soils is not clear, but may be considerable.

Long-term studies have repeatedly shown that perennial *Atriplex* associations exhibit differences in their population dynamics to perennial *Maireana* species. Typically, *Atriplex* associations consist of one or two perennial species dominating the particular site (rather than a mix of 6 to 10 or more *Maireana* species); *Atriplex* plants are individually shorter-lived, seedlings establish almost continuously (rather than as rare 'events') and occasionally succumb to massive mortality. Under heavy grazing pressure, the more palatable female plants can be greatly reduced from a particular stand.

A total loss of selectively overgrazed populations of *Atriplex vesicaria* from most footslope units below breakaways has occurred throughout the area. This has the effect of changing the species dominance from *Atriplex* to *Maireana* in such associations, where more persistent species such as ball-leaf bluebush (*M. glomerifolia*) and sago bush (*M. pyramidata*) survive the pressures of herbivory. Classifying individual sites as either saltbush or bluebush shrublands in such circumstances is difficult, and likely to be somewhat arbitrary. For the purposes of this report, the two types are reported on separately in the present section but data sets are combined under 'Condition of the land resource'.

Besides Bluebush, Saltbush Shrubland also intergrades with Mixed Halophyte Shrublands on alluvial saline plains subject to waterlogging, where variable associations of river saltbush or bladder saltbush with *Frankenia*, *Ptilotus*, *Halosarcia* and sage (*Cratystylis subspinescens*) are the rule rather than the exception. On better-drained sites elsewhere in the catchment, silver saltbush dominates some undegraded sites on sandy duplex and saline sand soils. It otherwise occurs as a co-dominant or understorey component with snakewood (*Acacia xiphophylla*) tall shrublands (Stony Snakewood

Shrubland, q.v.) mainly in the far west and south (on the Greenough River), but nowhere to the extent encountered in the Carnarvon Basin further to the north-west. Saltbush Shrubland also intergrades with Riverine Mixed Shrubland on the less saline areas of fine-textured soils of the river flood plains, where both silver and river saltbush communities merge into understorey components of well-mixed tall shrublands and low woodlands.

On duplex sites lower in the topography, it is often difficult to identify consistent soil factors or hydrological features which differentiate sites occupied by Saltbush Shrublands (including mixed snakewood (*A. xiphophylla*) chenopodiaceous shrublands dominated by *Atriplex* species) from those supporting Bluebush Shrubland or Mixed Halophyte Shrubland. On saline calcretes in the far east of the area, however, distinctive *Atriplex-Eucalyptus striatocalyx* alliances form a local Saltbush Shrubland characterised by open low woodland as the upper storey.

Grazing impact and the condition of perennial vegetation

No. of condition sites investigated:	60
Site methodology:	B
Site variables analysed:	dominant species in association; projected foliar cover (PFC); species composition index (SCI); ratio of palatable to unpalatable species (RPU); erosion status; distance from permanent water.

Results: condition of perennial vegetation: 4 classes

Class 1

Association dominated or co-dominated by perennial *Atriplex* spp. PFC $\geq 10\%$.

Class 2

Dominants as class 1. PFC $< 10\%$.

Class 3

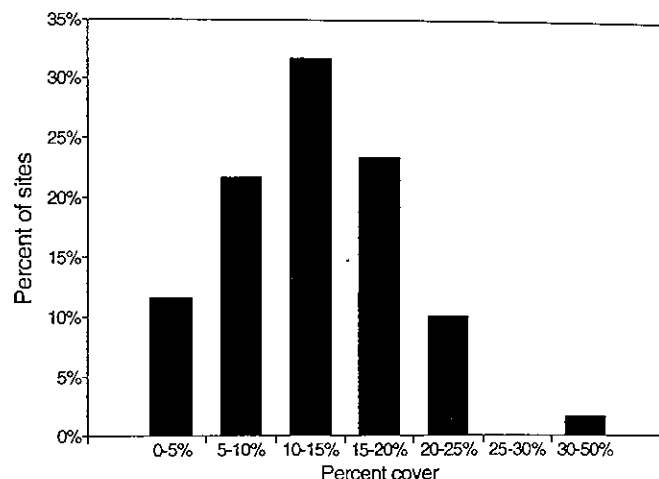
Site characteristics other than those defined by classes 1, 2 or 4.

Class 4

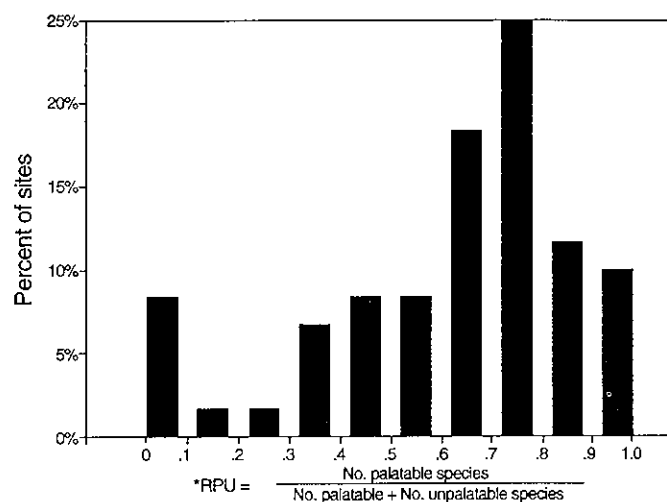
Association dominated or co-dominated by one or more unpalatable species with invasive tendencies, i.e.

Acacia victoriae
Cassia desolata/sturtii
C. helmsii
C. phyllodinea
Eremophila pterocarpa
Hakea preissii
Solanum orbiculatum.

Saltbush Shrubland (n=60)
Projected Foliar Cover (PFC)



Saltbush Shrubland (n=60)
Ratio of palatable to unpalatable spp. (RPU)*



Saltbush Shrubland (n=60)
Cover dominance by species composition index (SCI)*

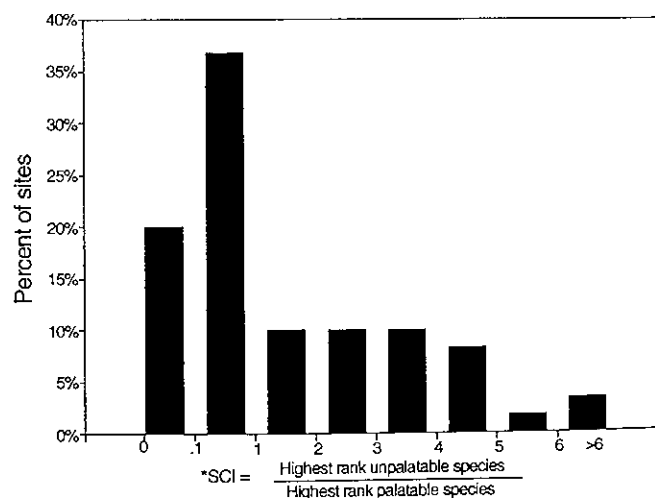


Figure 42. Frequency histograms for key vegetation characteristics of Saltbush Shrubland over the whole survey area.

Table 41. Site classification summary (n = 52)
Saltbush Shrubland sites

Class	No.	%	Cumulative %
1	24	46	46
2	5	10	56
3	8	15	71
4	15	29	100

Table 42. Erosion status: Incidence of accelerated erosion Saltbush Shrubland sites

Class	No. of eroding sites	%	Mean value of intensity ratings
1	12	50	0.5
2	5	100	2.6
3	8	100	3.0
4	15	100	3.3

Erosion status: incidence of accelerated erosion

Saltbush Shrubland that has escaped or recovered from long-term overgrazing and subsequent degradative changes are characterised by a cover dominance or co-dominance of perennial *Atriplex* and total shrub PFC above critical levels. Generally, about 10% PFC appears to be the minimum cover required to prevent accelerated erosion of the duplex soils. Ubiquitous evidence of accelerated erosion on **all** sites other than those in class 1 condition (Table 42) indicated that over half of all Saltbush Shrubland was eroded to some extent. By far the most severely affected land unit is in the Beringarra land system.

General conclusions and remarks

Besides being more widely degraded and eroded than Bluebush Shrubland, Saltbush Shrubland sites more rarely showed evidence of significant recovery from degradation and erosion. At a small number of sites, general death of saltbushes had been a recent event. It was only in the case of *A. amnicola* associations on deep, fine textured soils that cases of clearly improving trends in vegetation condition were encountered, and only in response to active protection from overgrazing. In a small number of cases, duplex sites were encountered at which a competitive 'balance' between partial loss of cover by perennial *Atriplex* and early stages of 'invasion' by key unpalatable species (mainly prickly acacia) was in evidence. Undoubtedly, such sites are more within the realms of manageability than those on which significantly accelerated loss of soil surface material was well underway.

For remarks on the process of secondary increases by invasive unpalatable species, see Bluebush Shrublands. Many other species of shrubs, particularly *Eremophila* spp., obtain competitive advantage where *Atriplex* cover declines. No evidence was obtained to suggest that total shrub PFC levels changed with distance from permanent water (Figure 43), despite trends in changed species composition (mean Species Composition Index was significantly higher at 4 km

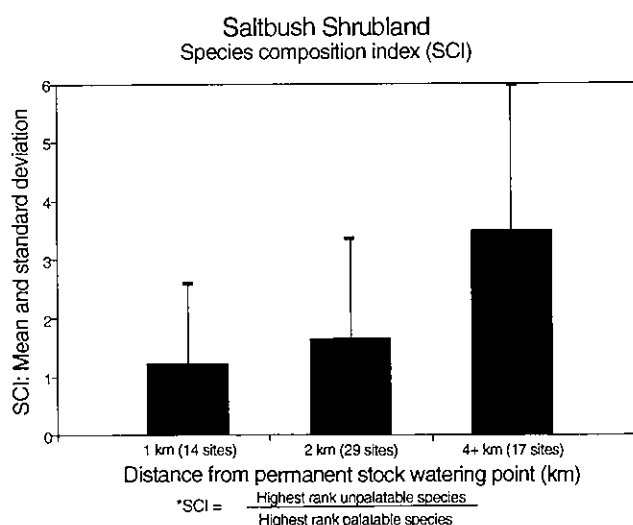
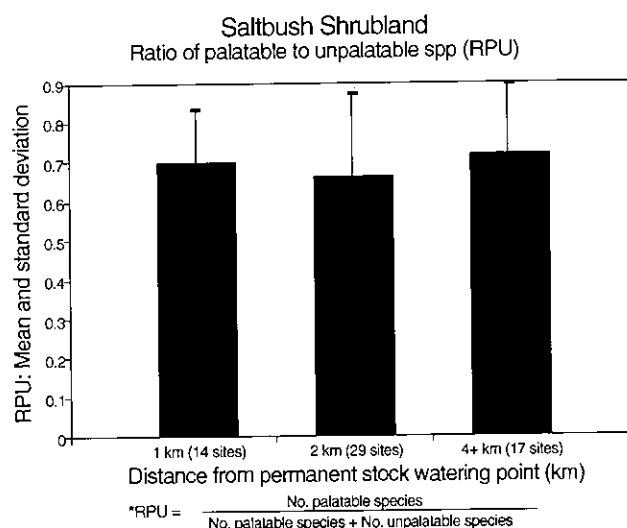
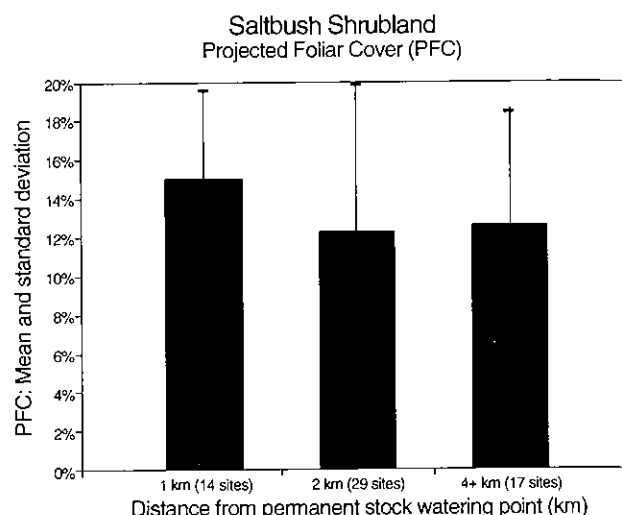


Figure 43. Vegetation attributes and the effect of site distance from the nearest stock water point for Saltbush Shrubland sites.

than at 1 km sites). Also just significant was the finding that sites in the south-eastern quadrant of paddocks were in condition class 1 more often than could be expected if all grazing impact were randomly distributed away from immediate fenceline effects.

Vegetation type 16: Bluebush Shrubland

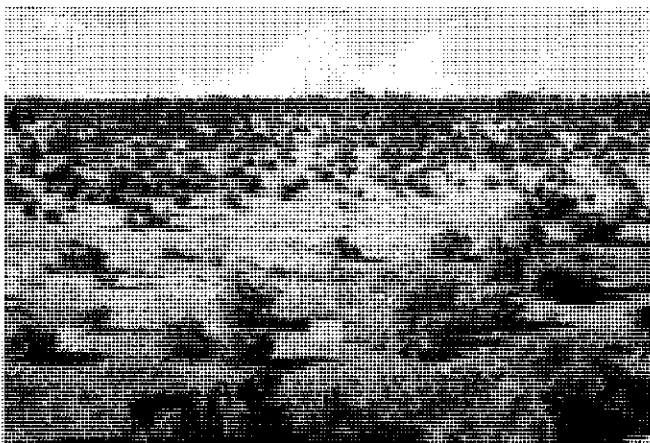
Bluebush Shrubland is a broad group of chenopodiaceous shrublands dominated by *Maireana* species and is among the most distinctive of the main types of vegetation encountered. While most of the management knowledge assumed of them has been gathered inductively through observation, in some cases associated with historical documentation (Lange *et al.* 1984) or with specific treatments such as exclosure, bluebush shrublands have recently been the subject of controlled grazing experiments near Carnarvon (Watson and Holm 1990) and in the survey area on Coodardy station (Holm 1991).

Bluebush Shrubland is a highly productive vegetation type in pastoral situations wherever the permanent water supply is not saline. Bluebush Shrubland in the Murchison exists patchily, at a scale of the land unit or smaller areas rather than over a land system. It is invariably grazed and managed in association with other less productive and less preferentially grazed types of vegetation. In the Murchison it is mostly found on very gently sloping river plains of land types 15 and 16 on hard-setting or crusted red duplex soils which are prone to accelerated erosion if the perennial shrub community becomes degraded.

It also grows more locally, on stony interfluvies and slopes where slightly saline and nutrient-enriched shallow soils develop, mainly where these are alkaline in reaction trend or also calcareous. Such land units occur within a number of land types particularly land types 4, 5, 7 and 8.

For these reasons, Bluebush Shrubland is frequently the subject of observation, monitoring or study as a possibly sensitive indicator of grazing impact and range condition.

General characteristics



Vegetation type 16: Bluebush Shrubland: Austin land system, Wondinong station.

Table 43. Commonest dominant shrub species at Bluebush Shrubland sites

Species	% of sites
<i>Maireana pyramidata</i>	sago bush 25
<i>M. triptera</i>	three-winged bluebush 10
<i>M. platycarpa</i>	shy bluebush 7
<i>M. glomerifolia</i>	ball-leaf bluebush 5
<i>M. georgei</i>	golden bluebush 2
<i>M. trichoptera</i>	pink seeded bluebush 3
<i>Cassia</i> species	6
<i>Acacia victoriae</i>	prickly acacia 5
<i>Hakea preissii</i>	needle bush 2
<i>Eremophila pterocarpa</i>	silver poverty bush 2
Others	33

Of 135 condition sites sampled in Bluebush Shrubland, the dominant cover species were, as indicated in Table 43.

Bluebush Shrublands are mostly encountered as low shrublands with minor components of mid and tall shrubs plus some trees. Sites with dominant mid or tall shrub storeys are invariably either degraded, with secondary increases in unpalatable shrubs, or transitional to another vegetation type. Total PFC is usually between 5 and 20%, rarely over 25%, even on shrub-invaded sites (Figure 44).

In good seasons, Bluebush Shrubland grows annual and ephemeral herbage of a high quality for grazing stock. At Coodardy, 150 to 300 kg/ha was produced on sites in the Challenge land system after both winter and summer growing seasons. Relationships between perennial vegetation condition and herbage response have not been quantified. However, field observations of the general susceptibility of soil surfaces to accelerated erosion in this vegetation type throughout the region suggests that loss of perennial condition often results in fragmented herbage responses, rather than generally better responses associated with decreased competition from perennials on other vegetation types with more stable soil surfaces not prone to erosion (see Graetz 1986).

Gradational associations

Bluebush Shrubland is frequently found juxtaposed with Saltbush Shrubland. Many individual sites show some degree of mixture between perennial *Maireana* and *Atriplex* dominance, often with discernible zonations within the particular land unit. Characteristically, Bluebush Shrubland associations in good condition are species-rich, (commonly 6+ species on a site) with relatively short-lived species (e.g. *M. tomentosa*, *M. villosa*, *M. melanocoma* and *M. triptera*) mixed with long-lived perennials, such as *M. pyramidata*, *M. atkinsiana*, *M. glomerifolia* and *M. polypterygia* (in the north-west).

Besides intergrading with Saltbush Shrubland, Bluebush frequently intergrades with Mixed Halophyte Shrubland and less often with Samphire Shrubland, particularly on clayey soils on the riverine land systems (land types 15 and 16) and saline lake systems (land type 17). On stony slopes and interfluvies, as well as saline drainage tracts,

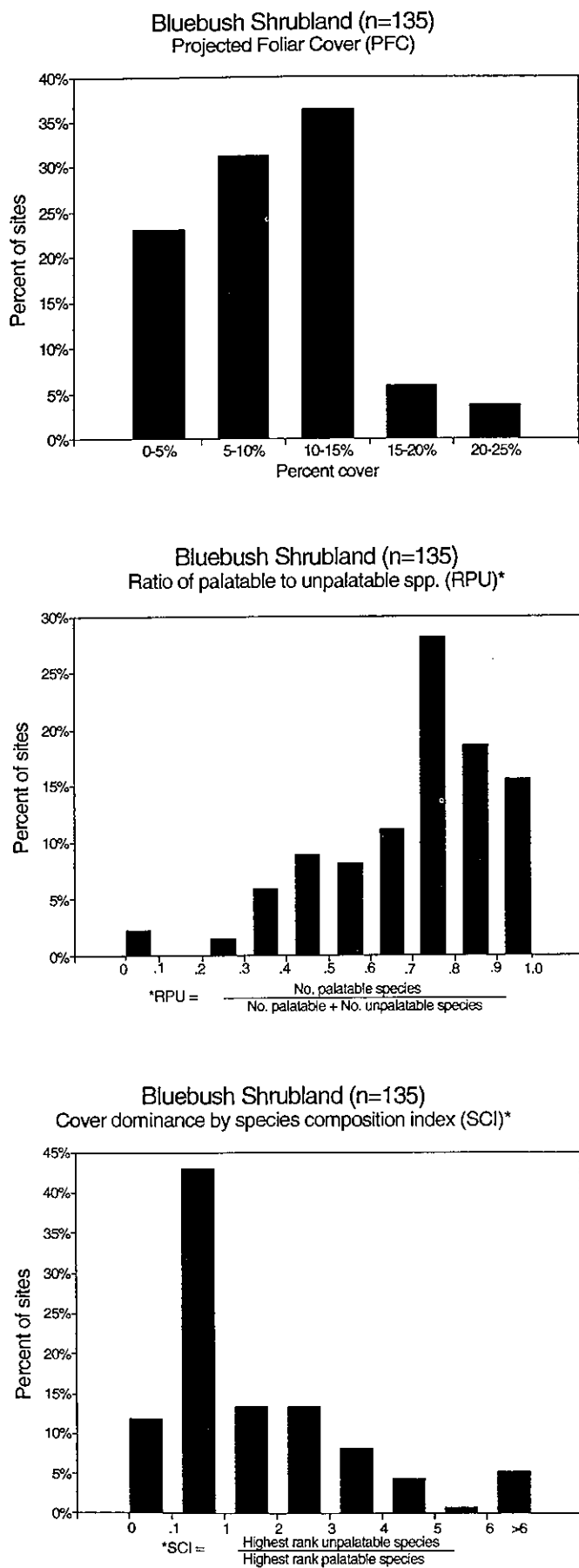


Figure 44. Frequency histograms for key vegetation characteristics of Bluebush Shrubland over the whole survey area.

intermediate associations between Bluebush and Stony Snakewood Shrubland are frequent, as are gradations with Mulga Chenopod Shrubland. In many instances, the gradational states may be dynamic, rather than fixed in time and space. Possibly they reflect cyclical events in overstorey regeneration, or the lack of it (by mulga, minnieritchie and snakewood) and shifts in the competitive balance between the tall and low shrub stages. Management impact (vegetation condition) clearly has the ability to mask and complicate any generalised and simple understanding of such variation. The more severe forms of vegetation degradation make recognition of the previous or original vegetation type difficult or impossible.

Grazing impact and the condition of perennial vegetation

No. of condition sites investigated:

137

Site methodology:

B

Site variables analysed:

dominant species in association;
projected foliar cover (PFC);
species composition index (SCI);
ratio of palatable species to unpalatable (RPU);
erosion status;
distance from permanent water.

Results: condition of perennial vegetation: 5 classes

Class 1

Association dominated or co-dominated by one or more key (palatable) species, i.e.

Maireana pyramidata
M. georgei
M. platycarpa
M. atkinsiana
M. polypterygia
M. integraltomentosa.

and PFC $\geq 10\%$, except where association dominated by *M. georgei*, where PFC $\geq 5\%$.

Class 2

As 1 but PFC $< 10\%$ except where association dominated by *M. georgei*, where PFC $< 5\%$.

Class 3

Association dominated by other palatable species, i.e.

Maireana glomerifolia
M. triptera
M. trichoptera

Class 4

Sites with association characteristics other than those defined by classes 1, 2, 3, or 5.

Class 5

Association dominated or co-dominated by one or more unpalatable species with invasive tendencies:

Hakea preissii
Acacia victoriae
Cassia desolata/sturtii
C. helmsii
C. phyllodinea
Eremophila pterocarpa
E. crenulata
Solanum orbiculatum.

Table 44. Site classification summary (n = 137) Bluebush Shrubland sites

Class	No.	%	Cumulative %
1	17	12	12
2	40	29	41
3	25	18	60
4	35	26	85
5	20	15	100

Table 45. Erosion status: incidence of accelerated erosion Bluebush Shrubland sites

Class	No. of eroding sites	%	Mean intensity rating
1	1	1	0.1
2	32	80	2.2
3	11	44	0.9
4	23	70	1.7
5	15	75	1.9

Erosion status: incidence of accelerated erosion

Sixty per cent of all sites showed accelerated erosion, which was most serious at sites of condition classes 4 or 5 (the grossly altered composition states) and also at class 2 sites, where the reduction of cover by the palatable species was the only major symptom of vegetation change.

While loss of cover by key palatable species appears to be a major symptom of long-term degradative change at one end of the condition spectrum, increases in undesirable species tend to negate any general trends of cover change as an indication of vegetation status in more altered associations. Sites that exhibit gross cover loss of key palatable perennials with little or no increase in unpalatable species tend to be more extensively eroded than sites exhibiting higher PFC levels (Table 45). Whether or not such secondary increase by 'undesirable' unpalatable species has had a significant mitigating effect on accelerated erosion is doubtful. Possibly such increases are mainly secondary in nature and occur mainly on sites which, for other local reasons of their soil, slope and hydrology, are inherently less susceptible to severe soil loss upon degradation of the key perennials and other surface-binding plant materials.

Severely 'shrub-invaded' Bluebush Shrubland sites of class 5 are characterised by high levels of cover dominated by only one or two species of unpalatable

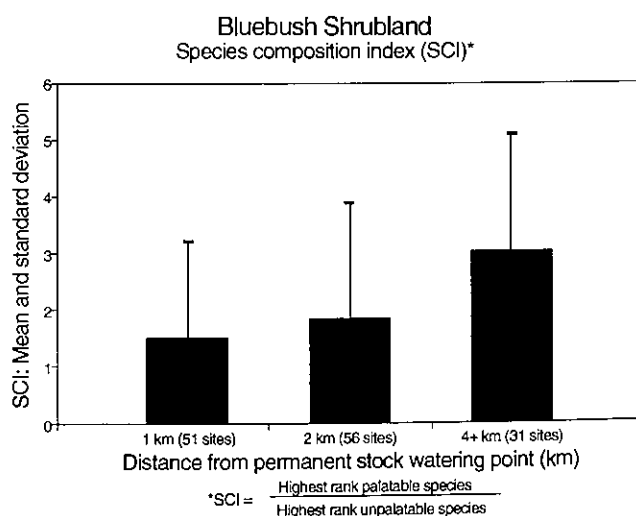
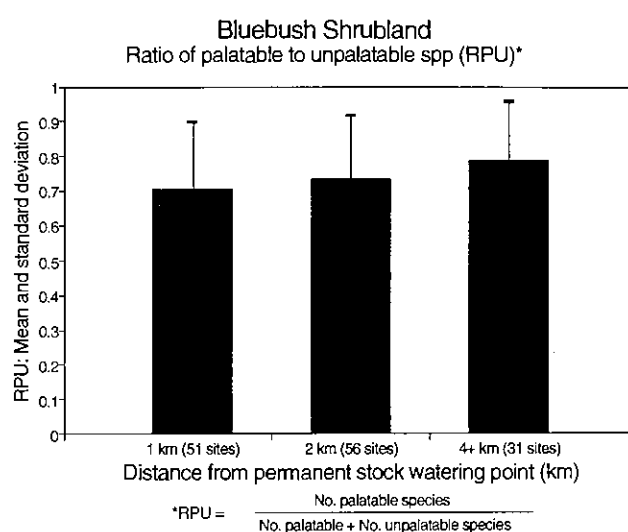
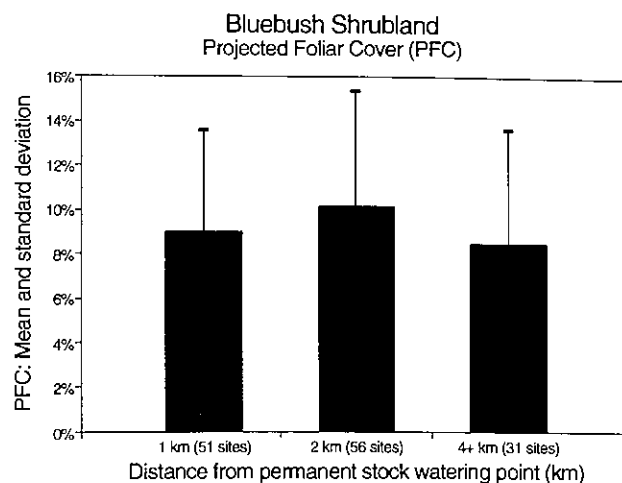


Figure 45. Vegetation attributes and the effect of site distance from the nearest stock water point for Bluebush Shrubland sites.

invasive shrubs and eroded topsoils. Their seasonal herbage responsiveness is probably reduced as a consequence.

General conclusions and remarks

Bluebush Shrublands that have escaped or recovered from long-term overgrazing and subsequent degradative changes are characterised by a cover dominance of one or more key desirable *Maireana* species and total shrub PFC above critical erosion-preventing levels. Critical cover levels appear to be generally about PFC > 10% for bluebush communities growing on alluvial plains (*M. pyramidata*, *M. platycarpa* or *M. atkinsiana* dominant) and PFC > 5% for *M. georgei* associations growing typically on stony sites with shallow soils over colluvium.

It is doubtful that associations dominated by *M. glomerifolia* are more than rarely in their original state; in such cases it appears that a dominant key desirable (usually *M. platycarpa*, *Atriplex vesicaria*, *M. pyramidata*, *M. atkinsiana* or *Ptilotus beardii*) has been reduced or lost from the associations. For these reasons, such associations have been excluded from class 1 for the Bluebush Shrubland vegetation type. For management purposes such class 2 sites should prove responsive and recoverable, but are often at risk of being severely affected by erosion.

No evidence was obtained to suggest that average total shrub PFC levels changed with distance from permanent water; nor did the mean value of the ratio of palatable to unpalatable species (RPU) have any trend (Figure 45). The species composition index (SCI), however, was significantly higher for sites ≥ 4 km from water than those at 1 km, which can be interpreted to mean that the relative cover as a rank measurement of the key palatable species compared with invasive unpalatable species present on a site is a measure of grazing-related effects on the association.

Vegetation type 17: Mixed Halophyte Shrubland

A characteristically variable assortment of halophytic shrublands is dealt with here under a single broad type. Within the broad type are 3 main sub-types:

Mixed Halophyte Shrubland (1) dominated by sage (*Cratystylis subspinescens*).

Mixed Halophyte Shrubland (2) dominated by frankenias (*Frankenia* spp.).

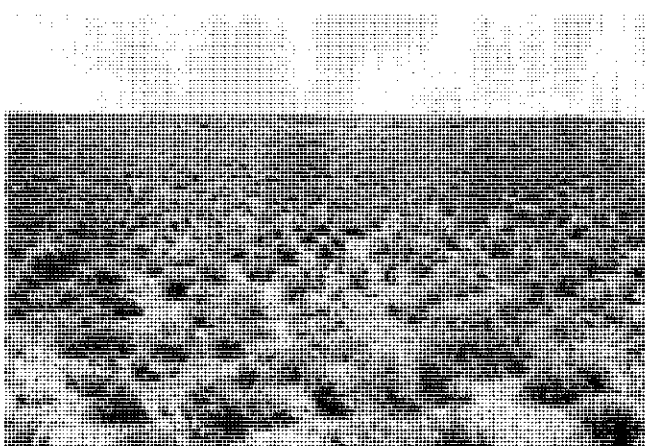
Mixed Halophyte Shrubland (3) dominated or co-dominated by mulla-mullas (*Ptilotus* spp.).

Mixed Halophyte Shrubland is found on units of land types 2, 4, 5, 6, 7, 8, 12, 16 and 17, always on sites receiving concentrated run-on and with saline soils. It mainly occurs on duplex soils of alluvial plains associated with the major drainages, particularly the internally draining systems characteristic of the Permian sedimentary rocks in the north-west of the

area (Byro, Sandiman, Boulder, Liver). Such associations also occur more locally on alluvial plains and footslopes below breakaways, in both granite-based and greenstone-based systems.

The value of Mixed Halophyte Shrubland for pastoral production probably lies in the combination of a diverse mixture of palatable forage shrubs, most of which are only mildly to moderately rich in salts, combined with palatable and nutritious seasonal herbage responses. Because such vegetation is normally only encountered on relatively small land units within whole systems, it is a preferentially grazed type. Structurally and floristically it has many similarities with Saltbush and Bluebush Shrubland types, and also some with mulga communities on sites where the mainly duplex soils are relatively shallow and overlie rocks or red-brown hardpan.

General characteristics



Vegetation type 17: Mixed Halophytic Shrubland: Bayou land system, Wooleen station.

Table 46. Commonest dominant shrub species at Mixed Halophyte Shrubland sites

Species		% of sites
<i>Frankenia</i> aff. <i>pauciflora</i>	frankenia	11
<i>Ptilotus beardii</i>	low mulla-mulla	11
<i>F.</i> aff. <i>magnifica</i>	frankenia	11
<i>Cratystylis subspinescens</i>	sage	8
<i>P. polakii</i>	Gascoyne mulla-mulla	8
<i>F.</i> aff. <i>setosa</i>	frankenia	6
<i>Eremophila pterocarpa</i>	silver poverty bush	6
<i>Cassia desolata</i>	grey cassia	6
Others		33

Of 36 condition sites sampled in Mixed Halophyte Shrubland, the dominant cover species were as shown in Table 46.

Mixed Halophyte Shrublands are predominantly low to mid shrublands with some tall shrubs but few or no trees or perennial grasses. Total perennial cover is typically higher on sage-dominated sites, where PFC levels of 25 to 30% are common; otherwise 5 to 15% is

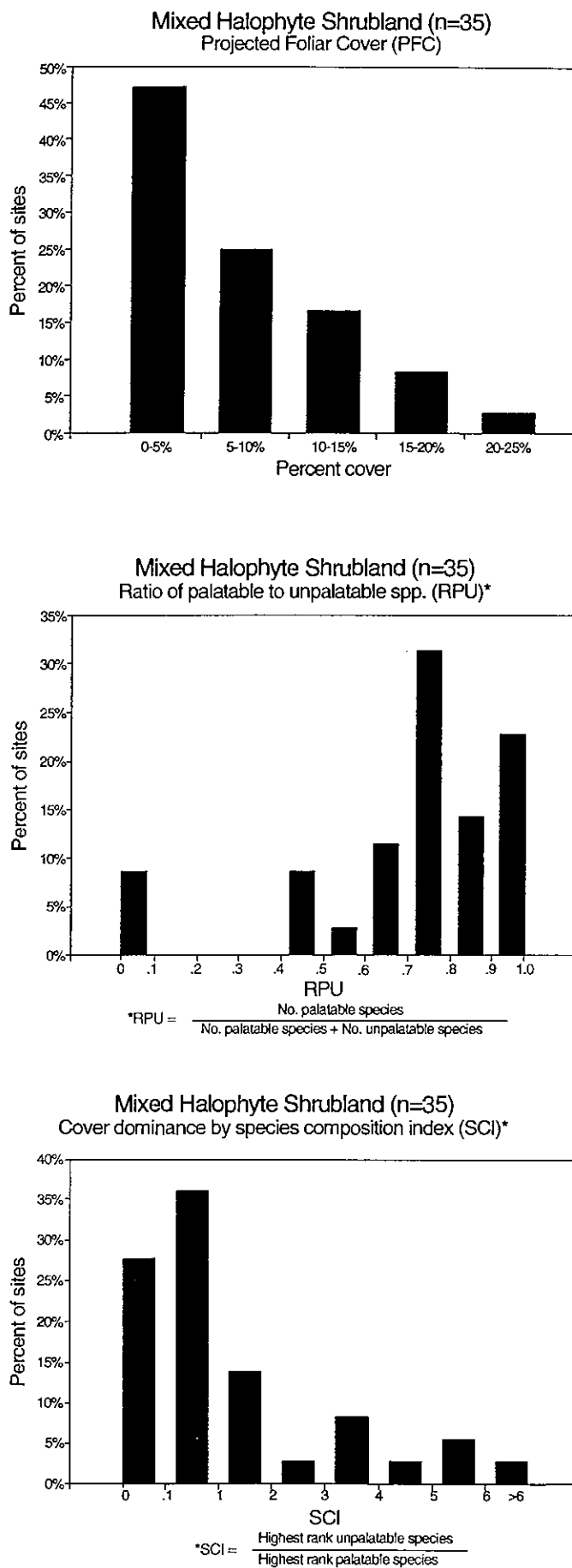


Figure 46. Frequency histograms for key vegetation characteristics of Mixed Halophyte Shrubland over the whole survey area.

more usual, and less on degraded sites (Figure 46). Soils are mainly hard-setting red duplex types, occasionally uniform fine-textured (clays) on sites dominated by sage or frankenias.

Well-mixed associations are the rule, with less tendency for sites to be overwhelmingly dominated by a single species, as in Saltbush (and to a lesser extent in Bluebush) Shrublands. A widespread occurrence of the endemic low mulla-mulla (*Ptilotus beardii*) in this vegetation type, to the extent of being the dominant species on many sites, was not known previously. More palatable to stock where it occurs alongside the similar Gascoyne mulla-mulla (*P. polakii*) on the Byro Plains, *P. beardii* has proved to be an exceedingly hardy perennial herb or low shrub, which contributes to the soil stability and dry season forage potential of many associations in the northern and eastern parts of the area. Other useful browse shrubs widespread in Mixed Halophyte Shrubland include various bluebushes (*Maireana atkinsiana*, *M. glomerifolia*, *M. pyramidata*, *M. platycarpa*, *M. amoenae*, *M. georgei*, *M. triptera*, *M. tomentosa*, *M. integra*) and saltbushes (*Atriplex amnicola*, *A. vesicaria*, *A. quinii*, *Rhagodia eremaea* and *Enchylaena tomentosa*) and other palatable 'indicator' species (e.g. *Cassia chatelainiana*, *Eremophila maculata*, *E. muelleriana*). Unpalatable species with invasive tendencies, particularly grey poverty bush (*Eremophila pterocarpa*) and needle bush (*Hakea preissii*), are invariably present but abundant only where palatable species have been degraded. Perennial grasses are common only in sage-dominated associations in good condition, where feather speargrass (*Stipa elegantissima*) is frequent.

Gradational associations

To some extent, Mixed Halophyte Shrubland is an unsatisfactory grouping of very variable associations, many of which are probably gradational (in spatial terms) or reflect more or less altered states of previously more readily identified vegetation types. The three sub-types mentioned above all show intermediate states with each other and with Saltbush, Bluebush and Samphire Shrublands. Otherwise, the broad type also shows transitional states with Mulga Chenopod Shrubland (on saline colluvium) and Riverine Mixed Shrubland where an open woodland component develops on the less saline higher flood plains of the riverine systems.

As with the other major types of shrublands found on saline duplex soils, the original species dominance of many degraded sites was virtually impossible to ascertain.

Grazing impact and the condition of perennial vegetation

No. of condition sites investigated:	36
Site methodology:	B
Site variables analysed:	dominant species in association;

projected foliar cover (PFC);
species composition index (SCI);
ratio of palatable to unpalatable species (RPU);
erosion status;
distance from permanent water.

Results: Mixed Halophyte Shrubland (1) 'Sage shrubland'. Condition of perennial vegetation: 3 classes

Class 1

Association dominated or co-dominated by *Cratystylis subspinescens*. (PFC > 15%).

Class 2

Sites other than 1 and 3.

Class 3

Site cover dominant is a species of unpalatable shrub with invasive tendencies.

Mixed Halophyte Shrubland (2) 'Frankenia shrubland'

Class 1

Association dominated by low shrub stratum; dominant low shrub is *Frankenia* sp. PFC ≥ 5%.

Class 2

A species of unpalatable shrub with invasive tendencies is co-dominant in the association.

Class 3

Association dominated by a species of unpalatable shrub with invasive tendencies.

Table 47. Site classification summary (n = 36) Mixed Halophyte Shrubland sites

Class	Mixed Halophyte Shrubland No.			%	Cumulative %
	(1)	(2)	(3)		
1	3	8	-	31	31
2	-	1	10	31	62
3	-	3	7	28	90
unclassified	-	-	4	10	100

Table 48. Erosion status: incidence of accelerated erosion Mixed Halophyte Shrubland sites

Class	No. of eroding sites	%	Mean intensity rating
1	3	27	0.5
2	8	73	1.3
3	7	70	1.9

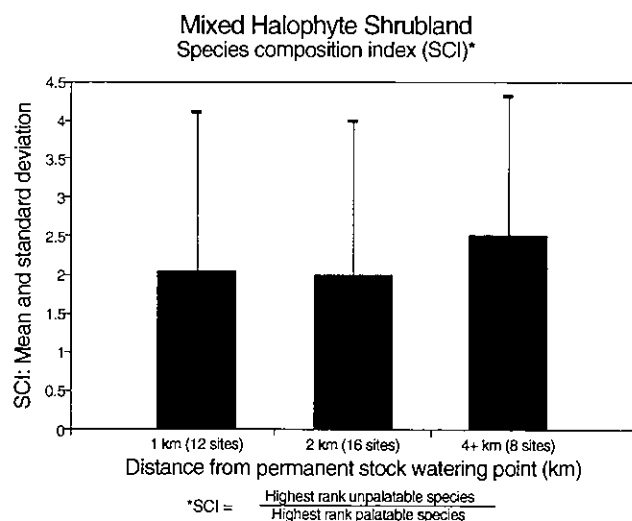
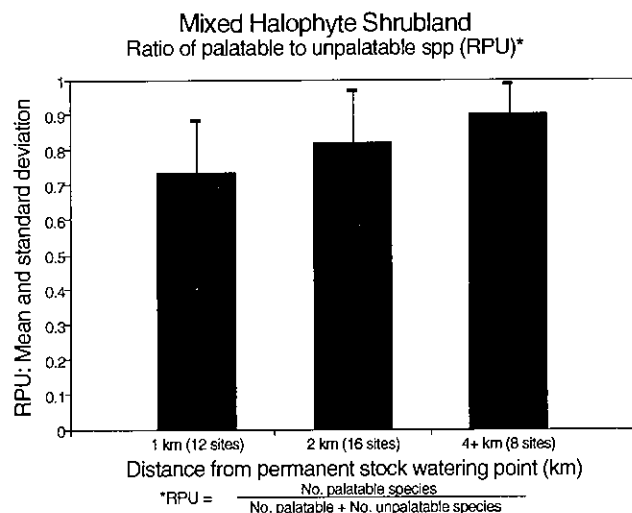
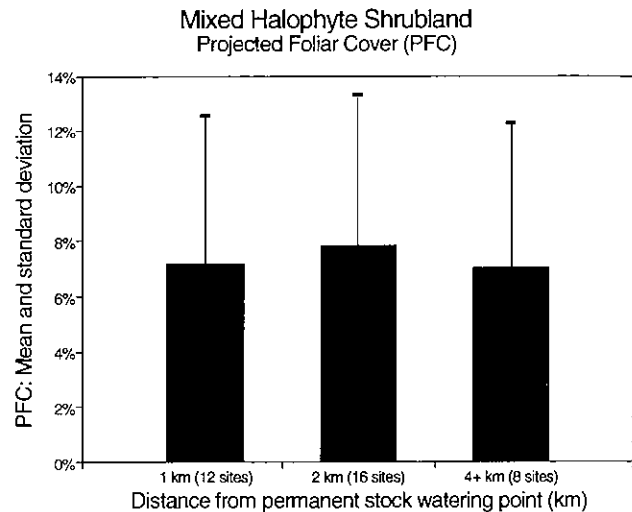


Figure 47. Vegetation attributes and the effect of site distance from the nearest stock water point for Mixed Halophyte Shrubland sites.

Mixed Halophyte Shrubland (3) 'Alluvial mulla-mulla'

Class 1

Association dominated or co-dominated by low shrub stratum. Dominant or co-dominant species is *Ptilotus beardii* or *P. polakii*. Neither second nor third dominant species in association is a species of unpalatable shrub with invasive tendencies. PFC $\geq 5\%$.

Class 2

Site other than 1 and 3.

Class 3

Association dominated or co-dominated by a species of unpalatable shrub with invasive tendencies.

Erosion status: incidence of accelerated erosion

Sage-dominated associations are less susceptible to degradation and accelerated erosion than the other two main sub-types. Sage appears more resistant to overgrazing than either frankenia or mulla-mulla sub-types, and typically grows on deeper less erodible soils, supported by more favourable moisture supplies.

General conclusions and remarks

Mixed Halophyte Shrubland exhibits broad characteristics and degradation symptoms in common with Bluebush and Saltbush shrublands. Retention of critical levels of cover (above about 7.5%) by the naturally predominant low shrub stratum is evidently the key to preserving its productivity, dry season reserves, seasonal responsiveness and resistance to soil erosion and shrub invasion.

No evidence was obtained to suggest that mean values for total shrub PFC levels, the ratio of palatable to unpalatable species (RPU) or the species composition index (SCI) changed with distance from permanent watering points (Figure 47).

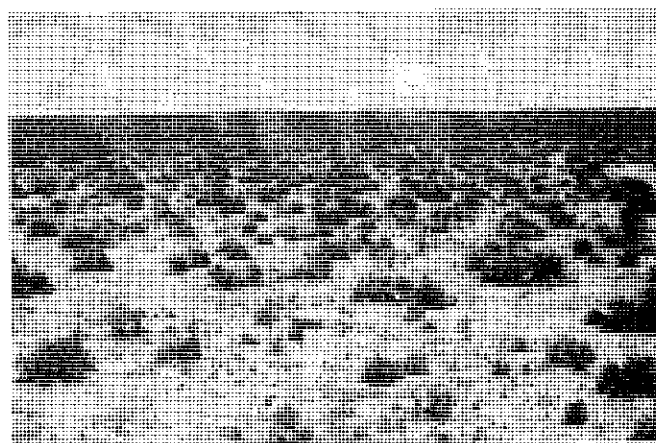
Vegetation type 18: Samphire Shrubland

Samphire Shrubland consists of very distinctive, characteristically uniform areas of low or very low chenopodiaceous shrubland growing on highly saline run-on sites prone to waterlogging. In the survey area these can be found in a variety of positions in the landscape, but principally on four types of land units. The majority of this vegetation occurs on the saline muds and solonchak soils of minor lake beds and salt lake fringes, e.g. on Carnegie, Wolarry and Liver land systems (land types 12 and 17). It is also common on the lowest, most flooded of the saline alluvial plains found along the rivers and major drainage systems; it also occurs on the banks and levees of the major watercourses (land type 16). Otherwise, Samphire Shrubland occurs on isolated claypans and low-lying kopi deposits in several systems, and also in many,

widely scattered sites higher in the catchment landscapes, most often in small diversions on plains receiving concentrated slightly saline run-on, below outcrops of deeply weathered crystalline rocks of many kinds. It also occurs, but much more locally, on equivalent sites on plains derived from sedimentary rocks such as the Permian mudstones and siltstones of the Mantle and Byro land systems.

Samphire Shrubland has not been studied to any extent in the arid zone in relation to grazing effects or other management influences. As the most saline of the vegetation types dominated by perennial chenopod shrubs, they are not normally regarded to be either sensitive to, or indicative of, grazing impacts in the arid zone. Geographically, the distribution of Samphire Shrublands in Murchison landscapes is highly correlated with the occurrence of saline or brackish groundwater. This further constrains consumption of so saline a source of browse as samphire by stock which cannot obtain fresh water during summer or poor seasons.

General characteristics



Vegetation type 18: Samphire Shrubland: Bayou land system, Billabalong station.

Table 49. Dominant species identified at Samphire Shrubland sites

Species		No. of sites dominant
<i>Halosarcia indica</i>	tall samphire	3
<i>H. pergranulata</i>	blackseed samphire	2
<i>H. doleiformis</i>	samphire	2
<i>H. pruinosa</i>	samphire	2
<i>H. halocnemoides</i>	shrubby samphire	2

Of 6 condition sites and 18 inventory sites investigated, all were low shrublands dominated by *Halosarcia* species. Where specifically identified, dominant species were as indicated in Table 49.

The only other genus of 'samphires' encountered dominating individual sites was *Tecticornia*, of which both *T. arborea* and *T. verrucosa* were found at distinctively isolated claypans. Most Samphire Shrubland showed definite zonation of species

composition related to the micro-topography of individual sites. Total perennial cover was mainly PFC 7.5 to 15%, with up to 30% cover very locally.

Most sites were occupied by two to four species of *Halosarcia*, with very variable minor proportions of other halophytes. These were mainly *Atriplex* and *Maireana* spp., particularly on the shallower soils of stony sites, where *Frankenia* spp. and *Eremophila* spp. also frequently occur at low density. Otherwise, only irregular occurrences of *Melaleuca*, *Cratystylis*, *Lawrencia*, *Ptilotus* and *Carpobrotus* relieve the exclusive dominance of *Halosarcia* over large areas of saline and gypsiferous deposits around the margins of the salt lakes.

Seasonally, the herbage response of most Samphire Shrubland is unimpressive and consists of mainly annual grasses with sparse herbs (mainly ephemeral *Chenopodiaceae*) and forbs (*Asteraceae*).

While in most situations, *Halosarcia* associations appear to be very long-lived, the dynamics of infrequently flooded alluvial deposits and their drying and cracking can give rise to the episodic gain or loss of entire areas of Samphire Shrubland, with instances of both even-aged recruitment over previously bare claypan and general death of old plants being recorded during the survey.

Grazing impact and the condition of perennial vegetation

Samphire Shrubland in the arid zone is not a favoured pasture for stock. Nonetheless, grazing impact clearly occurs, as evidenced by fenceline effects where the combined herbivory pressure from stock, kangaroos and rabbits is evident in most instances.

No. of condition sites analysed:	6
Site methodology:	B
Site variables analysed:	dominant species in associations; projected foliar cover (PFC); species composition index (SCI); ratio of palatable to unpalatable species (RPU); erosion status; distance from permanent water.

Results: condition of perennial vegetation: 2 classes

Class 1

Association dominated or co-dominated by *Halosarcia* spp. two or more additional palatable perennial species present (PFC \geq 5%).

Class 2

Other sites.

Table 50. Site classification summary (n = 6)
Samphire Shrubland sites

Class	No.	%
1	5	83
2	1	17

Erosion status: incidence of accelerated erosion

Samphire Shrublands are not normally encountered on sites which are susceptible to accelerated erosion, except on some areas with shallow duplex soils based on Permian sedimentary rocks.

General conclusions and remarks

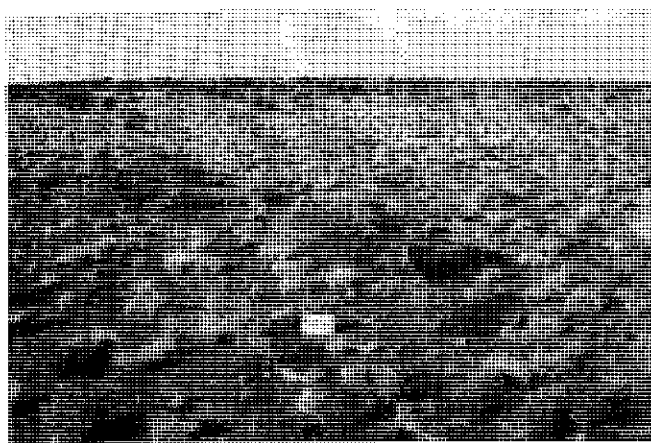
The small number of sites examined reflects the perceived lack of importance of significant grazing effects detectable within samphire shrublands. While clear impacts occur locally, natural patterns of variation in the cover and composition of such associations are too great to reveal condition effects other than those of losses in total cover by the dominant *Halosarcia* species. This probably constitutes vegetation degradation and corresponds to change at the lower end of a condition spectrum which otherwise remains obscure or has no consistent characteristics. Various minor species of perennials other than *Halosarcia* may be important in particular situations. For example, patchy samphire shrublands found on low-lying run-on sites associated with colluvium frequently support some *Maireana* species. On lake bed alluvium, the major association sometimes includes perennial grasses, *Eragrostis* aff. *dielsii* or *Sporobolus mitchellii*, whereas on gypsiferous lake fringing plains, other halophytic low shrubs and perennial herbs such as *Atriplex* and *Minuria* species may have some indicator value.

Otherwise, site results support the general finding, derived from traverse observations, that samphire shrublands in the Murchison catchment are mainly in good condition.

Vegetation type 19: Wanderrie Bank Grassy Shrubland

Wanderrie Bank Grassy Shrubland is the dominant vegetation type on the broad, low sandy banks which are widespread major units of land systems in **land type 13**. Such banks occur on Quaternary alluvial surfaces and appear to be partly aeolian in origin, but are now modified and clearly subject to the alluvial processes occurring on the wash plains in their wider context. Wanderrie banks exist in a bewildering variety of sizes, forms and patterns, but in general represent sites of moderately deep sandy (Uc5) soils which intercept sheetflow and store moisture for longer periods than the shallow loams of the intervening flat plains and interbank areas. Such banks also occur to a lesser extent on parts of **land types 3, 4, 12, 14, 16 and 17**.

General characteristics



Vegetation type 19: Wanderrie Bank Grassy Shrubland: Belele land system, Buttah station.

Wanderrie Bank Grassy Shrubland sites invariably support mixed shrubland and perennial tussock grasses, with very variable structural dominance, cover and species composition. About 75% of all sites were dominated by shrub cover rather than perennial grass cover. Only 4% of suitable sites supported no perennial grasses.

Any of the three shrub strata may be dominant or co-dominant with either of the others at a particular site. Trees are present at about 60% of sites, as a minor cover component. Tree-form mulga is the dominant tree in about 90% of cases. Total tree cover is always less than 2.5%, whereas the total shrub cover of Wanderrie Bank Grassy Shrubland sites normally varies between 5 and 20% PFC. The total canopy cover of the perennial grasses was below 10% in about 75% of cases, although this measure was subject to wide seasonal variation.

Wanderrie Bank Grassy Shrubland sites grow impressive seasonal herbage cover in response to major rainfall, and must be regarded as one of the most seasonally productive vegetation types in the region. Hacker (1986) has drawn attention to the small-scale patchiness of the growth response by wanderrie banks in the north-eastern Goldfields, indicating that perennial vegetation degradation can be accompanied by the spread of biologically unproductive 'capped' surfaces and a presumably poorer total seasonal value to grazing.

There are four important palatable perennial grasses which are widespread in Wanderrie Bank Grassy Shrubland: broad-leaved wanderrie (*Monachather*

paradoxa), soft wanderrie (*Thyridolepis multiculmis*), creeping wanderrie (*Eragrostis lanipes*) and woolly butt (*Eragrostis eriopoda*). The shrub component of many sites includes a range of palatable perennials, the most widespread of which are cotton bush (*Ptilotus obovatus*), Grevillea deflexa, rhagodia (*Rhagodia eremaea*), flat-leaved bluebush (*Maireana planifolia*) and warty fuchsia bush (*Eremophila latrobei*). Wilcox bush (*Eremophila forrestii*) appears to be less palatable on wanderrie banks (and on other sand soils) than on the clay loam soils of the adjacent interbank hardpan plains. On wanderrie banks overgrazing impacts have also occurred, as evidenced by many fenceline effects of shrub loss or replacement by other species.

Wanderrie Bank Grassy Shrubland is susceptible to fire following very good seasonal conditions and adequate levels of biomass in the herbage layer.

Gradational associations

Small, poorly developed banks tend to support vegetation of mixed characteristics between Wanderrie Bank Grassy Shrubland and Hardpan Mulga Shrubland. Sandy groves of shrub aggregation, such as those particularly common on parts of Yanganoo land system, are essentially intermediates between Wanderrie Bank Grassy Shrubland and Mulga Grove Woodland.

Larger wanderrie banks are very similar to the small sand sheets of the Kalli land system and other 'Old Plateau' surfaces, although in a different part of the landscape. Their vegetation often includes more species typical of sand plains and thus becomes intermediate between Wanderrie Bank Grassy Shrubland and Sandplain Wanderrie Grassy Shrubland.

Grazing impact and the condition of perennial vegetation

No. of condition sites investigated:	75
Site methodology:	E
Site variables analysed:	dominant species in association; projected foliar cover (PFC); canopy foliar cover of perennial grasses; distance from stock water point; paddock quadrant; erosion status.

Table 51. Commonest dominant species at Wanderrie Bank Grassy Shrubland sites

Tall shrubs	Mid-shrubs	Low shrubs	Perennial grasses
<i>Acacia aneura</i> <i>A. ramulosa</i> <i>A. kempeana</i> <i>A. tetragonophylla</i>	<i>Eremophila forrestii</i> <i>E. margarethae</i> <i>E. granitica</i> <i>Cassia helmsii</i> <i>C. sturtii</i> <i>A. aff. coolgardiensis</i>	<i>E. margarethae</i> <i>E. forrestii</i> <i>Ptilotus obovatus</i> <i>Solanum lasiophyllum</i> <i>Mirbelia spinosa</i> <i>E. granitica</i>	<i>Monachather paradoxa</i> <i>Eriachne helmsii</i> <i>Eragrostis lanipes</i> <i>Eragrostis eriopoda</i>

Results: condition of perennial vegetation: 5 classes

Class 1

Dominant or co-dominant perennial grass species is soft wanderrie. Perennial grass cover \geq class 2 (moderate cover).

Class 2

Dominant or co-dominant perennial grass species is broad-leaved wanderrie. Perennial grass cover \geq class 2 (moderate cover).

Class 3

Not 1 or 2. Dominant or co-dominant perennial grass species is creeping wanderrie or woolly butt. Perennial grass cover \geq class 2 (moderate cover).

Class 4

One or more of the palatable species (of classes 1-3) is dominant or co-dominant. Perennial grass cover is class 1 (very sparse to sparse).

Class 5

Other species of grass dominant.

Table 52. Site classification summary (n = 75) Wanderrie Bank Grassy Shrubland sites

Class	No.	%	Cumulative %
1	2	3	3
2	15	20	23
3	4	5	28
4	34	45	73
5	20	27	100

Erosion status: incidence of accelerated erosion.

Seven sites (9%) showed evidence of accelerated erosion, mainly as a result of water action from the upslope edge. All such sites had vegetation of class 5, with shrub cover levels \leq 7.5%.

General conclusions and remarks

Wanderrie Bank Grassy Shrubland associations appear to be subject to a high level of heterogeneity in their successional responses to impacts of grazing or past overgrazing. Characteristically, there may be considerable variation between the composition of one bank and its neighbours within the same part of a paddock, particularly in regard to the particular shrub species dominating the bank and the palatable species present or absent. The survey failed to find clear and consistent indications by which past or cumulative grazing impact on the shrub component could be gauged. While at many sites inedible shrubs such as sand bank poverty bush (*Eremophila margarethae*) and turkey bush (*E. gilesii*) could be surmised to have increased by competitive advantage over more palatable species, the shrub component of Wanderrie Bank Grassy Shrubland in little-used or 'reference' areas distant from stock water was not significantly

different, exhibiting unpredictable 'invasions' by unpalatable species such as *E. granitica*, *Chorizema ericifolium* and flannel bush (*Solanum lasiophyllum*), and equally unpredictable incidence in the distribution and density of palatable species.

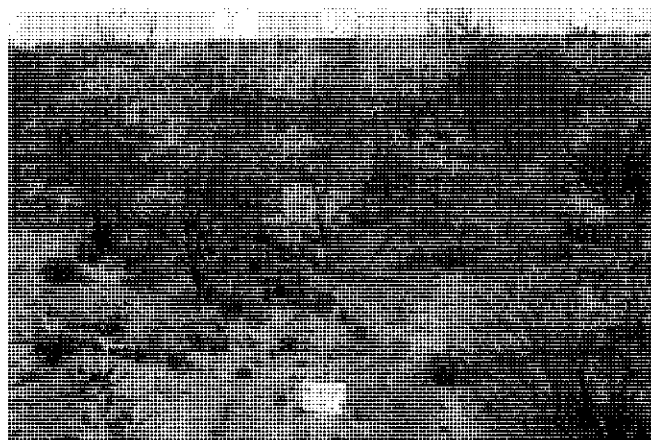
Chronic or historical overgrazing of perennial grasses has evidently resulted in losses of palatable species and locally increased unpalatable species, particularly buck wanderrie (*Eriachne helmsii*) and false wanderrie (*E. aristidea*). Generally increased shrub cover may also have resulted from shifts in the competitive balance between grass and shrub.

In terms of productive potential, Wanderrie Bank Grassy Shrubland associations are probably at their peak when the perennial grass component exceeds the shrub cover and is dominated by the palatable species, of which soft wanderrie is a preferentially grazed indicator (present at about 15% of sites) other than broad-leaved wanderrie, which should otherwise be relied on for the same indications.

Vegetation type 20: Sandplain Wanderrie Grassy Shrubland

Sandplain Wanderrie Grassy Shrubland is widespread on sand plains of land type 10, in which there are two main land systems in the area. In the western parts, the Sandplain land system is based largely on Permian and Cretaceous sedimentary rocks. The more fragmented sand plains of the Kalli land system are otherwise widely distributed, although mainly in the southern half of the area. Both systems support mainly Sandplain Wanderrie Grassy Shrubland vegetation. The perennial grass component is virtually absent and is naturally replaced by a greater density and variety of understorey shrubs in Sandplain Acacia Shrubland otherwise found on sand plains of the Kalli system, and to a lesser extent within land types 7 and 2.

General characteristics



Vegetation type 20: Sandplain Wanderrie Grassy Shrubland: Kalli land system, Woolgorong Station.

Sandplain Wanderrie Grassy Shrubland is generally a scattered to moderately close (PFC 15 to 35%) tall shrubland with lesser amounts of cover by lower

shrubs and perennial grasses. About 30% of all sites possess a tree or taller mallee overstorey, which is usually only a minor component of total cover. About 50% of all Sandplain Wanderrie Grassy Shrubland sites are dominated by wanyu (*Acacia ramulosa*); other sites may be dominated by any of several other tall shrubs or trees (Table 53). The mid and low shrub strata are usually dominated by Wilcox bush (*Eremophila forrestii*), flannel bush (*Solanum lasiophyllum*), *Eremophila georgei* or young regeneration of mulga (*A. aneura*) or wanyu. Low densities of palatable shrubs augment the perennial grasses.

The perennial grass component is dominated by broad-leaved wanderrie (*Monachather paradoxa*) in approximately 60% of all instances. Most other sites are dominated by either soft wanderrie (*Thyridolepis multiculmis*) or buck wanderrie (*Eriachne helmsii*). Over a third of all sites have all three major grass species present.

Sandplain Wanderrie Grassy Shrubland cover and composition strongly suggests that this vegetation type would be susceptible to fire on a very long interval of return. Very little of it showed evidence of actually having carried fires.

Sandplain Wanderrie Grassy Shrubland grows on deep sand soils (mainly Uc5.21) which respond to significant rainfall with major herbage responses of forbs in winter and grasses in summer and autumn. It is thus a useful seasonal pasture type, even where perennial grasses are very scarce.

Gradational associations

Sandplain Wanderrie Grassy Shrubland intergrades and is irregularly and unpredictably replaced by more shrubby Sandplain Acacia Shrubland vegetation on the same landscape units, particularly so towards the south-east of the area. For this reason, local knowledge of the plant composition and shrub/grass balance is needed to assess the grazing potential of Kalli and Sandplain land systems in any particular paddock.

Towards the fringes of each underlying sand sheet, Sandplain Wanderrie Grassy Shrubland normally intergrades with Lateritic Acacia Shrubland, Hardpan Mulga Shrubland or Granitic Mulga Shrubland.

Grazing impact and the condition of perennial vegetation

No. of condition sites investigated:	71
Site methodology:	E
Site variables analysed:	dominant species in association; projected foliar cover (PFC); canopy foliar cover of perennial grasses; distance from stock water point; paddock quadrant; erosion status.

Results: condition of perennial vegetation: 5 classes

Class 1

Dominant or co-dominant perennial grass species is soft wanderrie. Perennial grass cover > class 2 (moderate cover).

Class 2

Dominant or co-dominant perennial grass species is broad-leaved wanderrie. Perennial grass cover \geq class 2 (moderate cover).

Class 3

Not 1 or 2. Dominant or co-dominant perennial grass species is creeping wanderrie or woolly butt. Perennial grass cover \geq class 2 (moderate cover).

Class 4

One or more of the palatable species of classes 1 to 3 is dominant or co-dominant. Perennial grass cover is class 1 (very sparse to sparse).

Class 5

Other species dominant on site.

Erosion status: incidence of accelerated erosion

There was no evidence of accelerated erosion on any of the sites.

Table 53. Commonest dominant species at Sandplain Wanderrie Grassy Shrubland sites

Low trees	Tall shrubs	Mid and low shrubs	Perennial grasses
<i>Acacia aneura</i>	<i>A. ramulosa</i>	<i>Eremophila forrestii</i>	<i>Monachather paradoxa</i>
<i>A. pruinocarpa</i>	<i>A. aneura</i>	<i>Solanum lasiophyllum</i>	<i>Thyridolepis multiculmis</i>
<i>A. ramulosa</i>	<i>A. aff. coriacea</i>	<i>E. georgei</i>	<i>Eriachne helmsii</i>
<i>Callitris columellaris</i>	<i>Grevillea</i> spp.	<i>A. ramulosa</i>	<i>Eragrostis eriopoda</i>
<i>Bursaria spinosa</i>	<i>Acacia</i> MRS 013	<i>A. aneura</i>	<i>E. lanipes</i>
<i>Eucalyptus oldfieldii</i>	<i>Stylobasium spathulatum</i>	<i>Ptilotus schwartzii</i>	
		<i>A. daviesioides</i>	
		<i>E. granitica</i>	
		<i>A. aff. coriacea</i>	
		<i>Bursaria occidentalis</i>	

General conclusions and remarks

The above classification appears to reflect site variation owing to factors other than cumulative grazing impact. Analysis for grazing-related trends showing as effects of distance from water or paddock quadrant showed no significant correlations or pattern. What component of the observed variation may, in fact, be a result of whole paddock changes induced by grazing could not be elucidated. Nor is it known to what degree changes between the states of grass cover and composition described (which are almost identical to those found on wanderrie banks) are permanent features of sites or are otherwise cyclical or successional in nature.

Comments on increases by unpalatable species and productive potential given under Wanderrie Bank Grassy Shrubland apply equally to this vegetation type.

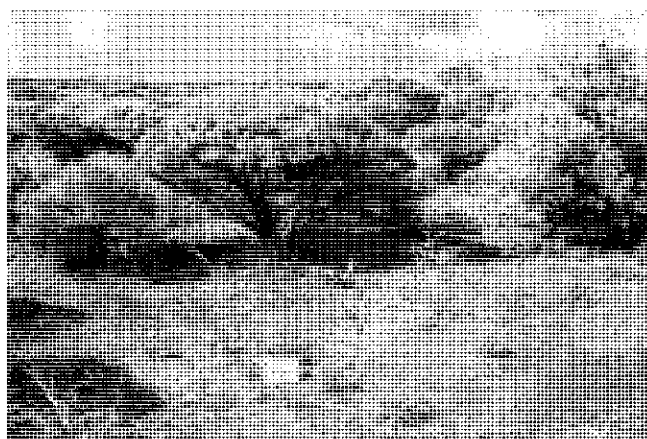
Table 54. Site classification summary (n = 71) Sandplain Wanderrie Grassy Shrubland sites

Class	No.	%	Cumulative %
1	6	8	8
2	16	23	31
3	2	3	34
4	37	52	86
5	10	14	100

Vegetation type 21: Sandplain Acacia Shrubland

Sandplain Acacia Shrubland occurs mainly on the broad areas of sandplains (**land type 11**) in the south east of the survey area on the Kalli and Woodline land system. Sandplain Acacia Shrubland associations resemble Sandplain Wanderrie Grassy Shrubland in many respects, differing chiefly in an absence or near-absence of wanderrie perennial grasses in the understorey, while generally displaying a greater density of low shrubs.

General characteristics



Vegetation type 21: Sandplain Acacia Shrubland: Kalli land system, Yarraquin station.

Sandplain Acacia Shrubland is generally a moderately close to close (PFC 20 to 40%) tall shrubland with lesser amounts of cover by mid-shrubs, trees and low shrubs. About 70% of all Sandplain Acacia Shrubland sites are dominated by wanyu (*Acacia ramulosa*); most other sites are dominated by mulga (*A. aneura*).

Table 55. Commonest dominant species at Sandplain Acacia Shrubland sites

Low trees	Tall shrubs	Mid shrubs	Low shrubs
<i>Acacia aneura</i>	<i>A. ramulosa</i> <i>A. aneura</i>	<i>A. ramulosa</i> <i>A. aff. coolgardiensis</i> <i>Eremophila georgei</i> <i>E. forrestii</i>	<i>E. forrestii</i> <i>E. georgei</i> <i>E. punicea</i> <i>Ptilotus obovatus</i>

Table 56. Main palatable perennial species at Sandplain Acacia Shrubland sites

<i>Eremophila forrestii</i> <i>Ptilotus schwartzii</i> <i>Spartothamnella teucriflora</i> <i>Maireana aff. villosa</i> <i>Sida</i> sp. <i>P. obovatus</i> <i>Rhagodia eremaea</i> <i>Maireana convexa</i> <i>E. aff. compacta</i>	Wilcox bush horse mulla-mulla Mulga broombush cotton bush tall saltbush mulga bluebush
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Sandplain Acacia Shrubland grows on moderately deep and deep earthy sand soils (Uc5.21) on red sandplains and sand sheet land units. While these units have some seasonal growth response of ephemeral shrubs and grasses, the generally low densities of palatable shrubs and likely low nutrient levels of soils and forage suggests that the pastoral value of such vegetation is generally low.

Gradational associations

Sandplain Acacia Shrubland intergrades with Hardpan Mulga Shrubland on the major unit of the Woodline land system and is replaced by Sandplain Mallee Acacia Spinifex in the far south-east. This vegetation type is replaced by the more grassy and diverse Sandplain Wanderrie Grassy Shrubland with increasing frequency toward the west. As with that vegetation type, Sandplain Acacia Shrubland normally intergrades with Lateritic Acacia Shrubland at the fringes of each sand sheet.

Grazing impact and the condition of perennial vegetation

No. of condition sites investigated:	19
Site methodology:	D, E

Site variables analysed:

- dominant species in association;
- projected foliar cover (PFC);
- plant density;
- species richness;
- palatable species density;
- palatable species richness;
- perennial diversity (Shannon-Weiner);
- palatable species diversity (Shannon-Weiner);
- species evenness (equitability);
- distance from stock waterpoint;
- paddock quadrant;
- erosion status.

Results: condition of perennial vegetation: 3 classes

Class 1

No. of palatable spp. $\geq 7/1000 \text{ m}^2$.
 Density of palatable spp. $\geq 150/1000 \text{ m}^2$.

Class 2

Not as class 1.

No. of palatable spp. $\geq 4 < 7/1000 \text{ m}^2$.
 Density of palatable spp. $\geq 10 < 150/1000 \text{ m}^2$.

Class 3

Not as class 1 or 2.

Table 57. Site classification summary (n = 19)
Sandplain Acacia Shrubland sites

Class	No.	%	Cumulative %
1	2	13	13
2	11	74	87
3	2	13	100
unclassified	4		

Erosion status: incidence of accelerated erosion

Sandplain Acacia Shrubland is not normally susceptible to accelerated erosion.

General conclusions and remarks

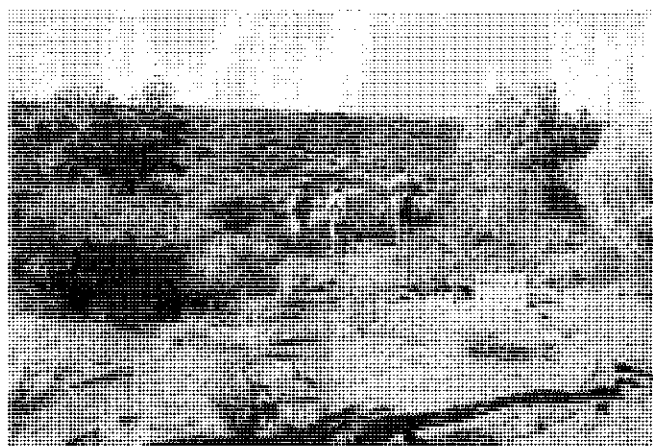
From the small sample of condition sites that were investigated, indications are that Sandplain Acacia Shrubland is best regarded as a shrubby form of Sandplain Wanderrie Grassy Shrubland rather than a (degraded) state of the latter from which the wanderrie grass has been largely lost. Sandplain Acacia Shrubland generally supports a sparse palatable low shrub component rather than perennial grasses. This, and other botanical and geographical differences between the two types which dominate sandplains of the Kalli land system, suggests that they are not merely variations of the same type which replace each other in space and time, at least on a

managerial timescale. In other words, areas of Kalli sandplain that support no wanderrie grasses may be naturally so and are not necessarily degraded. Instead, they should be considered as shrublands on their own merits.

Vegetation type 22: Sand Dune Shrubland

Sand Dune Shrubland is included here as a major vegetation type, although it is probably the least extensive of the 23 types described. Sand Dune Shrubland occurs on dunes of siliceous sands which occur widely as a minor unit of land systems in **land types 17 and 12**, with local occurrences in **land type 10**.

General characteristics



Vegetation type 22: Sand Dune Shrubland: Sandplain land system, Muggon station.

Sand Dune Shrubland is characteristically a moderately close shrubland (PFC 20 to 30%) dominated by tall shrubs, everywhere other than where soils are sufficiently saline and/or calcareous to permit halophytic mid- and low-shrubs to flourish, as on the transitional 'edges' of dunes in saline lake beds and drainages.

In most instances, the tall shrub stratum is dominated or co-dominated by sand dune grevillea (*Grevillea stenobotrya*), bowgada (*Acacia linophylla*) or limestone wattle (*A. sclerosperma*). A stratum of scattered trees (usually mulga) is encountered at about 20% of sites. Otherwise, understorey shrubs are always present, either as a predominantly mid-height stratum dominated by species such as currant bush (*Scaevola spinescens*), pebble bush (*Stylobasium spathulatum*), young wattles and *Eremophila georgei*, or by low shrubs such as cotton bush (*Ptilotus obovatus*), *Thryptomene* spp. and distinctive association members such as *Pityrodia* spp., *Sida* and *Abutilon* spp.

Perennial grasses (mainly buck wanderrie) are present at about 70% of sites, but only rarely in significant quantities.

Palatable shrub species found in such associations vary primarily in relation to any calcareous, gypsiferous or saline content in the sand soils. Where

Table 58. Common dominant perennials on Sandplain Mallee-Acacia-Spinifex sites

Trees	Tall shrubs	Mid and low shrubs	Perennial grasses
<i>Eucalyptus kingsmillii</i> <i>E. leptopoda</i> <i>E. oleosa</i> <i>Acacia aneura</i>	<i>Acacia ramulosa</i> <i>Duboisia hopwoodii</i> <i>A. acuminata</i> <i>Grevillea</i> spp. <i>A. murrayana</i> <i>A. royeri</i>	<i>A. aneura</i> <i>A. ramulosa</i> <i>Eremophila glabra</i> <i>E. granitica</i> <i>Pityrodia</i> sp. <i>Thryptomene decussata</i> <i>Prostanthera</i> sp. <i>Olearia pimelioides</i> <i>Dianella revoluta</i> <i>Solanum lasiophyllum</i>	<i>Triodia basedowii</i> <i>T. lanigera</i> <i>Plectrachne melvillei</i> <i>Eriachne helmsii</i> <i>Paraneurache muelleriana</i> <i>Monachather paradoxa</i>

this occurs, species such as ragged-leaf scaevola (*Scaevola tomentosa*), Rhagodia spp., ruby saltbush (*Enchylaena tomentosa*), felty bluebush (*Maireana tomentosa*) and sage (*Cratystylis subspinescens*) are encountered. Otherwise, palatable chenopods other than scrambling saltbush (*Chenopodium gaudichaudianum*) are normally scarce on such sites, being replaced by semi-perennial Malvaceae (*Sida* and *Abutilon* spp.), green cassia (*Cassia chatelainiana*) and poverty bushes (*Eremophila* spp. mainly Wilcox bush).

Gradational associations

On land type 10, dune associations tend to be intermediate between Sand Dune Shrubland and Sandplain Acacia Shrubland in their composition. Low, poorly developed linear dunes and banks fringing lakebeds and saline areas support intermediate semi-halophytic shrublands where the soils are relatively shallow.

Grazing impact and the condition of perennial vegetation

Where Sand Dune Shrubland exists as a minor unit within extensive areas of saline shrublands, palatable perennial shrubs are often subject to high levels of herbivory from sheep, rabbits and goats. In this way, Sand Dune Shrubland sites are vulnerable to overgrazing. Preferential herbivory may be especially marked where stock depend on brackish water supplies, reducing animal intake of saline forage.

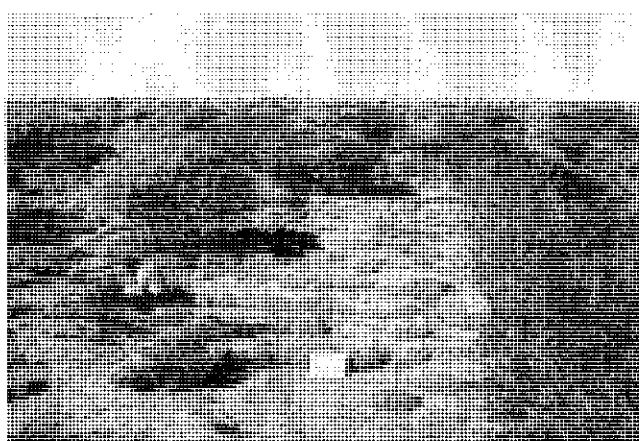
A substantial proportion of Sand Dune Shrubland sites examined exhibited unexpectedly low densities of palatable shrubs and/or high levels of plant utilisation, although no quantitative data are available. Sand Dune Shrublands appear to be resistant to degradative changes, through the effect of a preponderance of very deep-rooted unpalatable species and low susceptibility to accelerated erosion wherever the canopy cover remains.

Vegetation type 23: Sandplain Mallee-Acacia-Spinifex

Sandplain Mallee-Acacia-Spinifex is mainly confined to the far south-east of the survey area, on the Bullimore land system and, on Mt Farmer station,

as a local variant on the Kalli land system. It is not, therefore, a widespread vegetation type of the Murchison catchment but is included for the sake of completeness by its predominance on parts of three pastoral leases (Wynyangoo, Wondinong and Mt Farmer). Characteristically, it occurs on extensive sheets of siliceous sand and represents the only type of 'spinifex country' found in the area. Even so, it is not a spinifex-dominated vegetation type; overstorey shrubs, with or without mallee eucalypts, provide more foliar cover at the vast majority of sites.

General characteristics



Vegetation type 23: Sandplain Mallee-Acacia-Spinifex Shrubland: Kalli land system, Mt Farmer station.

A variable, patchy and often only sparse ground cover of 'hard' spinifex hummocks and rings grows between rather clumped tall shrubs of 10 to 20% total cover (PFC). The total cover by spinifex is usually < 10%. About 70% of sites support scattered overstorey trees or mallee eucalypts.

Gradational associations

Transitional zones with floristic characteristics intermediate between Sandplain Mallee-Acacia-Spinifex and Sandplain Wanderrrie Grassy Shrubland are common in the far south-east of the area. Elsewhere, intermediates between Sandplain Mallee-Acacia-Spinifex and Sandplain Acacia Shrubland occur.

Grazing impact and the condition of perennial vegetation

Sandplain Mallee Acacia Shrubland has only very low potential for pastoral use. Zones with slightly better soil development carrying local sheet flow tend to support some of the palatable shrubs typical of Hardpan Mulga Shrubland, but at only very low densities. The nutrient content of these perennials is likely to be poor on such leached soils. For pastoral purposes, the value of Sandplain Mallee-Acacia-Spinifex areas is generally limited to seasonal opportunities after good rains promote annual plants, particularly following prescribed burning.

In some severely overgrazed areas (holding paddocks etc.) the inedible hard spinifex has tended to increase where shrubs have been depleted. On other sites the converse appears to have taken place in concert with fire suppression. However, most parts within the survey area have evidently received little grazing use at least during recent decades.

General conclusions on the patterns and condition of vegetation in the survey area

1. Small-scale natural patterning

The natural patterning exhibited by the major types of the shrub-dominated arid vegetation in the area is, almost everywhere, on a strikingly small-scale mosaic. It is controlled by the patterning of landforms, run-off and soil types. Otherwise, gradients, clines and other trends in regional biogeography are subtle and subdued, rather than steep and striking.

Arguably, the general observation that variation in vegetation associations is greater within the component lands of each sub-catchment than between catchments, is the key to understanding how it may be possible to regenerate and recover much of the extensive degradation of perennial vegetation that has occurred after a century of grazing.

2. Widespread but uneven incidence of degradation

By a variety of measures, the incidence of vegetation degradation is high throughout the area, but by no means ubiquitous, nor evenly distributed across vegetation types (Table 59). The major vegetation types which have suffered most from significantly degraded composition and/or gross structural degradation are Hardpan Mulga Shrubland (the most widespread vegetation type), Stony Mulga Mixed Shrubland, Saltbush Shrubland, Bluebush Shrubland and Calcareous Shrubby Grassland. Those that are least affected by degradation are Rocky Hill Mixed Shrubland, Sandplain Wanderrie Grassy Shrubland, Sandplain Acacia Shrubland, Sandplain Mallee-Acacia-Spinifex Shrubland and Samphire Shrubland.

3. Paddock-size impacts

Quantitative measures taken during the survey indicated that degradation of perennials has tended to occur to a large extent throughout the affected paddocks. Although some significant effects related to distance from permanent watering points were detected, in general paddocks have been sufficiently small and water quality sufficiently high for stock and other grazing animals to have grazed or overgrazed throughout the paddock. This does not imply that impacts have been even, across different vegetation types. Preferential grazing of some land units over others has often led to marked unevenness of impact within a paddock.

4. Continuous, uni-modal distributions of vegetation characteristics

Results from large numbers of condition sites which sampled perennial vegetation composition in the major vegetation types gives weight to the concept that degradation states are encountered as type-specific continuums of changes, in attributes such as canopy cover, plant density, palatable plant density, species richness, diversity and equitability, and community structural dominance. The gross

Table 59. Main symptoms of degradation exhibited by the worst affected vegetation types

Vegetation type	Estimated proportion of survey area	Symptoms of degradation
Hardpan Mulga Shrubland	30%	decreased perennial plant density decreased density of palatable plants decreased frequency of palatable species decreased species richness decreased species diversity
Stony Mulga Mixed Shrubland	12%	as above
Bluebush Shrubland	9%	decreased cover by key palatable species decreased frequency of palatable species increased cover by unpalatable shrubs with invasive tendencies ('woody weeds') accelerated erosion
Saltbush Shrubland	9%	as above
Calcareous Shrubby Grassland	1%	decreased frequency, cover and biomass of palatable perennial grasses increased cover by unpalatable perennial shrubs

distributions of such characteristics between equivalent sites throughout the area in almost all instances indicated continuous uni-modal distributions of variation.

5. *The vegetation attributes of any site, and therefore the 'condition' class allocated to a site reflect both long-term management impact and natural variation in botanical attributes*

Variation between sites, and the characteristics of any particular site, **always** results partly from variations in site potential (attributable to its particular set of biophysical characteristics) and partly from the cumulative impact of all land use, management history and grazing pressure. The impossibility of 'controlling' the background natural variation in site potential in order to quantify the assessment of management impact means that quantified classification of individual sites, such as that given here, constitutes information on **condition-related** characteristics of the perennial resource as it was encountered during the survey.

In other words, a 'condition class' of sites exhibiting similar characteristics will, to some extent, group any sites of higher biological potential, but which have received more degradative impacts, together with sites which have received less degradative impacts and changes but were inherently less productive, i.e. of a lower biological potential. The resultant compounding of these two effects does not negate the value of the information to a manager of that land. It is the outcome of the two variables in combination which is the determinant of the long-term status of the vegetation on the land sampled, and its relative position within the whole spectrum of condition variation (on a regional scale) which is being gauged and assessed for management implications.

6. *The likely importance of non-vascular plants in maintaining vascular plant productivity*

While the present survey program did not collect quantitative data on the occurrence of non-vascular plants (e.g. blue-green algae, lichens and liverworts), the importance of these widespread groups (see Cranfield 1990, Rogers 1989) cannot be overemphasised in proffering soil surface crusts which fix, concentrate and recycle nutrients, stabilise dispersible topsoils, and form natural seeding mats, infiltration zones and evapotranspiration shields.

Any future monitoring of remotely-sensed changes in land surface 'cover' in this area will require a far more rigorous understanding of the ecology and seasonal dynamics of these cryptogams than is currently available.

7. *Despite widespread degradation, the conservation status of the flora at species level appears to be favourable and encouraging*

As a result of findings from this survey, there are no longer any 'missing' plant species known or suspected to have become extinct from the area. Previously inadequate and inaccurate knowledge of the status of some little-known endemic species, such as *Prostanthera* (= *Eichlerago*) *tysoniana*, and *Ptilotus*

beardii, has been redressed by encouraging findings on their occurrence, while the status of some other rare plants such as *Grevillea subtiliflora*, *Maireana murrayana* and *Lepidium* aff. *xyloides* gives rise for concern. A small number of currently more widespread species such as sandalwood (*Santalum spicatum*) do not appear to be reproducing at anything like sustainable rates under current land management and will require special management provision if they are not to be lost from many parts when the current generation of adult plants has gone.

8. *Reference areas, where examples of vegetation types exist in good condition, still exist for major vegetation types*

This is true with the exception of Calcrete Shrubby Grassland, for which there are no known sites that have avoided the chronic overgrazing pressures exerted by rabbits and red kangaroos irrespective of the presence of sheep. Sites are known which have reasonable levels of cover of the native perennial grass species, at least by the living rhizomes. These would almost certainly respond to effective grazing control. To achieve this, management controls would need to be developed for stock, kangaroos and rabbits.

9. *Many isolated examples of locally regenerated or improved vegetation condition exist in the area, but are mainly little-known or undocumented*

The survey encountered a number of sites, paddocks and larger areas which showed circumstantial evidence of significant long-term improvement in vegetation condition. While identifying causative factors was sometimes difficult or impossible without fuller information on the management history of individual areas, changes in grazing management practices could sometimes be identified and related to vegetation characteristics. In some cases, benign neglect or disuse, for example after the demise of a stock water supply, may have triggered natural regeneration.

While a few leases have significantly benefited from successful long-term attempts to improve the grazing management and condition of the vegetation resource, most have not. The potential to plan, support and implement vegetation recovery through sub-catchment scale management programs has yet to be tested. Such programs could be based on rigid control of all grazing animals, strategic and tactical grazing use of each land type and through non-mechanical enhancement of natural processes.

10. *The recovery of degraded chenopodiaceous shrublands and their associated soil erosion depends on the effective control of all grazing pressure*

Past and present total grazing pressure on well-watered, poorly fenced areas of river plains dictates that natural processes of recovery and stabilisation of eroded areas cannot begin without changes to management practices. Likely pre-requisites for the recovery of Saltbush and Bluebush Shrublands on river frontages include improved condition in Hardpan Mulga Shrublands adjacent to the rivers, effective fencing by land type boundaries, and the ability for managers to deny access to all large grazing animals at critical times.

Table 60. Summary of vegetation types in the Murchison rangeland survey area

Vegetation type	Landform and vegetation characteristics	Vegetation and erosion status
Hardpan Mulga Shrubland (HPMS) Approx. percentage of survey area: 27%	Extensive flat plains of shallow alluvium; shallow uniform soils over cemented alluvium (hardpan), sparse trees (<i>Acacia aneura</i>) and tall shrubs (<i>A. tetragonophylla</i>) above a scattered mid shrub (<i>Cassia</i> and <i>Eremophila</i> spp.) and low shrub layer (<i>Ptilotus obovatus</i>); perennial grasses usually absent; PFC 10-25%. Moderate pastoral value.	Palatable shrubs mostly depleted by drought and overgrazing; slightly susceptible to minor surface stripping on washplains, isolated pockets of moderate and severe erosion on broad drainage tracts.
Stony Mulga Mixed Shrubland (SMMS) Approx. percentage of survey area: 13%	Stony piedmont plains, interfluvies and footslopes; soils mostly < 30 cm deep; very scattered tall shrublands of <i>Acacia aneura</i> , <i>Eremophila spathulata</i> and <i>Ptilotus</i> spp.; perennial grasses mostly absent; PFC 5-15%. Mainly low pastoral value.	Vegetation generally in fair to poor condition; stony mantle bestows resistance to erosion except for fluvial wash formations with minor erosion evident.
Sandplain Wanderrie Grassy Shrubland (SWGGS) Approx. percentage of survey area: 12%	Flat to gently undulating sandplain; deep uniform sandy soils; tall shrublands of <i>Acacia ramulosa</i> with a patchy grass storey of <i>Monachather paradoxa</i> , <i>Eriachne</i> and <i>Eragrostis</i> spp.; PFC 15-35%. Moderate to low pastoral value.	Vegetation mostly in fair to good condition, although perennial grasses are depleted in parts; generally resistant to erosion except for short periods after fire when prone to wind erosion.
Granitic Mulga Shrublands (GMUS) Approx. percentage of survey area: 9%	Variable plains on granite foundation with sandy surfaces and occasional mantles; shallow sandy soils; scattered tall shrublands of <i>Acacia aneura</i> , <i>A. quadrimarginea</i> , <i>Eremophila</i> spp. and <i>Ptilotus obovatus</i> . PFC 5-20%. Moderate pastoral value.	Vegetation on plains mostly in fair condition, not normally susceptible to accelerated erosion.
Bluebush Shrubland (BLUS) Approx. percentage of survey area: 8%	Alluvial flood plains, saline stony plains and saline footslopes below breakaways; variable trees and tall shrubs (<i>Acacia victoriae</i> , <i>A. xiphophylla</i>) over low shrublands of <i>Maireana pyramidata</i> , <i>M. triptera</i> , <i>M. georgei</i> and <i>Cassia</i> spp.; occasional perennial grasses (<i>Stipa</i> and <i>Enneapogon</i> spp.); PFC 5-20%. High pastoral value.	Vegetation generally degraded, accelerated erosion common; some sites susceptible to shrub invasion by <i>Acacia victoriae</i> and <i>Cassia</i> spp.
Wanderrie Bank Grassy Shrubland (WBGS) Approx. percentage of survey area: 7%	Elevated sandy banks of variable extent on broad hardpan plains; soils are deep (to 1 m+) uniform sands or clayey sands; tall shrublands of <i>Acacia aneura</i> with a mid shrub layer of <i>Eremophila forrestii</i> and <i>Cassia</i> spp.; perennial grasses <i>Monachather paradoxa</i> , <i>Thyridolepis</i> , <i>Eriachne</i> and <i>Eragrostis</i> spp.; PFC 5-20%. Moderate pastoral value.	Vegetation usually in fair condition, some sites subject to encroachment by undesirable grasses and shrubs; moderately resistant to erosion, although accelerated erosion by wind and water can occur if vegetation cover is severely depleted.
Rocky Hill Mixed Shrubland (RHMS) Approx. percentage of survey area: 6%	Sloping stony interfluvies and footslopes, rugged hillslopes and crests of mountain ranges, breakaway plateaux and slopes; very sparse <i>Acacia</i> tall shrub layer with a variable, scattered under storey of <i>Eremophila</i> and <i>Cassia</i> spp.; perennial grasses mostly absent; PFC 10-25%. Low to very low pastoral value (20-30 ha/ssu).	Vegetation generally in good condition although sometimes locally overgrazed by feral goats and, on lower slopes and accessible valleys, by domestic stock; erosion is generally negligible owing to dense stony surface mantles.
Saltbush Shrubland (SALS) Approx. percentage of survey area: 4%	Alluvial plains and flood plains of major drainage systems; also swampy drainage floors and depressions of major tributary drainage zones; deep (> 1 m) duplex clay loams, saline clays and also sandy banks; mostly low shrublands of <i>Atriplex amnicola</i> , <i>A. bunburyana</i> and <i>A. vesicaria</i> but often with tall shrub layer of <i>Acacia</i> , <i>Eremophila</i> or <i>Hakea</i> spp.; perennials grasses uncommon, PFC 5-20%. High pastoral value.	Vegetation frequently degraded but condition varies from very good to very poor, degraded sites often dominated by undesirable <i>Acacia</i> and <i>Eremophila</i> species; sites with significant loss of cover usually show moderate or severe accelerated erosion, particularly on frequently flooded tracts.

Table 60. Summary of vegetation types in the Murchison rangeland survey area—continued

Vegetation type	Landform and vegetation characteristics	Vegetation and erosion status
Mulga Grove Woodland (MGRW) Approx. percentage of survey area: 2%	Discrete groves, drainage foci and swamps on hardpan plains and other drainage systems; loamy and clayey soils mostly > 1 m deep; tall woodlands of <i>Acacia aneura</i> , <i>A. distans</i> , <i>A. pruinocarpa</i> and <i>Canthium latifolium</i> with a dense mid storey of <i>A. tetragonophylla</i> and <i>A. kempeana</i> ; low shrubs <i>Ptilotus obovatus</i> , <i>Solanum lasiophyllum</i> , <i>Eremophila</i> spp. and numerous others; occasional tussock perennial grasses; PFC 25-> 50%. High pastoral value.	Generally resilient to grazing and in fair or good condition, some overgrazed groves show increased unpalatable <i>Eremophila</i> and <i>Solanum</i> species, erosion is mostly absent.
Mixed Halophytic Shrubland (MXHS) Approx. percentage of survey area: 2%	Saline alluvial plains and flood plains, saline footslopes below breakaways; stony plains on Permian rocks. Soils are mainly duplex types to 1 m+ deep with occasional sparse surface mantles. Low shrublands with scattered tall and mid shrub layer of <i>Acacia</i> , <i>Eremophila</i> and <i>Hakea</i> spp., low shrubs <i>Ptilotus beardii</i> , <i>Cratystylis subspinescens</i> , <i>Frankenia</i> spp. and <i>Maireana</i> spp., few perennial grasses (<i>Eragrostis</i> spp.); mean PFC 5-30%. High pastoral value.	Vegetation often significantly degraded because of preferential grazing; some parts in protected areas remain in good condition; duplex soils with reduced cover are highly susceptible to accelerated erosion.
Creekline Shrubland (CRLS) Approx. percentage of survey area: 2%	Margin and banks of major creeks and drainage lines; clays and clay loams with various profiles though often uniform with recent depositions in flooded parts, hardpan foundations common with frequent exposures; tall shrublands or woodland of <i>Acacia aneura</i> , <i>A. burkittii</i> , <i>A. tetragonophylla</i> ; mixed mid and lower storey shrubs, occasional perennial grasses; PFC 15-50%. Moderate pastoral value.	Mostly in fair condition; erosion tends to be minor owing to protection conferred by dense vegetative cover, although, where exposed, duplex and unconsolidated soils are erodible.
Stony Snakewood Shrubland (SSWS) Approx. percentage of survey area: 1.5%	Saline stony footslopes and stony plains, also weakly saline granitic plains; soils are shallow, saline clays and clay loams, mostly with moderately dense quartz mantles, over various substrates. Shrubland of <i>Acacia xiphophylla</i> or <i>A. cuthbertsonii</i> with a variable mid shrub layer; low shrubs (<i>Maireana</i> and <i>Ptilotus</i> spp.) often dominant; perennial grasses rare; PFC 10-20%. Low to moderate pastoral value.	Vegetation frequently degraded through overgrazing of more palatable low shrubs, some areas show increases in undesirable species (<i>Eremophila pterocarpa</i> , <i>Hakea preissii</i> , <i>Cassia desolata</i>); generally not susceptible to accelerated erosion due to stony surface mantles.
Lateritic Acacia Shrubland (LACS) Approx. percentage of survey area: 1%	Lateritic plains, interfluvies and rises; sandy soils < 1 m deep with many gravel inclusions and laterite exposures; tall shrublands of <i>Acacia ramulosa</i> , <i>A. aneura</i> or <i>A. grasbyi</i> over a variable mid and low shrub layer; occasional patches of perennial grasses on deeper soils. PFC 10-30%. Low to moderate pastoral value.	Mostly in fair condition; not normally subject to accelerated erosion.
Calcrete Shrubby Grasslands (CSHG) Approx. percentage of survey area: 1%	Elevated calcrete platforms and alluvial plains of major drainage systems; shallow calcareous sands or loamy sands with calcrete inclusions and variable calcrete mantles; mixed shrublands with tall shrubs <i>Acacia aneura</i> , <i>A. sclerosperma</i> and <i>A. victoriae</i> ; mid and low shrubs <i>Cassia</i> , <i>Ptilotus</i> and <i>Solanum</i> spp.; perennial grasses <i>Enneapogon</i> , <i>Eragrostis</i> and <i>Stipa</i> spp.; mean PFC 10-25%. Moderate to high pastoral value.	Vegetation is preferentially grazed by stock, kangaroos and feral goats and is invariably degraded; some sites invaded by unpalatables such as <i>Cassia</i> spp.; erosion is mostly absent.

Table 60. Summary of vegetation types in the Murchison rangeland survey area—continued

Vegetation type	Landform and vegetation characteristics	Vegetation and erosion status
Samphire Shrublands (SAMS) Approx. percentage of survey area: < 1%	Strongly saline alluvial and gypsiferous plains associated with major drainage systems and lake margins; soils are deep saline clays, often with gypsiferous inclusions throughout; low shrublands of <i>Halosarcia</i> and <i>Lawrenzia</i> spp. with occasional sparse <i>Acacia</i> mid shrubs, perennial grasses rare; PFC mostly 7.5-20%. Very low pastoral value.	Generally good condition of vegetation reflects low acceptability of highly saline plants to livestock; use of these pastures is further limited by usually highly saline local groundwater. Erosion is mostly absent, except for isolated and minor tracts on margins of channels and active flood plains.
Mulga Chenopod Shrubland (MCHS) Approx. percentage of survey area: < 1%	Stony plains and footslopes below low hills and breakaways; occasionally saline alluvial plains; soils are usually shallow duplex types; tall mulga shrublands with a tall and mid shrub layer of mixed <i>Acacia</i> and <i>Eremophila</i> species; low shrubs <i>Maireana triptera</i> , <i>M. georgei</i> , <i>Solanum</i> and <i>Ptilotus</i> spp.; PFC 7.5-20%. Moderate pastoral value.	Vegetation condition is highly variable and is dependent on location and access to stock water to a large degree; accessible and freely grazed parts tend to have low densities of desirable species; elsewhere condition is fair or good. Accelerated erosion occurs locally, but is generally not significant or widespread.
Sand Dune Shrubland (SDUS) Approx. percentage of survey area: < 1%	Linear dunes to 12 m high with deep red sands; tall shrublands with an upper storey of <i>Acacia ramulosa</i> , <i>A. sclerosperma</i> or <i>Grevillea</i> spp., mid and lower storey of <i>Acacia</i> and assorted Myrtaceous shrubs; scattered perennial grasses <i>Eriachne</i> , <i>Eragrostis</i> and <i>Monochather</i> spp.; mean PFC 15-20%. Low to moderate pastoral value.	Vegetation mostly in fair condition owing to low palatability of dominant species although dunes associated with lake systems tend to be grazed more; inherently susceptible to wind erosion if vegetation cover is lost.
Sandplain Acacia Shrubland (SAAS) Approx. percentage of survey area: < 1%	Level or gently undulating sandplain with occasional dunes; deep uniform red sands; tall shrublands of <i>Acacia ramulosa</i> over a mid and low shrub storey of <i>A. spp.</i> , <i>Eremophila forrestii</i> and <i>E. georgei</i> ; very sparse perennial grasses <i>Eragrostis</i> and <i>Monachather</i> spp.; PFC 20-40%. Low pastoral value.	Vegetation condition mostly good; not normally susceptible to accelerated erosion but exposed parts, such as immediately after a fire, are prone to wind erosion.
Non Calcareous Shrubby Grassland (NCSG) Approx. percentage of survey area: < 0.5%	Non-saline floodplains and unchannelled drainage tracts; deep clayey soils; woodlands and tall shrublands of <i>Acacia distans</i> , <i>A. aneura</i> and <i>Eucalyptus coolabah</i> , mid shrubs <i>Eremophila laanii</i> , <i>Rhagodia eremaea</i> and prominent grass layer including <i>Eriachne flaccida</i> and <i>Eriachne</i> aff. <i>benthamii</i> . PFC 20-50%. High pastoral value.	Palatable shrubs and grasses frequently depleted, not normally susceptible to accelerated erosion.
Alluvial Tussock Grassland (ATUG) Approx. percentage of survey area: < 0.5%	Swamps, sluggish drainage zones of flood plains and gilgai plains; soils are deep clays; tussock grasslands with a variable overstorey of <i>Acacia</i> , <i>Eucalyptus</i> and <i>Hakea</i> spp.; dominant perennial grasses include <i>Eragrostis setifolia</i> and <i>Eriachne flaccida</i> with basal cover to 4%. High pastoral value.	Resilient to grazing and in fair or good condition, not usually susceptible to accelerated erosion.
Creekline Grassy Shrubland (CRGS) Approx. percentage of survey area: < 0.5%	Margins and banks of major channels, also floors of wider drainage zones with deep (to 1 m+) clay and clay loam soils. <i>Acacia</i> or eucalypt low woodlands or tall shrublands with mid and low shrubs and a grassy layer of <i>Eriachne</i> , <i>Eragrostis</i> , <i>Cenchrus</i> and <i>Chrysopogon</i> spp., PFC 20-30%. Pastoral value moderate to high.	Vegetation generally somewhat degraded, not generally susceptible to erosion except where channel banks are disturbed.

Table 60. Summary of vegetation types in the Murchison rangeland survey area—continued

Vegetation type	Landform and vegetation characteristics	Vegetation and erosion status
Riverine Mixed Shrubland (RIMS) Approx. percentage of survey area: < 0.5%	Alluvial plains, flood plains and drainage floors of major river systems; deep duplex clays and clay loams; mixed shrublands with a distinct tree (<i>Eucalyptus coolabah</i> , <i>Acacia</i> and <i>Grevillea</i> spp.) and tall shrub layer (<i>A. victoriae</i> , <i>A. tetragonophylla</i> and <i>A. sclerosperma</i>), mixed mid storey (<i>Acacia</i> and <i>Eremophila</i> spp.) and a dominant low shrub layer (<i>Ptilotus</i> , <i>Atriplex</i> , <i>Cassia</i> , <i>Cratystylis</i> and <i>Eremophila</i> spp.); PFC 10-20%. Moderate to high pastoral value.	Condition of low shrub layer varies from good to very poor, susceptible to erosion and to increases in unpalatable shrubs when degraded.
South Western Sandplain Shrubland (SWSS) Approx. percentage of survey area: < 0.1%	Undulating sandy surfaced plains with a laterite or weathered granite foundation, soils are variable depth uniform sands, often yellowish in colour; tall shrublands of <i>Acacia ramulosa</i> with a mixed mid and low shrub storey of <i>Acacia</i> and assorted myrtaceous shrubs; very sparse perennial grasses - <i>Monachather</i> and <i>Eriachne</i> spp.; PFC 15-30%. Low to very low pastoral value.	Vegetation largely unaltered by grazing (very few palatable plants), not generally susceptible to accelerated erosion.
Sandplain Mallee-Acacia-Spinifex Shrubland (MASS) Approx. percentage of survey area: < 0.1%	Mostly level or gently undulating sandplain with occasional dunes; soils are red sands; tall shrublands of <i>Acacia</i> spp. with sparse mallee eucalypts and various mid and low shrubs; often dense <i>Triodia basedowii</i> and <i>Plectrachne melvillei</i> spinifex grass layer; PFC 10-20%. Low to very low pastoral value.	Vegetation largely unaltered by grazing (very few palatable plants), not susceptible to erosion except for short periods immediately after fire.
Calcrete Eucalypt Woodland (CEUW) Approx. percentage of survey area: < 0.1%	Floodplains and calcreted plains; alkaline clayey soils; woodlands of <i>Eucalyptus coolabah</i> with numerous under shrubs <i>Acacia victoriae</i> , <i>Cassia</i> spp., <i>Ptilotus</i> spp. and scattered perennial grasses. PFC 10-30%. High pastoral value.	Low shrub layer and grasses frequently degraded, susceptible to increases by unpalatable shrubs, mildly susceptible to accelerated erosion.

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Condition of the land resource

Introduction

In order to provide benchmark assessments of the condition of the land resource throughout the study area, the survey attempted to define and quantify key measures of land degradation wherever possible. Conceptually what has been assessed or measured at any particular point or site on the ground is the cumulative impact of post-settlement pastoral land use. Biological indicators chosen for this purpose are those which have repeatedly proven to be the most powerful measures of ecosystem change:

- perennial vegetation;
- accelerated soil erosion.

In previous surveys of this type, the concept of 'range condition' has been used for the reporting of findings concerning these two key variables. In so doing, observations of changes to perennial vegetation were combined with those of accelerated soil erosion to formulate a very simple scale of condition relativities suitable for reporting to pastoral managers and administrators.

In this study, we present findings concerning the two factors separately. Many pastoral managers and administrators nowadays are skilled in identifying the symptoms of both vegetation decline and erosion and understand their causality in the ecological processes that link them in the arid rangelands. The provision of specific information on the degradation risks and symptoms for soil and vegetation within particular land units and vegetation types (see 'Land systems' and 'Vegetation' sections) also reflects this approach, to provide technical data specific to the land units being managed within a paddock or particular situation. In this way, measures of recovery and response to appropriate management are more easily made at the site, and by the land manager, rather than requiring re-assessment by Government resource experts.

This same principle of future self-help for land managers has been applied to the analysis of condition site data, and the application of objective criteria to site assessment at any time in the future. In this approach we provide a series of classifications of soil and vegetation attributes which are empirical and

probabilistic rather than judgemental. Data provided by this survey serve as a framework within which any future resource data collected at comparable sites may be compared and contrasted.

As indicated in the 'Methods' section of this report, two approaches to the assessment of soil and vegetation condition were used.

Traverse findings

Visual assessments of soil and vegetation condition were made at every kilometre along traverses using a set of standard definitions (Tables 9 and 10). In this way, the geographical extent of survey coverage was maximised and permanently recorded.

Three broad classes of vegetation condition were derived from the visual assessments. These levels of condition at 1 km points are referred to as good, fair and poor, and are reported accordingly on the accompanying map series.

A condition statement for the whole survey area has been compiled (see Table 61) by examining all 13,621 points of traverse data recorded during the survey. The table presents an overall summary, obtained from observations made mainly along station access tracks and otherwise through most parts of the survey area. The levels of coverage achieved throughout the region can be gauged from the line compilation of traverse routes, depicted in Figure 30.

Seventeen per cent of traverse observations indicate some form of accelerated erosion, with 5% and 1% indicating moderate and severe erosion respectively. Water rather than wind is clearly the major causal agent of accelerated erosion in the survey area. Most of the erosion is confined to a small number of land systems (see Table 62) and vegetation types subject to concentrated drainage flows and are generally those systems and vegetation types with high pastoral potential.

Fifty-eight per cent of traverse observations indicated vegetation condition in the fair and good categories (which might be regarded as acceptable condition). However, several important vegetation types are widely degraded (42% of all traverse observations indicated poor or very poor vegetation condition) with considerable loss of palatable perennial plants, general losses of perennial plants or, in some cases, marked increases in cover by unpalatable species ('woody weeds').

Table 61. Condition of survey area from traverse observation summary over all land systems*

Wind erosion	%	Water erosion	%	Total erosion	%	Vegetation condition	%
Nil	96	Nil	83	Nil	83	Very good to good	21
Minor	3	Minor	11	Minor	11	Fair	37
Moderate	1	Moderate	5	Moderate	5	Poor to very poor	42
Severe	0	Severe	1	Severe	1		

* 13,621 traverse observations were made on 68 land systems.

Incidence and extent of severely degraded and eroded areas

Areas of eroded soil surfaces larger than 40 ha in extent have been identified and mapped (at 1:250,000) as being severely degraded and eroded (see Table 62). This area totals 1560 km² and represents 1.8% of the survey area. Much of this degradation occurs on alluvial land systems with high pastoral potential such as Beringarra and Ero. For example, 10% (1043 km²) of the total area of those land systems falling into the high pastoral potential category were identified and have been mapped as severely degraded and eroded (sde). In contrast, less than 1% (0.8% or 322 km²) of the total area of those land systems of moderate pastoral potential were found to be severely degraded and eroded.

The extent and regional location of areas of sde are shown in Figure 48 and on the 1:250,000 scale land system maps accompanying this report. Although patches of sde are recorded on 30 of the 74 land systems in the survey area, the majority of the sde, as previously mentioned, occurs on a few important systems. These are:

- Land systems Bayou, Beringarra, Ero and Mileura - the river and tributary plains (land types 15 and 16) with major units characterised by duplex soils lacking in protective (stony) mantling and subject to accelerated concentrated flows through degraded areas.
- Land system Sherwood occurring as lateritised breakaways, footslopes with duplex soils and extensive lower plains on granite and gneiss (land type 4) and widely distributed through the survey area.

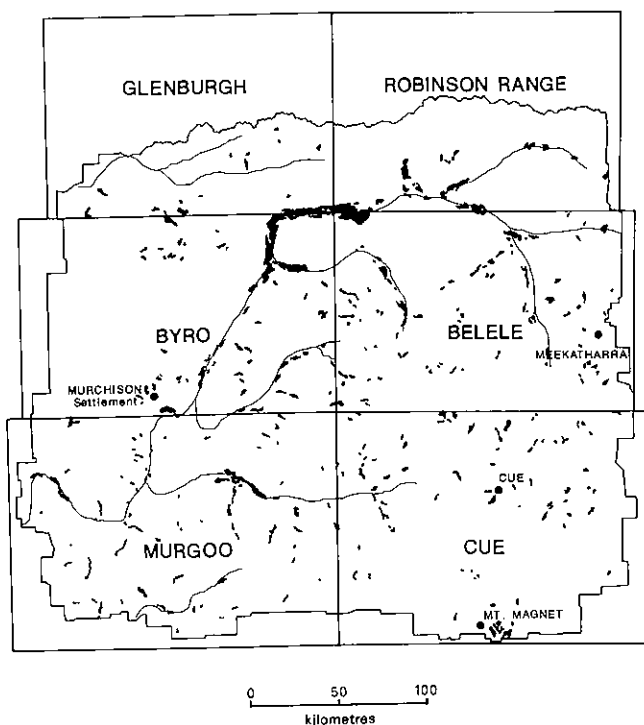


Figure 48. Areas of severe degradation and erosion (sde) within the survey area.

- Land systems Jundee, Tindalarra, Yandil and Yanganoo occurring as very extensive wash plains (land type 14) with red earths and other medium-textured soils over hardpan; their tracts of more concentrated drainage flows are particularly susceptible.

Condition of land systems

Traverse assessment records are summarised by land system in Tables 62 and 63. Table 62 also indicates the total mapped areas of severely degraded and eroded country (sde) on all land systems. Several salient points are indicated by an examination of those data.

1. Systems with high rates of erosion incidence are mainly those:
 - of high pastoral potential;
 - of land types 15 and 16 - alluvial plains which constitute parts of the major drainage zones in the area.
2. Accelerated erosion is very widespread in lands with high pastoral potential: 42% of all traverse assessments made on these lands indicated evidence of some accelerated erosion, and 10.2% of these land systems was mapped as sde, including 27% of the entire Beringarra land system.
3. Among the land systems of moderate pastoral potential, the worst affected are those based on Permian sedimentary rocks (e.g. Byro land system, 58% erosion-affected) and those with highly erodible units lying below breakaways (e.g. Sherwood land system).
4. Land systems of low or very low pastoral potential are much less affected by erosion. Overall, the broad, flat wash zones of the Yandil land system are the most widespread type of eroded country in these categories.
5. The vegetation of land systems of low or very low pastoral potential was assessed as being in mainly good or fair condition.
6. Vegetation in land systems of moderate pastoral potential was assessed to be in very variable condition. Worst affected by perennial vegetation decline are certain 'wash' systems supporting mulga shrublands on hardpan (e.g. Cole land system), preferentially grazed systems on greenstones (e.g. Trillbar land system) and internally drained systems (e.g. Breberle and Outcamp).
7. Vegetation condition in land systems of high pastoral condition is mainly poor or fair, with only those systems characterised by highly saline vegetation remaining in predominantly good condition. Again, systems of land types 15 and 16 - the major drainage plains adjacent to river channels - are the most severely affected.

Table 62. The frequency and severity of soil erosion for land systems

Patoral potential	Land system	Area (km ²)	No. of traverse assessments	Soil erosion (% of traverse assessments)				Severely degraded and eroded*	
				Nil	Minor	Moderate	Severe	(km ²)	(% of system)
Very high	Merbla	76	19	74	26	0	0	0	0.0
High	Austin	155	57	73	18	9	0	15	9.8
	Bayou	491	177	50	33	14	3	46	9.5
	Beringarra	2,629	626	31	32	31	6	704	26.8
	Carnegie	1,281	107	93	7	0	0	0	0.0
	Coolabulla	50	12	92	8	0	0	0	0.0
	Cunyu	1,083	234	79	16	4	1	11	1.1
	Ero	1,589	518	38	35	24	3	210	13.3
	Holmwood	355	27	85	11	4	0	2	0.4
	Mileura	1,007	301	74	19	6	1	27	2.7
	Roderick	407	74	30	37	32	1	17	4.1
	Siberia	43	19	68	21	11	0	0	0.0
	Weenyung	153	33	100	0	0	0	0	0.0
	Wolarr	368	78	73	23	4	0	1	0.3
	Wongong	317	62	77	18	5	0	0	0.0
	Wooleen	55	11	91	9	0	0	0	0.0
	Yewin	316	70	68	21	10	1	10	3.4
Sub-total		10,299	2,406	58	24	16	2	1,043	10.2
Moderate	Belele	4,701	773	89	7	3	1	27	0.6
	Bidgemia	221	25	80	16	4	0	0	0.0
	Boulder	832	146	87	12	1	0	0	0.0
	Breberle	115	27	100	0	0	0	0	0.0
	Bunny	485	108	97	3	0	0	0	0.0
	Byro	497	94	42	38	19	1	14	2.8
	Challenge	5,159	834	91	7	2	0	2	0.0
	Channel	94	12	100	0	0	0	0	0.0
	Cole	1,196	151	94	6	0	0	3	0.2
	Flood	439	60	93	7	0	0	0	0.0
	Frederick	36	3	100	0	0	0	0	0.0
	Horseshoe	204	30	100	0	0	0	0	0.0
	Jimba	36	Not traversed					0	0.0
	Liver	752		71	24	5	0	0	0.0
	Millex	500	87	83	14	3	0	7	1.4
	Mongolia	456	72	96	3	1	0	0	0.0
	Outcamp	44	12	8	42	42	8	11	24.5
	Sandiman	347	33	46	27	24	3	3	0.8
	Sherwood	4,839	762	70	19	9	2	100	2.1
	Tindalarra	3,091	741	80	16	4	0	50	1.6
	Trillbar	131	56	91	7	2	0	6	4.5
	Violet	1,078	260	92	6	2	0	3	0.2
	Wiluna	1,294	253	96	3	1	0	0	0.0
	Yanganoo	12,433	1976	91	7	2	0	96	0.8
Sub-total		38,980	6,606	86	10	3.5	0.5	322	0.8

Table 62.—continued

Pastoral potential	Land system	Area (km ²)	No. of traverse assessments	Soil erosion (% of traverse assessments)				Severely degraded and eroded*	
				Nil	Minor	Moderate	Severe	(km ²)	(% of system)
Low	Badgeradda	124	81	16	6	13	0	0	0.0
	Beasley	138	100	8	0	0	0	0	0.0
	Gabanintha	962	92	133	7	1	0	1	0.1
	Jundee	1,346	91	328	7	2	0	60	4.5
	Kalli	6,097	99	704	1	0	0	0	0.0
	Koonmarra	5,335	96	696	4	0	0	6	0.1
	Mantle	155	83	6	17	0	0	0	0.0
	Millrose	535	85	95	11	4	0	1	0.2
	Mindura	3,661	96	322	4	0	0	0	0.0
	Moogooloo	20	Not traversed					0	0.0
	Naluthanna	26	100	10	0	0	0	0	0.0
	Narryer	2,510	88	300	9	3	0	10	0.4
	Nerramyne	848	87	146	6	5	2	3	0.4
	Nerren	110	Not traversed					0	0.0
	Norie	1,321	96	71	4	0	0	0	0.0
	Pells	4	Not traversed					0	0.0
	Sandplain	2,884	99	209	0	1	0	0	0.0
	Thomas	458	31	97	0	3	0	0	0.0
	Waguin	748	102	92	8	0	0	0	0.0
	Woodline	2,932	542	96	3	1	0	5	0.2
	Wooramel	56	Not traversed					0	0.0
	Yalbalgo	127	16	94	6	0	0	0	0.0
	Yandil	3,402	610	84	11	4	1	110	3.2
	Yarrameedie	519	98	96	4	0	0	0	0.0
Sub-total		34,318	4,443	94	5	1	< 0.1	196	0.6
Very low	Agamemnon	423	6	100	0	0	0	0	0.0
	Augustus	83	Not traversed					0	0.0
	Bullimore	67	21	100	0	0	0	0	0.0
	Eurardy	195	17	100	0	0	0	0	0.0
	Farmer	81	19	100	0	0	0	0	0.0
	Peak Hill	503	2	100	0	0	0	0	0.0
	Weld	350	59	100	0	0	0	0	0.0
	Woodrarrung	371	15	100	0	0	0	0	0.0
	Yagahong	141	8	100	0	0	0	0	0.0
Sub-total		2,214	147	100	0	0	0	0	0.0
Total		85,887	13,621	83	11	5	1	1,561	1.8

* As mapped after photo interpretation and ground verification

Table 63. The condition of perennial vegetation on each land system (derived from traverse data)

Pastoral potential	Land system	No. of traverse assessments	Vegetation condition (% of traverse assessments)		
			Very good to good	Fair	Poor to very poor
Very high	Merbla	19	58	37	5
High	Austin	57	34	41	25
	Bayou	177	26	25	49
	Beringarra	626	7	18	75
	Carnegie	107	77	19	4
	Coolabulla	12	0	8	92
	Cunyu	234	12	29	59
	Ero	518	10	25	65
	Holmwood	27	59	19	22
	Mileura	301	31	37	32
	Roderick	74	10	27	63
	Siberia	19	42	32	26
	Weenyung	33	88	12	0
	Wolarry	78	20	39	33
	Wongong	62	13	32	55
	Wooleen	11	45	45	10
	Yewin	70	48	24	28
Moderate	Belele	773	20	36	44
	Bidgemia	25	48	40	12
	Boulder	146	25	54	21
	Breberle	27	4	41	55
	Bunny	108	32	46	22
	Byro	94	6	34	60
	Challenge	834	25	50	25
	Channel	12	50	50	0
	Cole	151	2	23	75
	Flood	60	27	32	41
	Frederick	3	0	100	0
	Horseshoe	30	16	47	37
	Jimba	Not traversed			
	Liver	91	29	45	26
	Millex	87	29	39	32
	Mongolia	72	39	39	22
	Outcamp	12	0	25	75
	Sandiman	33	18	49	33
	Sherwood	762	25	39	36
	Tindalarra	741	10	46	44
	Trillbar	56	0	21	79
	Violet	260	25	42	32
	Wiluna	253	25	35	40
	Yanganoo	1976	20	40	40

Table 63.—continued

Pastoral potential	Land system	No. of traverse assessments	Vegetation condition (% of traverse assessments)		
			Very good to good	Fair	Poor to very poor
Low	Badgeradda	16	37	25	38
	Beasley	8	25	75	
	Gabarintha	133	22	36	42
	Jundee	328	16	34	50
	Kalli	704	40	42	18
	Koonmarra	696	10	32	58
	Mantle	6	50	17	33
	Millrose	95	15	39	46
	Mindura	322	13	30	57
	Moogooloo	Not traversed			
	Naluthanna	10	80	20	0
	Narryer	300	11	35	54
	Nerramyne	146	16	40	44
	Nerren	Not traversed			
	Norie	71	31	54	15
	Pells	Not traversed			6
	Sandplain	209	65	29	32
	Thomas	31	29	39	32
	Waguin	102	22	46	25
	Woodline	542	23	52	
	Wooramel	Not traversed			6
	Yalbalgo	16	56	38	62
	Yandil	610	8	30	34
	Yarrameedie	98	22	44	34
Very low	Agamemnon	6	0	0	100
	Augustus	Not traversed			
	Bullimore	21	90	10	0
	Eurardy	17	76	24	0
	Farmer	19	63	32	5
	Peak Hill	2	0	0	100
	Weld	59	59	36	5
	Woodrarrung	15	40	40	20
	Yagahong	8	0	0	100
Total		13,621	21	37	42

Condition site findings

Analysis of data collected at 1289 condition sites provides many new and quantifiable findings about the status and characteristics of perennial vegetation throughout the survey area.

Some of the main findings are summarised below, under the following 10 headings.

1. Patterns of incidence of and variation in the major vegetation types

These patterns are indicated from the identification of types, and their composition as encountered by the landscape-selected sampling strategy (see under 'Survey methods' and 'Vegetation' sections). The extent to which Hardpan Mulga Shrubland predominated as the most encountered type is indicated by Table 64.

Table 64. Most sampled vegetation types encountered at condition sites

Vegetation type		Number of sites	Per cent
Hardpan Mulga Shrubland	HPMS	456	35
Stony Mulga Mixed Shrubland	SMMS	165	13
Bluebush Shrubland	BLUS	135	10
Granitic (and other baserock) Mulga Shrubland	GMUS	114	9
Wanderrie Bank Grassy Shrubland	WBGS	75	6
Sandplain Wanderrie Grassy Shrubland	SWGS	71	6
Saltbush Shrubland	SALS	60	5

A complete summary record of the condition sites is reproduced in this report (Appendix 5) and is also available as a database.

It should be re-emphasised that the sampling of these sites was **not** random, in order to select comparable sites from equivalent positions in the landscape and to eliminate effects of transitions, edges, ecotones and drainage inconsistencies wherever possible.

While the approach may have been largely successful in achieving this, the corollary is that many minor units and vegetation types have been passed over as subjects for investigating pastoral impact. This is particularly true for widely occurring small and minor units, some of which (e.g. narrow drainage lines) may have disproportionately high value in terms of ecosystem functioning. However, until satisfactory sampling techniques are developed by which management impacts upon such variable or steeply ecotonal units can be assessed, investigation of more uniform and internally consistent major units remains the mainstay for gauging management impact.

2. Biogeographical patterns in perennial vegetation

The geolocated condition site database, in conjunction with the inventory site database, provides a detailed biogeography of the major perennial species in the survey area.

Where appropriate, remarks on the regional occurrence of vegetation types have been included in their individual accounts. Descriptions of each land system also include biogeographical information on vegetation types, by inference in relation to the illustrated gross distributions of land systems in the survey area.

The main patterns of occurrence shown by common perennial species across each mapped land type are summarised in Appendix 3. More detailed accounts of the occurrence of particular species and associations are beyond the scope of this report, while remaining obtainable from the database.

3. Major parameters of the perennial vegetation

The main measures of vegetation recorded at each site have been summarised on a regional basis in Figures 49 to 52.

It is unlikely that observed distribution patterns in the key variables presented here have previously been recorded for any comparable arid area in Australia; or from as large a sample base. The same cautionary remarks (see 1 above) about non-random sampling apply here.

Figures 49 to 52 depict distributions of variables for the whole survey area. A tendency towards skewed uni-model frequency distributions is evident for a variety of variables. This pattern is partly attributable to the frequency of sites with degraded vegetation being sampled. Other implications of these distributions are discussed under 8 below. It should be noted that:

- (a) data for 'mulga' sites (vegetation types Hardpan Mulga Shrubland, Granitic Mulga Shrubland and Stony Mulga Mixed Shrubland) are density-based,

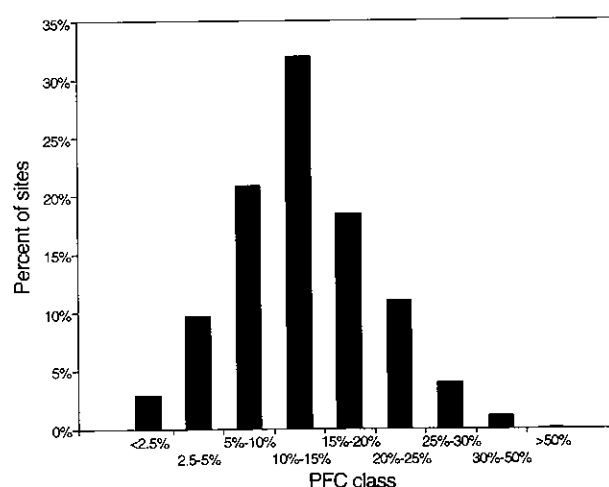


Figure 49. Distribution of total perennial plant projected foliar cover (PFC) estimates for 1256 condition sites in the survey area.

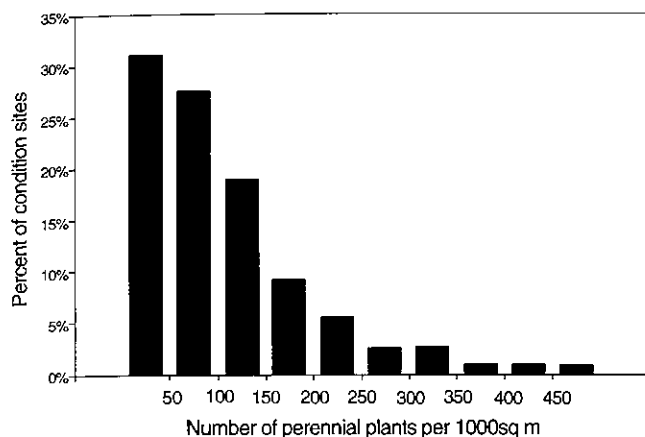


Figure 50. Distribution of woody perennial plant density values at condition sites (all C and D sites) in the survey area. 732 sites for three vegetation types (GMUS, HPMS and SMMS; site techniques 'C' and 'D').

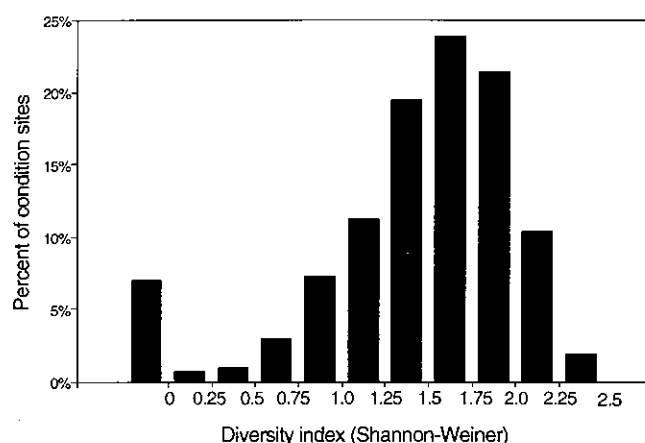


Figure 51. Distribution of perennial plant diversity (Shannon-Weiner) at condition sites in the survey area. 732 sites for three vegetation types (GMUS, HPMS and SMMS; site techniques 'C' and 'D').

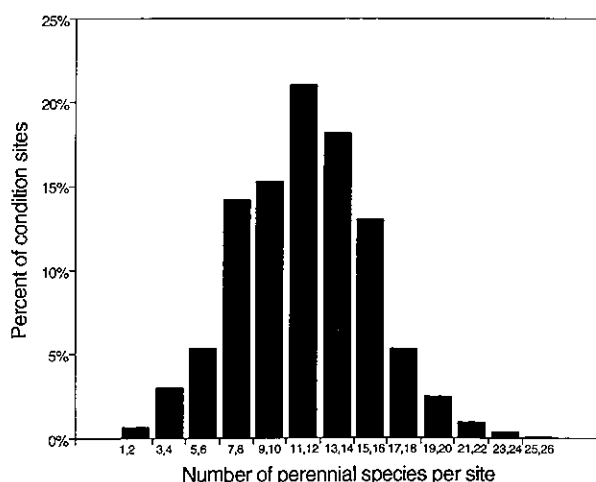


Figure 52. Number of perennial species found at condition sites in the survey area.

i.e. related only to numbers of individual plants per species per unit area, and contain no size or demographic discrimination;

(b) data for 'halophyte' shrubland sites (vegetation types Saltbush Shrubland, Bluebush Shrubland and Mixed Halophytic Shrubland) refer to ordinal data for species, rather than density measurements.

4. Comparison with data from an ungrazed 'benchmark' area

Collection of a small but significant set of condition site data from Open Country on Boolardy station in 1991 enabled a limited comparison to be made between data for pastoral land throughout the survey area and a small 'control' area of virtually ungrazed country. Sites of three major vegetation types (Hardpan Mulga Shrubland, Saltbush Shrubland and Bluebush Shrubland) found in the benchmark area are contrasted with those from the survey area for these types, after initially combining the data for Saltbush Shrubland and Bluebush Shrubland to reflect the partly intermediate composition states encountered on Open Country and to compensate for the small sample of site data available (Figure 53).

Significant differences were found between mean values for grazed versus benchmark sites for six attributes of the Hardpan Mulga Shrubland sites:

- total perennial density;
- density of palatable woody perennials;
- number of perennial species;
- number of palatable species;
- Shannon-Weiner (diversity) index for all perennials;
- Shannon-Weiner index for palatable species.

Higher values were obtained from the benchmark area in all cases. In terms of seasonal conditions, those prevailing at the benchmark area in 1991 were evidently more adverse than encountered elsewhere during the entire survey program. Hence the mean values, and their differences indicated here, probably understate the real difference between the two distributions of site values (see under 'Vegetation' section - Hardpan Mulga Shrubland, Figure 37).

Despite this limitation to comparison between data sets, the results are highly indicative for identifying parameters susceptible to grazing - induced changes and hence indicators of condition. Note that total perennial cover is not among the attributes significantly different between data sets for Hardpan Mulga Shrubland (the major vegetation type in the region) suggesting this variable is not highly sensitive to grazing pressure.

In contrast, data obtained for Bluebush Shrubland / Saltbush Shrubland vegetation types show significant differences between total perennial cover and the species composition index (see under 'Vegetation' section, Saltbush Shrublands).

The implication here is that total perennial cover and species composition may be sensitive indicators of grazing changes in Saltbush and/or Bluebush Shrubland vegetation types. Other lines of evidence support this contention (see below).

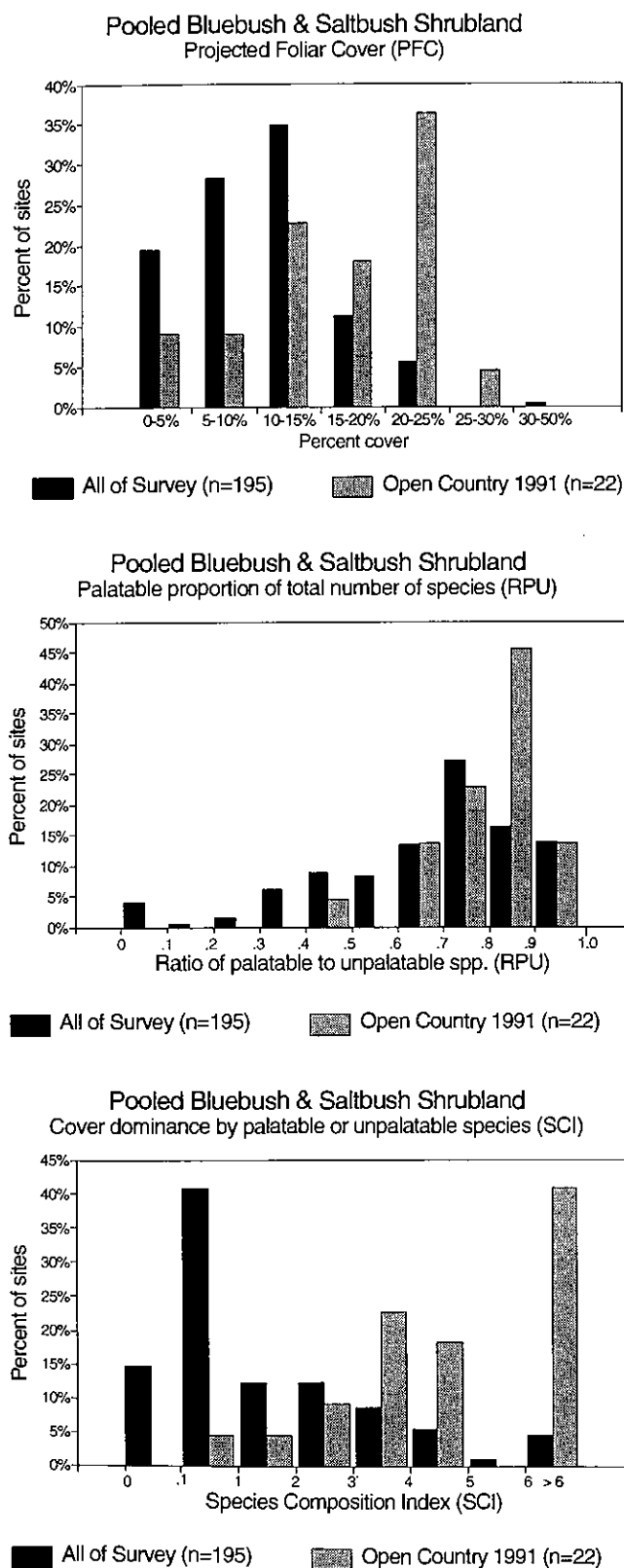


Figure 53. Frequency histograms for key vegetation characteristics of Bluebush and Saltbush Shrubland over the whole survey area and from an ungrazed benchmark area (Boolardy 'Open Country') sampled in 1991.

5. Evidence of 'indicator' species with populations susceptible to grazing impact

Site data from the 'mulga' vegetation types Hardpan Mulga Shrubland, Stony Mulga Mixed Shrubland and Granitic Mulga Shrubland provide a large sample from which the sampling stratification, based on distance from stock watering points, allows analysis of species population trends.

Table 65 indicates that most of the common woody perennials showed no significant differences between their rates of incidence and abundance at 1 km from water from those encountered at 4 km or greater, where long-term grazing pressure might be expected to have been less if water distribution limited grazing impact in such vegetation types.

However, four palatable species exhibited significantly higher densities (= greater abundance) at sites further from water. This constitutes a new line of empirical evidence that for these vegetation types, cotton bush (*Ptilotus obovatus*), horse mulla-mulla (*P. schwartzii*), mulga bluebush (*Maireana convexa*) and warty fuchsia bush (*Eremophila latrobei*) were particularly responsive to gradients in grazing pressure operating within the existing normal paddock infrastructures. Of the four, horse mulla-mulla showed the most marked response to distance from water, and was the only species to show an accompanying decrease in frequency, i.e. the proportion of condition sites at which it was present, closer to water. These results suggest that at least when present at any monitoring site in these 'mulga' vegetation types, *Ptilotus schwartzii* populations may be the most sensitive indicator of changes in grazing pressure.

One species, turpentine bush, showed significantly increased densities closer to water. This 'increaser' response at 1 km sites confirmed the observed trend of increased turpentine bush otherwise more generally noticeable much closer to water points. Increased average plant size may also contribute to the visibility of this effect (see under vegetation type Hardpan Mulga Shrubland).

A few other species that have traditionally been regarded as good indicators of grazing impact and vegetation condition in Murchison mulga communities showed no significant differences in occurrence with distance from water. The potential importance of contributors to browse biomass, such as tall saltbush (*Rhagodia eremaea*) (Mitchell and Wilcox 1994), is not diminished by this finding that may be partly in the statistical limitation of the data sets (small means and large variances characterise the bulk samples of sites) and also in demographic differences, such as in populations of old, large individuals being masked by patchy establishment of young recruits. The effective management of such browse species should not be under-rated, while the condition sites combined data indicate that density information alone may not prove to be a sensitive measure of long-term change in overall condition.

6. Trends of condition in relation to pastoral infrastructure

(a) Distance from water points

Several other trends in condition sites results emerged from comparisons between sites at 1, 2, 4 and > 5 km from water, within a particular vegetation type and across the whole survey area (Figures 41 to 47).

Within the 'mulga' vegetation types 1, 6, and 7 there were no significant differences or trends in the total projected foliar cover of sites, or in the perennial species richness or Shannon-Weiner diversity indices. However, the total density of woody perennials was higher at 4 km from water than at closer distances, for both Hardpan Mulga Shrubland and Stony Mulga Mixed Shrubland vegetation types. Palatable species richness (i.e. the number of palatable perennial species per unit area) and corresponding diversity indices for this sub-set of browse species also averaged higher at 4 km than at 1 and 2 km, although between-site variance was so high that the differences between means for distance samples are not significant at the 0.05 probability level. There were no such trends apparent for Granitic Mulga Shrubland sites.

For the halophytic vegetation types, total projected foliar cover of Saltbush Shrubland averaged higher at 1 km than further from water. This trend appears to be accounted for by the high incidence of unpalatable

shrub invasion on degraded sites, rather than there being more 'saltbushes' (mainly *Atriplex* spp.) closer to water. This explanation is supported by data for the species composition index, which averaged significantly lower (indicating cover dominance by unpalatable species) closer to water points (Figure 43). A similar pattern is evidenced by Bluebush Shrubland and Mixed Halophytic Shrubland vegetation types (Figures 45 and 47).

These insights could be mainly slight and subtle trends of differential patterns of grazing impact rather than major and consistent differences in impact on the resource being controlled by (inadequate) water distribution which limited grazing. The condition site findings suggest that in cases of non-saline vegetation ('mulga' types), the net long-term impact of grazing is not marked by steep 'piosphere' grazing gradients focussed on water points, at least at distances of 1 km and over. Instead, grazing impact has been very variable within a vegetation type but tends to be reflected by changes across whole paddocks (Burnside *et al.* 1990).

(b) Effects of prevailing winds

Responses to wind direction are frequently noticed in the grazing behaviour of sheep (Stafford Smith 1988). The question arises as to how prevailing wind direction might be reflected as impact on vegetation or soil surface condition.

Table 65. The 20 most frequently encountered perennial shrubs and trees in 1000 and 2000 m² quadrats at condition sites in 'mulga' (vegetation types 1, 6 and 7) throughout the survey area, which showed significant differences in population density and site frequency between sites at 1, 2, 4 and > 5 km from stock water points

No.	Species	Common name	Population response from > 5 to 1.0 km from water points		
			% Frequency	Site frequency	Density
1.	<i>Ptilotus obovatus</i>	cotton bush	84.0	-	Decreaser
2.	<i>Acacia aneura</i>	mulga	75.2	-	-
3.	<i>Solanum lasiophyllum</i>	flannel bush	73.8	-	-
4.	<i>Acacia tetragonophylla</i>	curara	71.2	-	-
5.	<i>Rhagodia eremaea</i>	tall saltbush	53.5	-	-
6.	<i>Cassia helmsii</i>	crinkled cassia	40.4	-	-
7.	<i>Cassia desolata/sturtii</i>	grey/variable cassia	40.0	-	-
8.	<i>Eremophila fraseri</i>	turpentine bush	39.9	-	Increaser
9.	<i>Maireana planifolia</i>	flat leaf bluebush	38.3	-	-
10.	<i>Eremophila forrestii</i>	wilcox bush	35.4	-	-
11.	<i>Ptilotus schwartzii</i>	horse mulla mulla	34.9	Decreaser	Decreaser
12.	<i>Maireana villosa</i>		32.2	-	-
13.	<i>Maireana convexa</i>	mulga bluebush	27.0	-	Decreaser
14.	<i>Eremophila latrobei</i>	warty fuchsia bush	26.4	-	Decreaser
15.	<i>Sida calyxhymenia</i>	tall sida	25.4	-	-
16.	<i>Acacia ramulosa</i>	bowgada/wanyu	23.4	-	-
17.	<i>Sida</i> sp.		19.8	-	-
18.	<i>Acacia grasbyi</i>	miniritchie	18.9	-	-
19.	<i>Maireana thesioides</i>	lax bluebush	15.7	-	-
20.	<i>Cassia phyllodinea</i>	banana leaf cassia	15.1	-	-

Condition site resampling by paddock quadrant (NW, NE, SE or SW) produced a small number of significant differences and some inconsistent trends in differences between the condition characteristics of paddock sectors.

In the 'mulga' vegetation types, Stony Mulga Mixed Shrubland sites in NE quadrants of paddocks showed significantly lower densities of palatable perennials than the other quadrants (Figure 39), suggesting a differential impact in the **opposite** direction of prevailing winds.

7. Large sample sizes (for some major vegetation types) allow objective condition standards to be set from a framework of quantified regional variation

Condition classes defined under vegetation types can be applied as measures of condition attainment on a scale of regional relativities. They are available for use by future land managers and field workers monitoring the land resource.

For example, by referring to the details of condition classes defined for Hardpan Mulga Shrubland (given under the account for that type in the 'Vegetation' section), any sampled site of the Hardpan Mulga Shrubland type can be fitted into one of four classes by the criteria defined. Relativities to the 1985-87 regional picture may be gauged from the site classification (Table 18) which indicates the percentiles of each class against the whole sample of sites examined.

8. Information on patterns of variation in key variables has implications for mechanisms of condition change

In a similar way, the large samples allow critical examination of frequency distributions of the various vegetation parameters on a regional basis.

A preponderance of negatively-skewed unimodal distributions emerge as repeating pictures of vegetation attributes, the distributions of which tend to be continuous and without marked division. Are the implications of such patterns of continuous variation those of continuous gradual or incremental change from benchmark condition to poorer states? If so, is this supported by theoretical models of changes of state in the shrublands?

Concepts of discontinuous change, or changes by alternative states, have become increasingly prevalent in Australian and overseas theory for arid rangelands (Westoby *et al.* 1989, Friedel 1988, 1991). The change mechanism proposed would operate through the existence of many alternative short-lived states under different combinations of season, grazing and site variables. Vegetation or soil can be 'pushed' by changes in conditions experienced (seasonal, grazing, rare events etc.) into a new state that is not easily reversible. The episodic nature of climatic events and vegetation growth response in arid environments makes this model attractive (Stafford Smith and Morton 1990).

While the results of this survey cannot be readily interpreted as demonstrating the existence of any steady states or clear discontinuities in the distribution of variables at 'equivalent' sites, the question of scale is relevant in the assessment. For example, if changes in state (e.g. of species composition) occurred irregularly, discontinuously or episodically at the small scale of the bush-mound, a large 'sampling' transect would record the effect of such changes as merely incremental within the whole community's state. Comprehensive regional surveys and repeated monitoring sampling efforts alike could fail to record the mechanism operating within the site.

Hence, the continuous and unimodal distributions of vegetation and soil variation presented in this report can only be interpreted as indicating that gross alternative states have not been recorded generally at the scale of the sites examined (≥ 0.1 ha).

9. Evidence of the incidence, type and severity of accelerated soil erosion away from roads, tracks and infrastructure

Erosion data collected on previous surveys has been collected as observations made along vehicle traverse routes, plus that concerning severely degraded and eroded areas detected on aerial photography. 'Interference' factors operating around roads, tracks and fences introduces a potential for bias in gathering data to assess overall areal incidence of erosion. The observation criteria adopted by this survey were designed to combat such bias as much as possible, but it is only by a sampling strategy away from infrastructure that unbiased assessment can be made.

The condition site assessment of erosion summarised in Figure 54 indicates that 15.4% of sites sampled were affected by accelerated erosion in some form. This figure compares with a 17% rate of incidence observed in traverse observations.

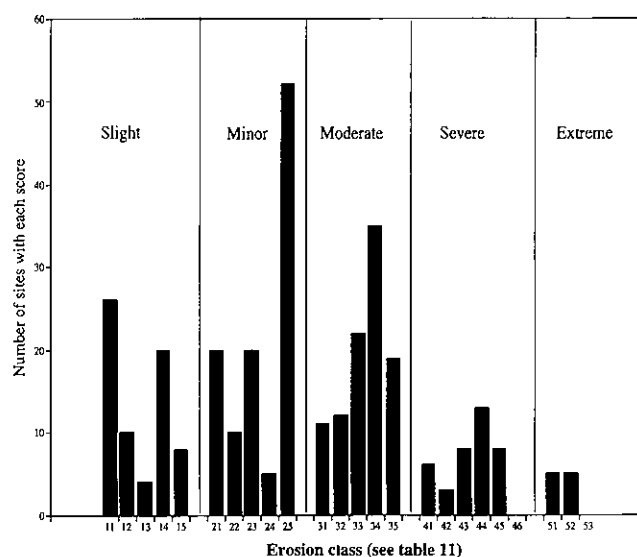


Figure 54. Frequency of erosion type and intensity classes recorded at sites (198 of 1289 sites) in the survey area.

Details of the type and intensity classes provide a permanent record of erosion symptoms and status at individual sites throughout the survey area, recorded with complementary vegetation data. Summary findings in this regard are detailed in the 'Vegetation' and 'Land system' sections of this report.

A major conclusion drawn from the approach is that for most of the shallow red duplex soil types, attempting to distinguish between erosion by wind and erosion by water is of limited use. The commonest features of erosion - sheeting, microterracing and scalding, showed evidence of being worked and re-worked by both agents. Site inspections tend to highlight symptoms left by the most recent erosion events rather than (necessarily) the greater causative force which has either initiated or most exacerbated the problem.

10. Interpretation of traverse condition assessments with condition site data

Incidence of accelerated erosion

The closeness by which two methods of estimating the areal extent of total land surface affected by accelerated erosion correspond for the survey area is indicated under 9 (above).

Relationship of traverse observations to condition classes

The very large number of condition sites assessed by the above objective criteria were also assessed in the field by the general observation criteria defined under 'Methods' (Traverse methods). In this way, the 'goodness of fit' (or reliability) of the traverse observations made for various vegetation types can be tested against the quantitative classification of site characteristics.

Table 66. Relationship between traverse method (5-class) observations and condition site method (4-class) results on vegetation condition for Hardpan Mulga Shrubland sites

Traverse method: condition scores as allotted to condition sites	Site method: mean values of vegetation condition classes for sites by each traverse score	Means expected for 5→4 classes if perfect correlation
1	1.58 ± 0.69	1.0
Good 2	1.93 ± 0.69	1.5
Fair 3	2.59 ± 0.57	2.5
Poor 4	3.18 ± 0.49	3.25
5	3.76 ± 0.42	4.0

A comparison of the two assessments (quantitative versus observational) is given for the most extensive vegetation type, Hardpan Mulga Shrubland, in Table 66. In this example, in the first row, sites rated 1 are (very) good by the traverse observation criteria, had a mean class of condition of 1.58 by the quantitative

criteria. If the two methods had perfect direct correlation, every site would have fallen within class 1 in a 4-class system by the quantitative criteria. Table 66 indicates important findings.

- That traverse observations generally correlated well with site condition classes but the confidence limits of an individual traverse assessment are not sufficiently high to justify the reporting of 5 classes of observable condition in traverse data.
- That traverse observations were more accurate and more reliable for sites assessed as being in poor or very poor condition than they were for observations of fair to very good condition.
- That traverse observations were least accurate in distinguishing between 'good' and 'very good' condition states, although sites assigned traverse score 1 proved to belong to vegetation condition class 1 significantly more often than those assigned traverse score 2.

For practical purposes, most mapped traverse assessments of Hardpan Mulga Shrubland vegetation as being in 'good' condition (originally traverse condition scores 1 and 2) will represent points at which, if sampled by the condition site method, either vegetation condition class 1 or class 2 would have resulted. Likewise, mapped traverse assessments of 'poor' condition Hardpan Mulga Shrubland will indicate points at which site investigations could be expected to have revealed vegetation in either condition class 3 or 4.

Similar considerations evidently apply to the comparison of traverse and condition site data for other, less extensively sampled vegetation types and by implication to the mapped traverse record as a whole. While it is not possible to calibrate traverse assessments against the more vigorous observations and quantified data obtained at condition sites, it is possible to indicate which of the vegetation classes of each vegetation type may be considered as being in good, fair or poor condition (Table 67).

Assumptions implicit here include:

- that 'background' environmental variation in the potential for each site to support perennials is responsible for an unknown proportion of the total variation which is otherwise attributable to grazing impact;
- that the use of value judgements as terms for quantitatively and qualitatively defined classes is helpful and appropriate for pastoral management, because those classes imply qualities of both pastoral impact on the vegetation and the relative value of the sites as resource of palatable perennial vegetation;
- the term 'poor' condition is likely to have wider implications for ecosystem health and resilience, when the key criteria for classes assigned as such are low species richness, high levels of implied management impact, modified to grossly altered structural and/or cover characteristics, and (on susceptible soil types) increased risk of soil surface breakdown and accelerated erosion.

Table 67. Notional condition levels of condition site classes

Vegetation type	Condition site classes equivalent to		
	Good	Fair	Poor
Hardpan Mulga Shrubland	1	2	3, 4
Stony Mulga Mixed Shrubland	1	2	3, 4
Granitic Mulga Mixed Shrubland	1	2	3, 4
Calcrete Shrubby Grassland	1	2	3, 4, 5
Alluvial Tussock Grassland	1	2	3
Riverine Mixed Shrubland	1	2	3
Mulga Chenopod Shrubland	1	2, 3	4
Stony Snakewood Shrubland	1	2, 3	4
Saltbush Shrubland	1	2	3, 4
Bluebush Shrubland	1	2, 3	4, 5
Mixed Halophytic Shrubland	1	2	3
Samphire Shrubland	1	2	
Wanderrie Bank Grassy Shrubland	1, 2	3, 4	5
Sandplain Wanderrie Grass Shrubland	1, 2	3, 4	5
Sandplain Acacia Shrubland	1	2	3

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Examples of varying condition in the survey area



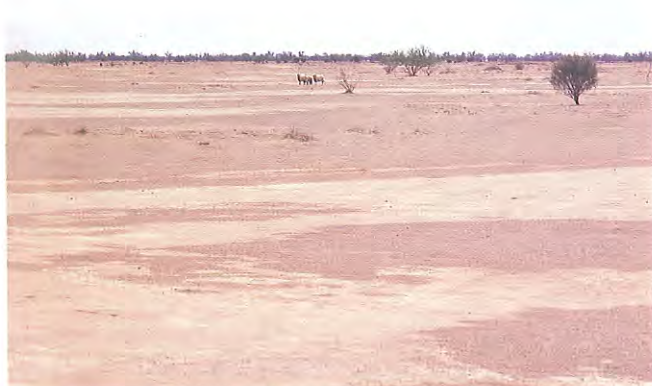
1. Plain of 'billy buttons' flowering on one area of the Yandil land system, Mt Padbury station. Note the complete absence of live perennial plants in the foreground. Areas such as this in poor to very poor vegetation condition retain their seasonal response as 'herb fields' and remain resistant to sheet erosion, apparently as a consequence of extensive mantling by ironstone and quartz pebbles.



2. Other areas of Yandil land system with degraded perennial vegetation are less favourably endowed with protective mantling, and/or experience more intense surface flows; severe sheet erosion to the red-brown hardpan can result, with virtually complete loss of biological activity on some areas.



3. Vegetation degradation along the occasional drainage tracts which cross the broad 'wash' plains of land systems in land type 14 can result in upstream gullying. The gully head shown here reveals the shallowness of the soil profile (usually 20-50 cm) which is developed over the exposed red-brown hardpan.



4. Severe degradation and erosion as an historical legacy: one of several areas of Beringarra land system reported to have been transformed from a saltbush plain to a desert-like state by the 1940s.



5. Severe degradation and erosion as an ongoing process: an area of dead and dying saltbush on the same unit of the Beringarra land system, June 1986. Note the deflated bases of the saltbush relics on the scalded areas, the residual hummocks accumulating windblown material, and the 'wall' of *Acacia victoriae* thicket in the background.



6. Fragmentation of biological activity on eroded alluvial plain, Ero land system. Note the sharp demarcation between the sterile, scalded surfaces predominantly and the sandy residual, where seeds, moisture and some nutrients remain to yield a winter seasonal response.



7. One example of a relict area of fragile landscape still in near-pristine condition without permanent watering points and having never been subject to grazing pressure. Here, at the extreme south-eastern point in its range, Gascoyne bluebush (*Maireana polypterygia*) grows on stony slopes over fossiliferous Permian sandstones on the Sandiman land system, Innouendy station. Other less stony parts of the Sandiman land system are highly erodible if the vegetation cover is depleted.



8. Wind erosion re-works de-stabilised soil surfaces left by water erosion events, and vice-versa. As a result, the causal agent (wind or water) most evident at a particular site may vary depending on whichever type of event was most recent.



9. Some granite and breakaway country has not been developed for stock grazing owing to the presence of kite leaf poison (*Gastrolobium laytonii*). This area, on inherently fragile footslopes of the Sherwood land system, supports a good cover of diverse low shrubs.



10. This tiny enclosure of Birdwood grass *Cenchrus setiger* introduced to the Murchison frontage (Beringarra land system on Curbur station) indicates a site with local potential for this exotic pasture species to spread. Both this species and buffel grass (*C. ciliaris*) occur only very locally on disturbed, nutrient-enriched sites in the survey area.

Appendix I

Station reports

Station reports, as a one page summary table, are presented alphabetically. The summaries should be considered in conjunction with the relevant 1:250,000 scale land system maps which show cadastral (station lease) boundaries, land system boundaries, watering points, major topographic features, traverse routes and recordings, range evaluation (inventory) sites, range condition assessment sites and severely degraded and eroded areas.

Each report provides some general statistics about the station and a summary statement concerning the type and condition of the soil and vegetation resources of the station. A condition site summary score derived by pooling scores from the condition

Table 1.1. Land systems (in good range condition) arranged according to pastoral potential

Pastoral potential in good range condition	Land system
Very high (5 ha/dse*)	Merbla
High (7 ha/dse)	Austin Bayou Beringarra Carnegie Coolabulla Cunyu Ero Holmwood Mileura Roderick Siberia Weenyung Wolarr Wooleen Yewin
Moderate (12 ha/dse)	Belele Bidgemia Boulder Breberle Bunny Byro Challenge Channel Cole Flood Frederick Horsehoe Jimba Liver Millex Mongolia Outcamp Sandiman Sherwood Tindalarra Trillbar Violet Wiluna Yanganoo

Table 1.1—continued

Pastoral potential in good range condition	Land system
Low (20 ha/dse)	Badgeradda Beasley Jundee Kalli Koonmarra Mantle Millrose Mindura Moogooloo Naluthanna Narryer Nerramyne Nerren Norie Pells Sandplain Thomas Waguin Woodline Wooramel Yalbalgo Yandil Yarrameedie
Very low (30 ha/dse)	Agamemnon Augustus Bullimore Eurardy Farmer Peak Hill Weld Woodrarrung Yagahong

* Dry sheep equivalents.

sampling sites on the station is recorded but only if the number of condition sites is ≥ 10 . This score enables limited comparisons to be made between leases and with the survey area average (survey average = 50; range 28, poorest - 77, best).

Each report lists the land systems that occur on the station and indicates their pastoral potential (see Table 1.1), area and (if present) the area of severe degradation and erosion (sde). Soil and vegetation condition statements, derived from traverse data, are presented for each land system. Statements for component units of each land system are not presented here, but these data are available on computer print-out.

Each station report suggests a recommended carrying capacity **over summer** (November to April) for range condition as seen at the time of survey. This figure is calculated on a land system by land system basis by determining from traverse data, the proportion of vegetation in good, fair and poor condition and applying stocking rates (see Table 1.2) to each condition level.

The actual stocking rates suggested in Table 1.2 are derived as much as possible from empirical data on vegetation and animal production, obtained during long-term grazing trials (e.g. Watson and Holm 1990, Holm 1991), which have been conducted in the region and elsewhere in the arid shrublands of Western Australia. For poorer pastoral potential classes of land systems, for which there is no experimental evidence,

we have drawn on experience from leases on which grazing management has evidently achieved long-term resource conservation, as indicated through range monitoring and records of animal productivity (e.g. Morrissey and O'Connor 1988).

The recommended carrying capacity is a guideline figure for carrying **over summer following a significant growth period during the preceding winter**. This is the 'normal' situation for pastoral management in the survey area. The figure assumes that all of the station is developed and adequately watered for livestock use.

The recommended carrying capacity is suggested as being a reasonable approximation for long-term sustainable production. There is no requirement for it to be rigidly applied by managers, nor is it appropriate for it to be used as a basis for legislative or regulatory controls.

Each station report shows an overall traverse assessment (i.e. over all land systems on the station) for soil erosion and vegetation condition. For comparison purposes it also shows the average assessment over the whole survey area.

Individual station reports presented in this appendix are for the following stations:

Annean, Austin Downs, Ballythunna, Beebyn, Belele, Beringarra, Billabalong, Boolardy, Boogardie, Bullardoo, Buttah, Byro, Coodardy, Culculli, Curbur, Dalgaranga, Glen, Erong Springs (part), Hy Brazil, Innouendy, Jingemarra, Kalli, Karbar, Koonmarra, Lakeside, Madoonga, Meeberrie, Meka, Melangata, Mileura, Milly Milly, Moorarie, Mt Farmer, Mt Gould (part), Mt Hale, Mt Narryer, Mt Padbury (part), Mt Wittenoom, Muggon, Murgoo, Nallan, Narloo, New Forest, Nookawarra, Norie, Pinegrove, Polelle, Twin Peaks, Wanarie, Wondinong, Wooleen, Woolgorong, Wynyangoo, Yallalong, Yarlalweelor (part), Yarraquin, Yoothapina (part), Yuin.

Table 1.2. Recommended over summer carrying capacities for land systems of each class of pastoral potential, at three levels of vegetation condition

Pastoral potential	Vegetation condition	Recommended carrying capacity (ha/dse)
Very high	Good	5
	Fair	10
	Poor	16
High	Good	7
	Fair	12
	Poor	18
Moderate	Good	12
	Fair	16
	Poor	16
Low	Good	20
	Fair	25
	Poor	25
Very low	Good	30
	Fair	30
	Poor	30

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Annean station

Meekatharra shire
Meekatharra Land Conservation District
Mapsheet reference (1:250,000): Belele

Lease area: 168,048 ha

Area of various reserves, freehold and vacant Crown land within managed area: 4585 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (35) summary score for whole lease: 52 (survey average = 50).

Traversed assessment (302 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
83	12	5	0	22	44	34

Major (mapped) areas of severe degradation and erosion (sde): 600 (nearest 10 ha).

Land systems of Annean station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition							Rcc* (dse)	Occ** (dse)	
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair			Poor
High pastoral potential													
Austin +	950	0.5	360	0	73	18	9	0	34	41	25	92	136
Carnegie	4,710	2.8		21	100	0	0	0	81	19	0	620	673
Cunyu	3,170	1.9		13	92	8	0	0	0	23	77	197	453
Mileura	3,880	2.3		23	35	35	30	0	0	35	65	233	554
	12,710	7.5											
Moderate pastoral potential													
Belele	15,080	9.0		14	86	14	0	0	29	36	35	1,034	1,257
Sherwood	10,910	6.5		22	77	14	9	0	45	23	32	784	909
Violet	3,280	1.9		4	50	50	0	0	0	75	25	205	273
Wiluna	5,040	3.0		19	84	5	11	0	0	42	58	315	420
Yanganoo	42,790	25.5		68	94	6	0	0	29	45	26	2,933	3,566
	77,100	45.9											
Low pastoral potential													
Gabanintha	4,610	2.7		13	92	8	0	0	8	69	23	188	231
Jundee	5,840	3.5		9	89	11	0	0	22	67	11	246	292
Kalli	8,660	5.2		7	100	0	0	0	29	71	0	371	433
Koonmarra	27,240	16.2		70	90	7	3	0	14	52	34	1,117	1,362
Millrose	2,380	1.4		3	100	0	0	0	0	100	0	95	119
Mindura	4,200	2.5		5	100	0	0	0	0	60	40	168	210
Norie +	740	0.4		0	96	4	0	0	31	54	15	32	37
Waguin +	700	0.4		0	92	8	0	0	22	46	32	30	35
Yandil	9,880	5.9	237	11	82	18	0	0	9	46	26	395	494
Yarrameedie +	90	< 0.1		0	96	4	0	0	22	44	34	4	5
	64,340	38.3											
Very low pastoral potential													
Farmer +	700	0.4		0	100	0	0	0	63	32	5	23	23
Yagahong +	470	0.3		0	100	0	0	0	0	0	100	16	16
	1,170	0.7											
No pastoral potential													
Bare lakebed	12,730	7.6											
Totals	168,050	100.0	597	302	83	12	5	0	22	44	34	9,098	11,498
Survey area average				13,621	83	11	5	1	21	37	42		

+ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 9100 dry sheep equivalents (dse).

** Original carrying capacity over summer 11,500 dse.

Austin Downs station

Lease area: 165,687 ha

Area of various reserves, freehold and vacant Crown land within managed area: 18,062 ha.

Cue shire
Cue Land Conservation District
Mapsheet reference (1: 250,000): Cue

Soil and vegetation condition summary data (1986-87)

Condition sites (27) summary score for whole lease: 56 (survey average = 50).

Traversed assessment (269 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
88	8	4	0	35	50	15

Major (mapped) areas of severe degradation and erosion (sde): 1490 (nearest 10 ha).

Land systems of Austin Downs station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Austin	5,210	3.1	86	6	67	17	17	0	17	83	0	479	744
Carnegie	5,576	3.4		15	93	7	0	0	53	40	7	630	797
Cunyu	1,410	0.9		3	100	0	0	0	0	0	100	78	201
Ero	3,250	2.0	609	15	40	33	27	0	7	33	60	196	464
Mileura	13,800	8.3	204	43	86	7	7	0	44	42	14	1,446	1,971
	29,246	17.7											
Moderate pastoral potential													
Challenge	26,820	16.2		33	88	6	6	0	21	67	12	1,793	2,235
Millex	2,250	1.4		6	50	50	0	0	67	33	0	172	188
Sherwood	6,130	3.7	76	5	80	20	0	0	80	20	0	479	511
Violet	690	0.4		2	100	0	0	0	50	50	0	50	58
Wiluna +	1,570	1.0		0	96	3	1	0	25	35	40	106	131
Yanganoo	59,620	36.0	430	91	97	3	0	0	36	53	11	4,146	4,968
	97,080	58.6											
Low pastoral potential													
Gabanintha	4,560	2.8		5	100	0	0	0	100	0	0	228	228
Jundee	3,040	1.8		6	100	0	0	0	33	67	0	132	152
Kalli	7,210	4.3		12	100	0	0	0	0	58	42	288	361
Norie +	3,980	2.4		0	96	4	0	0	31	54	15	172	199
Waguin	2,380	1.4		7	71	29	0	0	29	57	14	102	119
Woodline	6,270	3.8		14	100	0	0	0	57	36	7	287	314
Yandil	6,390	3.9	85	6	100	0	0	0	0	100	0	252	320
	33,830	20.4											
No pastoral potential													
Bare lakebed	5,534	3.3											
Totals	165,690	100.0	1,490	269	88	8	4	0	35	50	15	11,036	13,961
Survey area average				13,621	83	11	5	1	21	37	42		

+ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 11,040 dry sheep equivalents (dse).

** Original carrying capacity over summer 13,960 dse.

Ballythunna station

Murchison shire
Murchison Land Conservation District
Mapsheet reference (1:250,000): Byro, Glenburgh

Lease area: 141,450 ha

Area of various reserves, freehold and vacant Crown land within managed area: 0 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (16) summary score for whole lease: 32 (survey average = 50).

Traversed assessment (124 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
44	36	19	1	9	37	54

Major (mapped) areas of severe degradation and erosion (sde): 1370 (nearest 10 ha).

Land systems of Ballythunna station

Land systems of Dalrymple station				Traversed assessment of land resource condition									Rcc* (dse)	Occ** (dse)
Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	No of obs	Soil erosion (%)				Perennial vegetation (%)					
					Nil	Minor	Mod.	Severe	Good	Fair	Poor			
High pastoral potential														
Cunyu ⁺	520	0.4	1,374	0	79	16	4	1	13	29	58	39	74	
Wongong ⁺	<u>730</u>	<u>0.5</u>		0	77	18	5	0	13	32	55	55	104	
	1,250	0.9												
Moderate pastoral potential														
Bidgemia	11,990	8.5		10	60	30	10	0	10	60	30	774	999	
Boulder ⁺	2,240	1.6		0	87	12	1	0	25	54	21	150	187	
Byro	48,750	34.5		94	41	38	19	1	6	34	60	3,022	4,063	
Channel ⁺	1,360	1.0		0	100	0	0	0	50	50	0	99	113	
Jimba ⁺	3,600	2.5		0	63	24	10	3	19	40	41	239	300	
Liver ⁺	220	0.2		0	71	24	5	0	29	45	26	15	18	
Sandiman	<u>22,270</u>	<u>15.7</u>		19	47	32	21	0	16	42	42	1,466	1,856	
	90,430	64.0												
Low pastoral potential														
Mantle	12,770	9.0		1	83	17	0	0	50	17	33	575	639	
Moogooloo ⁺	1,540	1.1		0	95	0	5	0	58	37	5	71	77	
Pells ⁺	380	0.3		0	56	33	11	0	22	56	22	16	19	
Sandplain ⁺	28,250	20.0		0	99	0	1	0	65	29	6	1,314	1,413	
Thomas ⁺	50	< 0.1		0	97	0	3	0	29	65	6	2	3	
Wooramel ⁺	2,330	1.6		0	92	6	2	0	36	28	36	102	117	
Yalbalgo ⁺	<u>1,860</u>	<u>1.3</u>		0	94	6	0	0	56	38	6	85	93	
	47,180	33.3												
Very low pastoral potential														
Agamemnon ⁺	2,590	1.8		0	100	0	0	0	0	0	100	86	86	
Totals														
	141,450	100.0	1,374	124	44	36	19	1	9	37	54	8,110	10,161	
Survey area average				13,621	83	11	5	1	21	37	42			

+ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 8110 dry sheep equivalents (dse).

** Original carrying capacity over summer 10,160 dse.

Beebyn station

Cue shire
Cue Land Conservation District
Mapsheet reference (1:250,000): Cue, Bebele

Lease area: 59,815 ha

Area of various reserves, freehold and vacant Crown land within managed area: 0 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (18) summary score for whole lease: 56 (survey average = 50).

Traversed assessment (156 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
94	5	1	0	18	47	35

Major (mapped) areas of severe degradation and erosion (sde): 1240 (nearest 10 ha).

Land systems of Beebyn station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Cunyu	1,300	2.2		9	100	0	0	0	11	33	56	97	186
Moderate pastoral potential													
Challenge	100	0.2		7	100	0	0	0	0	100	0	6	8
Sherwood	2,320	3.9		7	86	14	0	0	57	43	0	173	193
Violet	15,270	25.5		57	95	5	0	0	25	52	23	1,034	1,273
Wiluna	10,170	17.0		13	100	0	0	0	38	62	0	716	848
Yanganoo ⁺	<u>1,400</u>	<u>2.3</u>		0	91	7	2	0	20	40	40	93	117
	29,260	48.9											
Low pastoral potential													
Gabanintha	6,220	10.4		7	100	0	0	0	14	43	43	258	311
Jundee	8,590	14.4	897	39	92	5	3	0	5	46	49	312	430
Kalli ⁺	4,770	8.0		0	99	1	0	0	40	42	18	210	239
Waguin ⁺	560	0.9		0	92	8	0	0	22	46	32	24	28
Yandil	5,570	9.3	341	15	87	13	0	0	0	0	100	209	279
Yarrameedie	<u>840</u>	<u>1.4</u>		2	100	0	0	0	50	50	0	38	42
	26,550	44.4											
Very low pastoral potential													
Weld ⁺	2,700	4.5		0	100	0	0	0	17	78	5	90	90
Totals	59,810	100.0	1,238	156	94	5	1	0	18	47	35	3,260	4,044
Survey area average				13,621	83	11	5	1	21	37	42		

⁺ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* **Recommended carrying capacity over summer (if preceded by an effective winter season)** 3260 dry sheep equivalents (dse).

** **Original carrying capacity over summer** 4040 dse.

Belele station

Meekatharra shire
Meekatharra Land Conservation District
Mapsheet reference (1:250,000): Belele

Lease area: 279,705 ha

Area of various reserves, freehold and vacant Crown land within managed area: 11,414 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (32) summary score for whole lease: 49 (survey average = 50).

Traversed assessment (385 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
84	9	5	2	27	33	40

Major (mapped) areas of severe degradation and erosion (sde): 6300 (nearest 10 ha).

Land systems of Belele station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Beringarra	1,490	0.5		4	50	50	0	0	0	25	75	93	213
Cunyu	11,140	4.0	521	30	63	17	13	7	34	40	26	1,044	1,591
Ero	9,490	3.4	2,685	30	44	23	23	10	0	10	90	404	1,356
Mileura	9,230	3.3	753	13	77	8	8	8	23	61	16	813	1,319
	31,350	11.2											
Moderate pastoral potential													
Belele	95,110	34.0	1,063	120	88	8	4	1	15	43	42	6,175	7,926
Sherwood	7,920	2.8	60	12	75	17	8	0	25	42	33	533	660
Violet	3,410	1.2		2	100	0	0	0	0	100	0	213	284
Wiluna	4,880	1.8		7	100	0	0	0	0	29	71	305	407
Yanganoo	30,270	10.8		52	98	2	0	0	90	8	2	2,459	2,523
	141,590	50.6											
Low pastoral potential													
Gabarintha	600	0.2		1	100	0	0	0	0	100	0	24	30
Jundee ⁺	2,840	1.0	17	0	91	7	2	0	16	34	50	117	142
Kalli	7,390	2.6		9	100	0	0	0	100	0	0	370	370
Koonmarra	30,160	10.8		26	96	4	0	0	0	38	62	1,206	1,508
Mindura ⁺	5,150	1.8		0	96	4	0	0	13	30	57	213	258
Millrose	5,800	2.1		2	100	0	0	0	0	0	100	232	290
Yandil	51,600	18.5	1,206	72	92	7	0	1	24	37	39	2,140	2,580
	103,540	37.0											
Very low pastoral potential													
Yagahong	3,230	1.2		5	100	0	0	0	0	0	100	108	108
Totals	279,710	100.0	6,305	385	84	9	5	2	27	33	40	16,449	21,565
Survey area average				13,621	83	11	5	1	21	37	42		

+ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* **Recommended carrying capacity over summer (if preceded by an effective winter season)** 16,450 dry sheep equivalents (dse).

** **Original carrying capacity over summer** 21,560 dse.

Beringarra station

Lease area: 140,322 ha

Murchison shire
Murchison Land Conservation District
Mapsheet reference (1:250,000): Belele, Byro, Glenburgh,
Robinson Range

Area of various reserves, freehold and vacant Crown land within managed area: 9143 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (16) summary score for whole lease: 42 (survey average = 50).

Traversed assessment (244 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
72	14	13	1	18	32	50

Major (mapped) areas of severe degradation and erosion (sde): 15,280 (nearest 10 ha).

Land systems of Beringarra station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition									Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)					
					Nil	Minor	Mod.	Severe	Good	Fair	Poor			
High pastoral potential														
Beringarra	31,480	22.4	15,160	82	26	33	38	4	4	16	80	1,157	4,497	
Mileura	470	0.3	109	4	75	25	0	0	25	25	50	34	67	
	31,950	22.7												
Moderate pastoral potential														
Belele	42,380	30.2		61	95	5	0	0	38	34	28	2,984	3,532	
Cole	14,920	10.6	1	34	94	6	0	0	0	50	50	933	1,243	
Flood	3,640	2.6	1	9	100	0	0	0	33	67	0	252	303	
	60,940	43.4												
Low pastoral potential														
Koonmarra	20,360	14.5	4	21	100	0	0	0	14	29	57	843	1,018	
Mindura	12,420	8.9	1	11	100	0	0	0	18	64	18	519	621	
Yandil	2,900	2.1	1	3	100	0	0	0	0	0	100	116	145	
Yarrameedie	6,280	4.5		13	100	0	0	0	31	46	23	270	314	
	41,960	30.0												
Very low pastoral potential														
Weld	5,470	3.9		6	100	0	0	0	67	33	0	182	182	
Totals	140,320	100.0	15,277	244	72	14	13	1	18	32	50	7,290	11,922	
Survey area average				13,621	83	11	5	1	21	37	42			

* Recommended carrying capacity over summer (if preceded by an effective winter season) 7,290 dry sheep equivalents (dse).

** Original carrying capacity over summer 11,920 dse.

Billabalong station

Murchison shire
Murchison Land Conservation District
Mapsheet reference (1:250,000): Murgoo

Lease area: 130,920 ha

Area of various reserves, freehold and vacant Crown land within managed area: 11,570 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (27) summary score for whole lease: 41 (survey average = 50).

Traversed assessment (330 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
81	14	5	0	11	25	64

Major (mapped) areas of severe degradation and erosion (sde): 2480 (nearest 10 ha).

Land systems of Billabalong station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Bayou	17,240	13.2	643	98	64	30	6	0	26	23	51	1,424	2,463
Coolabulla ⁺	420	0.3		0	92	8	0	0	0	8	92	24	60
Cunyu	870	0.7		6	100	0	0	0	0	50	50	60	124
Ero	1,480	1.1	721	18	39	33	22	6	11	11	78	59	211
	20,010	15.3											
Moderate pastoral potential													
Bunny	1,340	1.0		3	100	0	0	0	0	67	33	84	112
Challenge	8,370	6.4	44	8	100	0	0	0	0	25	75	521	698
Mongolia ⁺	420	0.3		0	96	3	1	0	39	39	22	30	35
Tindalarra	1,300	1.0		10	90	10	0	0	0	60	40	82	108
Violet ⁺	900	0.7		0	93	6	2	0	26	43	31	61	75
Yanganoo	45,910	35.1	1,001	108	90	6	4	0	0	14	86	2,807	3,826
	58,240	44.5											
Low pastoral potential													
Gabanintha ⁺	1,290	1.0		0	92	7	1	0	22	36	42	55	65
Jundee ⁺	70	< 0.1		0	91	7	2	0	16	34	50	3	4
Kalli	17,900	13.7	5	19	100	0	0	0	47	32	21	800	895
Narryer	28,390	21.7	69	60	93	5	2	0	0	37	63	1,133	1,420
Nerramyne ⁺	130	0.1		0	87	6	5	2	17	40	43	5	7
Norie ⁺	310	0.2		0	96	4	0	0	31	54	15	13	16
Waguin ⁺	2,250	1.7		0	92	8	0	0	22	46	32	95	113
Yalbalgo ⁺	1,490	1.1		0	94	6	0	0	56	38	6	68	75
	51,830	39.5											
Very low pastoral potential													
Woodrarrung ⁺	840	0.7		0	100	0	0	0	40	40	20	28	28
Totals	130,920	100.0	2,483	330	81	14	5	0	11	25	64	7,352	10,335
Survey area average				13,621	83	11	5	1	21	37	42		

+ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 7350 dry sheep equivalents (dse).

** Original carrying capacity over summer 10,330 dse.

Boogardie station

Mt Magnet and Cue shires
Mt Magnet Land Conservation District
Mapsheet reference (1:250,000): Cue

Lease area: 161,477 ha

Area of various reserves, freehold and vacant Crown land within managed area: 6723 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (26) summary score for whole lease: 60 (survey average = 50).

Traversed assessment (316 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
80	14	6	0	50	37	13

Major (mapped) areas of severe degradation and erosion (sde): 460 (nearest 10 ha).

Land systems of Boogardie station

Land systems of Beegood station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition									Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)					
					Nil	Minor	Mod.	Severe	Good	Fair	Poor			
High pastoral potential														
Austin	240	0.2	229	2	100	0	0	0	100	0	0	34	34	
Carnegie	3,005	1.8		18	89	11	0	0	89	11	0	410	429	
Ero	6,440	4.0		40	28	40	30	3	25	47	28	570	920	
Mileura	1,970	1.2		13	62	38	0	0	31	46	23	188	281	
	11,655	7.2												
Moderate pastoral potential														
Challenge	29,100	18.0	143	59	93	7	0	0	51	47	2	2,126	2,425	
Milllex	5,250	3.2		9	67	33	0	0	100	0	0	437	437	
Sherwood	16,160	10.0		43	72	14	14	0	46	36	18	1,165	1,347	
Violet	1,560	1.0		3	100	0	0	0	67	33	0	119	130	
Wiluna	2,130	1.3		13	100	0	0	0	84	8	8	170	177	
	54,200	33.5												
Low pastoral potential														
Gabanintha	2,920	1.8	86	8	88	13	0	0	75	25	0	139	146	
Jundee	3,310	2.1		6	100	0	0	0	67	33	0	148	166	
Kalli	21,950	13.6		17	94	0	6	0	52	24	24	992	1,098	
Woodline	63,790	39.5		84	92	7	1	0	41	42	17	2,813	3,190	
Yandil	780	0.5		1	0	100	0	0	0	100	0	31	39	
	92,750	57.5												
No pastoral potential														
Bare lakebed	2,875	1.8												
Totals	161,480	100.0	458	316	80	14	6	0	50	37	13	9,342	10,819	
Survey area average				13,621	83	11	5	1	21	37	42			

* Recommended carrying capacity over summer (if preceded by an effective winter season) 9340 dry sheep equivalents (dse).

** Original carrying capacity over summer 10,820 dse.

Boolardy station

Lease area: 346,748 ha

Area of various reserves, freehold and vacant Crown land within managed area: 26,630 ha.

Murchison shire

Murchison Land Conservation District

Mapsheet reference (1:250,000): Byro, Belele, Murgoo

Soil and vegetation condition summary data (1986-87)

Condition sites (36) summary score for whole lease: 54 (survey average = 50).

Traversed assessment (484 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
71	16	11	2	22	39	39

Major (mapped) areas of severe degradation and erosion (sde): 12,500 (nearest 10 ha).

Land systems of Boolardy station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Bayou ⁺	590	0.2		0	50	33	14	3	25	23	52	49	84
Beringarra	34,460	9.9	7,591	85	31	32	31	6	9	20	71	1,954	4,923
Cunyu	850	0.3		10	80	20	0	0	10	50	40	66	121
Ero	24,040	6.9	2,025	65	50	26	22	2	28	25	47	1,977	3,434
Mileura	5,040	1.4	391	18	82	6	6	6	11	33	56	353	720
Roderick	<u>10,980</u>	<u>3.2</u>	1,670	23	22	39	35	4	21	9	70	746	1,569
	75,960	21.9											
Moderate pastoral potential													
Belele	11,150	3.2	132	15	80	13	7	0	27	46	27	752	929
Challenge	38,050	11.0		37	95	5	0	0	60	37	3	2,854	3,171
Sherwood	24,710	7.1	4	24	88	13	0	0	29	50	21	1,694	2,059
Tindalarra ⁺	1,730	0.5		0	80	16	4	0	10	46	44	112	144
Violet ⁺	220	0.1		0	92	6	2	0	26	43	31	15	18
Wiluna ⁺	700	0.2		0	96	3	1	0	25	35	40	47	58
Yanganoo	<u>142,340</u>	<u>41.0</u>	353	167	92	6	2	0	20	53	27	9,467	11,861
	218,900	63.1											
Low pastoral potential													
Gabanintha ⁺	140	< 0.1		0	92	7	1	0	22	36	42	6	7
Jundee ⁺	230	0.1		0	91	7	2	0	16	34	50	10	12
Kalli	2,330	0.7		1	100	0	0	0	0	100	0	93	117
Koonmarra	17,370	5.0		15	100	0	0	0	33	47	20	752	869
Millrose	3,170	0.9		3	100	0	0	0	33	67	0	137	159
Mindura ⁺	3,980	1.2		0	96	4	0	0	13	30	57	164	199
Narryer	7,510	2.2		1	0	0	100	0	0	0	100	300	376
Norie ⁺	1,270	0.4		0	96	4	0	0	31	54	15	55	64
Thomas ⁺	950	0.3		0	97	0	3	0	29	39	32	41	48
Waguin ⁺	750	0.2		0	92	8	0	0	22	46	32	32	38
Yandil	9,140	2.6	359	20	90	10	0	0	5	55	40	356	457
Yarrameedie ⁺	<u>140</u>	<u>< 0.1</u>		0	96	4	0	0	22	43	35	6	7
	46,980	13.6											
Very low pastoral potential													
Agamemnon ⁺	4,910	1.4		0	100	0	0	0	0	0	100	164	164
Totals	346,750	100.0	12,525	484	71	16	11	2	22	39	39	22,202	31,608
Survey area average				13,621	83	11	5	1	21	37	42		

+ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 22,220 dry sheep equivalents (dse).

** Original carrying capacity over summer 31,610 dse.

Bullardoo station

Mullewa shire
Murchison Land Conservation District
Mapsheet reference (1:250,000): Murgoo

Lease area: 41,942 ha

Area of various reserves, freehold and vacant Crown land within managed area: 4259 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (5) summary score for whole lease: Insufficient sites (survey average = 50).

Traversed assessment (110 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
86	7	5	2	11	25	64

Major (mapped) areas of severe degradation and erosion (sde): (nearest 10 ha).

Land systems of Bullardoo station

Traversed assessment of land resource condition													
Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	No of obs	Soil erosion (%)				Perennial vegetation (%)			Rcc* (dse)	Occ** (dse)
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Wolarry	910	2.2		9	100	0	0	0	11	33	56	68	130
Moderate pastoral potential													
Boulder	50	0.1		1	100	0	0	0	0	100	0	3	4
Challenge	1,940	4.6		9	100	0	0	0	0	0	100	121	162
Tindalarra	2,250	5.4		8	50	38	13	0	0	38	62	141	188
	4,240	10.1											
Low pastoral potential													
Kalli	16,570	39.5		34	100	0	0	0	12	44	44	683	829
Nerramyne	14,350	34.2	167	39	69	13	13	5	0	8	92	567	718
Norie +	1,060	2.5		0	96	4	0	0	31	54	15	46	53
	31,980	76.2											
Very low pastoral potential													
Eurardy	4,810	11.5		10	100	0	0	0	70	30	0	160	160
Totals	41,940	100.0	167	110	86	7	5	2	11	25	64	1,789	2,244
Survey area average				13,621	83	11	5	1	21	37	42		

+ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 1,790 dry sheep equivalents (dse).

** Original carrying capacity over summer 2,240 dse.

Buttah station

Meekatharra shire
Meekatharra Land Conservation District
Mapsheet reference (1:250,000): Belele, Robinson Range

Lease area: 147,679 ha

Area of various reserves, freehold and vacant Crown land within managed area: 111 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (24) summary score for whole lease: 51 (survey average = 50).

Traversed assessment (212 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
94	6	0	0	7	50	43

Major (mapped) areas of severe degradation and erosion (sde): 1,180 (nearest 10 ha).

Land systems of Buttah station

Land systems of Dutton station				Traversed assessment of land resource condition									Rcc* (dse)	Occ** (dse)
Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	No of obs	Soil erosion (%)				Perennial vegetation (%)					
					Nil	Minor	Mod.	Severe	Good	Fair	Poor			
High pastoral potential														
Cunyu	7,720	5.2		7	100	0	0	0	43	43	14	811	1,103	
Moderate pastoral potential														
Belele	24,510	16.6		37	95	5	0	0	27	43	30	1,670	2,043	
Flood	1,830	1.2		7	100	0	0	0	0	43	57	114	153	
Violet	2,220	1.5		12	92	8	0	0	0	83	17	139	185	
Wiluna	<u>780</u>	<u>0.5</u>		3	100	0	0	0	0	100	0	49	65	
	29,340	19.8												
Low pastoral potential														
Beasley +	120			0	100	0	0	0	25	75	0	5	6	
Gabanintha	1,350			2	100	0	0	0	0	0	100	54	68	
Koonmarra	59,710			60	100	0	0	0	3	55	42	2,406	2,986	
Millrose	1,310			5	60	40	0	0	0	20	80	53	66	
Mindura	12,170			15	93	7	0	0	0	27	73	487	609	
Yandil	<u>32,860</u>	<u>22.3</u>	1,184	64	89	9	2	0	2	50	48	1,274	1,643	
	107,520	72.9												
Very low pastoral potential														
Agamemnon +	2,440	1.7		0	100	0	0	0	0	0	100	81	81	
Peak Hill +	<u>660</u>	<u>0.4</u>		0	100	0	0	0	0	0	100	22	22	
	3,100	2.1												
Totals	147,680	100.0	1,184	212	94	6	0	0	7	50	43	7,165	9,030	
Survey area average				13,621	83	11	5	1	21	37	42			

+ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 7160 dry sheep equivalents (dse).

** Original carrying capacity over summer 9030 dse.

Byro station

Murchison shire
Murchison Land Conservation District
Mapsheet reference (1:250,000): Byro, Glenburgh

Lease area: 237,872 ha

Area of various reserves, freehold and vacant Crown land within managed area: 9240 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (35) summary score for whole lease: 51 (survey average = 50).

Traversed assessment (290 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
83	8	8	1	24	28	48

Major (mapped) areas of severe degradation and erosion (sde): 5280 (nearest 10 ha).

Land systems of Byro station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)	
				No of obs	Soil erosion (%)				Perennial vegetation (%)					
					Nil	Minor	Mod.	Severe	Good	Fair	Poor			
High pastoral potential														
Beringarra	9,500	4.0	1,346	44	36	27	32	5	2	0	98	469	1,357	
Cunyu	13,090	5.5		18	94	6	0	0	0	22	78	807	1,870	
Mileura	3,370	1.4		7	100	0	0	0	0	71	29	254	481	
Wongong ⁺	<u>890</u>	<u>0.4</u>		0	77	18	5	0	13	32	55	67	127	
	26,850	11.3												
Moderate pastoral potential														
Belele	260	0.1	293	2	100	0	0	0	0	50	50	16	22	
Bidgemia	9,750	4.1		15	93	7	0	0	73	27	0	758	813	
Boulder	17,570	7.4		21	80	10	10	0	38	33	29	1,237	1,464	
Breberle ⁺	1,010	0.4		0	100	0	0	0	4	41	55	64	84	
Bunny ⁺	5,170	2.2		0	97	3	0	0	32	46	22	357	431	
Byro	2,220	1.0		5	80	20	0	0	40	20	40	157	185	
Flood	12,050	5.0		7	100	0	0	0	57	29	14	896	1,004	
Liver	16,310	6.9		11	100	0	0	0	46	18	36	1,176	1,359	
Sandiman	4,500	1.9		6	83	0	17	0	0	83	17	263	375	
Yanganoo	<u>48,400</u>	<u>20.3</u>		61	85	8	7	0	10	26	64	2,940	4,033	
	117,240	49.3												
Low pastoral potential														
Badgeradda ⁺	2,120	0.9	664	0	81	6	13	0	38	19	43	93	106	
Kalli	8,930	3.8		14	100	0	0	0	65	21	14	415	447	
Mindura ⁺	2,640	1.1		0	96	4	0	0	13	30	57	109	132	
Moogooloo ⁺	440	0.2		0	95	0	5	0	58	37	5	20	22	
Narryer	33,670	14.2		36	91	3	6	0	19	22	59	1,384	1,684	
Sandplain	30,010	12.6		27	100	0	0	0	48	48	4	1,344	1,501	
Thomas	11,230	4.7		10	90	0	10	0	10	60	30	460	562	
Yandil	<u>4,410</u>	<u>1.8</u>		4	100	0	0	0	0	100	0	176	221	
	93,450	39.3												
Very low pastoral potential														
Woodrarrung	330	0.1		2	100	0	0	0	0	0	100	11	11	
Totals	237,870	100.0	5,278	290	83	8	8	1	24	28	48	13,473	18,291	
Survey area average				13,621	83	11	5	1	21	37	42			

+ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 13,470 dry sheep equivalent (dse).

** Original carrying capacity over summer 18,290 dse.

Coodardy station

Lease area: 165,519 ha

Area of various reserves, freehold and vacant Crown land within managed area: 1922 ha.

Cue and Murchison shires
Cue Land Conservation District
Mapsheet reference (1:250,000): Cue

Soil and vegetation condition summary data (1986-87)

Condition sites (21) summary score for whole lease: 69 (survey average = 50).

Traversed assessment (236 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
78	14	8	0	29	47	24

Major (mapped) areas of severe degradation and erosion (sde): 3,130 (nearest 10 ha).

Land systems of Coodardy station

Traversed assessment of land resource condition													
Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	No of obs	Soil erosion (%)				Perennial vegetation (%)			Rcc* (dse)	Occ** (dse)
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Cunyu ⁺	2,160	1.3	2,335	0	79	16	4	0	13	29	58	162	309
Ero	15,860	9.6		46	20	45	35	0	2	30	68	910	2,266
Mileura	3,940	2.4		8	37	38	25	0	13	50	37	316	563
	21,960	13.3											
Moderate pastoral potential													
Belele	670	0.4	420	3	100	0	0	0	100	0	0	56	56
Challenge	43,170	26.1		60	97	3	0	0	37	53	10	3,031	3,598
Millex ⁺	410	0.2		0	83	14	3	0	29	39	32	28	34
Sherwood ⁺	5,310	3.2		0	70	19	9	2	25	39	36	361	443
Violet	1,660	1.0		3	100	0	0	0	67	33	0	127	138
Wiluna ⁺	740	0.5		0	96	3	1	0	25	35	40	50	62
Yanganoo	65,020	39.3		108	95	4	1	0	34	50	16	4,498	5,418
	11,690	70.7											
Low pastoral potential													
Gabanintha ⁺	2,810	1.7	335	0	92	7	1	0	22	36	42	119	141
Jundee	4,110	2.5		1	0	100	0	0	0	100	0	151	206
Kalli ⁺	1,750	1.1		0	99	1	0	0	40	42	18	77	88
Norie	14,470	8.7		5	100	0	0	0	40	60	0	637	724
Yandil	3,050	1.8		2	50	50	0	0	50	50	0	137	153
Yarrameedie ⁺	390	0.2		0	96	4	0	0	22	43	35	16	20
	26,580	16.0											
Totals	165,520	100.0	3,130	236	78	14	8	0	29	47	24	10,676	14,219
Survey area average				13,621	83	11	5	1	21	37	42		

⁺ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* **Recommended carrying capacity over summer (if preceded by an effective winter season)** 10,680 dry sheep equivalents (dse).

** **Original carrying capacity over summer** 14,220 dse.

Cullculli station

Cue shire
Cue Land Conservation District
Mapsheet reference (1:250,000): Belele, Cue

Lease area: 58,025ha

Area of various reserves, freehold and vacant Crown land within managed area: 103 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (9) summary score for whole lease: Insufficient sites (survey average = 50).

Traversed assessment (138 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
86	9	5	0	34	40	26

Major (mapped) areas of severe degradation and erosion (sde): 940 (nearest 10 ha).

Land systems of Cullculli station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Carnegie +	52	0.1		0	93	7	0	0	78	19	3	7	7
Cunyu+	280	0.5		0	79	16	4	1	13	29	58	21	40
Ero +	170	0.3		0	38	35	24	3	9	23	68	12	24
Mileura +	80	0.1		0	74	19	6	1	31	37	32	7	11
	582	1.0											
Moderate pastoral potential													
Challenge	530	0.9		1	100	0	0	0	0	100	0	33	44
Millex	470	0.8		2	100	0	0	0	50	0	50	34	39
Sherwood	8,930	15.4	127	29	76	17	7	0	51	21	28	645	744
Violet	5,900	10.2	201	17	82	12	6	0	6	47	47	364	492
Wiluna	8,400	14.5		22	95	5	0	0	32	45	23	581	700
Yanganoo	12,430	21.4	156	20	95	5	0	0	50	35	15	896	1,036
	39,180	67.5											
Low pastoral potential													
Gabanintha	2,180	3.8		5	80	20	0	0	20	60	20	92	109
Jundee	13,780	23.7	456	27	78	7	15	0	19	51	30	559	689
Kalli	2,520	4.3		14	100	0	0	0	50	36	14	113	126
Koonmarra	400	0.7		1	96	4	0	0	100	0	0	20	20
Mindura +	1,720	3.0		0					13	30	57	71	86
	18,080	31.2											
No pastoral potential													
Bare lakebed	188	0.3											
Totals	58,030	100.0	940	138	86	9	5	0	34	40	26	3,455	4,167
Survey area average				13,621	83	11	5	1	21	37	42		

+ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 3450 dry sheep equivalents (dse).

** Original carrying capacity over summer 4170 dse.

Curbur station

Murchison shire
Murchison Land Conservation District
Mapsheet reference (1:250,000): Byro

Lease area: 178, 168 ha

Area of various reserves, freehold and vacant Crown land within managed area: 0 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (42) summary score for whole lease: 51 (survey average = 50).

Traversed assessment (298 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
76	19	5	0	15	35	50

Major (mapped) areas of severe degradation and erosion (sde): 1,540 (nearest 10 ha).

Land systems of Curbur station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Beringarra	4,400	2.5	1,201	22	14	54	32	0	0	14	86	195	629
Cunyu	540	0.3		5	20	80	0	0	0	0	100	30	77
Wongong	5,240	2.9		24	58	29	13	0	4	21	75	340	749
	10,180	5.7											
Moderate pastoral potential													
Boulder	22,970	12.9	152	49	78	22	0	0	16	49	35	1,512	1,914
Breberle	6,120	3.4		16	100	0	0	0	0	38	62	383	510
Bunny ⁺	3,010	1.7		0	97	3	0	0	32	46	22	208	251
Byro ⁺	1,070	0.6		0	80	20	0	0	6	34	60	68	89
Liver	25,570	14.4		41	66	27	7	0	26	47	27	1,737	2,131
Sandiman ⁺	730	0.4		0	0	0	0	0	0	0	0	47	61
Yanganoo	9,960	5.6		14	86	7	7	0	0	21	79	613	830
	69,430	39.0											
Low pastoral potential													
Kalli	8,040	4.5	25	14	71	29	0	0	7	65	28	327	402
Millrose ⁺	20	< 0.1		0	85	11	4	0	58	37	5	1	1
Mindura ⁺	2,810	1.6		0	96	4	0	0	13	30	57	116	141
Narryer	41,000	23.0		68	94	6	0	0	6	40	54	1,663	2,050
Sandplain	35,040	19.6		28	100	0	0	0	68	21	11	1,640	1,752
Thomas	3,330	1.9		6	100	0	0	0	0	0	100	133	167
Yandil	8,310	4.7		11	64	27	9	0	0	10	90	326	416
	98,550	55.3											
Totals	178,160	100.0	1,537	298	76	19	5	0	15	35	50	9,339	12,170
Survey area average				13,621	83	11	5	1	21	37	42		

+ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 9,340 dry sheep equivalents (dse).

** Original carrying capacity over summer 12,170 dse.

Dalgaranga station

Lease area: 102,549 ha

Yalgoo shire
Yalgoo Land Conservation District
Mapsheet reference (1:250,000): Murgoo, Cue

Area of various reserves, freehold and vacant Crown land within managed area: 712 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (18) summary score for whole lease: 54 (survey average = 50).

Traversed assessment (209 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
92	8	0	0	7	46	47

Major (mapped) areas of severe degradation and erosion (sde): 410 (nearest 10 ha).

Land systems of Dalgaranga Station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition									Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)					
					Nil	Minor	Mod.	Severe	Good	Fair	Poor			
High pastoral potential														
Cunyu	2,330	2.3	34	14	86	14	0	0	0	14	86	139	333	
Ero	1,110	1.1		5	40	60	0	0	20	40	40	92	159	
	3,440	3.4												
Moderate pastoral potential														
Challenge	16,190	15.8	105	30	87	10	3	0	3	50	47	1,022	1,349	
Sherwood	7,630	7.4		11	91	9	0	0	0	55	45	477	636	
Tindalarra	540	0.5		3	100	0	0	0	0	67	33	34	45	
Violet	8,540	8.3		21	95	5	0	0	5	33	62	543	712	
Wiluna	2,380	2.3		3	100	0	0	0	0	67	33	149	198	
Yanganoo	22,570	22.0		52	98	2	0	0	10	48	42	1,451	1,881	
	57,850	56.3												
Low pastoral potential														
Gabanintha ⁺	410	0.4	230	0	92	7	1	0	22	36	42	17	21	
Jundee	4,670	4.6		17	76	24	0	0	0	29	81	196	234	
Kalli	20,080	19.6		30	100	0	0	0	20	70	10	843	1,004	
Norie	2,380	2.3		1	100	0	0	0	0	100	0	95	119	
Waguin ⁺	1,510	1.5		0	92	8	0	0	22	46	32	65	76	
Woodline	7,820	7.6	38	14	100	0	0	0	7	36	57	318	391	
Yarrameedie	740	0.7		4	50	50	0	0	0	0	100	28	37	
	37,610	36.7												
Very low pastoral potential														
Farmer	3,650	3.6		4	100	0	0	0	0	75	25	122	122	
Totals	102,550	100.0	407	209	92	8	0	0	7	46	47	5,591	7,317	
Survey area average				13,621	83	11	5	1	21	37	42			

+ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 5590 dry sheep equivalents (dse).

** Original carrying capacity over summer 7320 dse.

Erong Springs station (part)

Lease area: 32,490 (part)

Area of various reserves, freehold and vacant Crown land within managed area: 0 ha.

Upper Gascoyne shire

Upper Gascoyne Conservation District

Mapsheet reference (1:250,000): Glenburgh

Soil and vegetation condition summary data (1986-87)

Condition sites (7) summary score for whole lease: Insufficient sites (survey average = 50).

Traversed assessment (87) observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
99	1	0	0	11	32	57

Major (mapped) areas of severe degradation and erosion (sde): 180 (nearest 10 ha).

Land systems of part of Erong Springs station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
Moderate pastoral potential													
Frederick	850	2.6	182	1	100	0	0	0	0	100	0	53	71
Yanganoo	<u>1,330</u>	<u>4.1</u>		1	100	0	0	0	0	100	0	83	111
	2,180	6.7											
Low pastoral potential													
Koonmarra	5,560	17.1	182	23	96	4	0	0	0	9	91	215	278
Mindura	12,900	39.7		45	100	0	0	0	11	40	49	530	645
Thomas	5,130	15.8		11	100	0	0	0	45	46	9	228	257
Yandil	<u>2,060</u>	<u>6.3</u>		3	100	0	0	0	0	33	67	82	103
	25,650	78.9											
Very low pastoral potential													
Agamemnon	4,660	14.4		3	100	0	0	0	0	0	100	155	155
Totals	32,490	100.00	182	87	99	1	0	0	11	32	57	1,346	1,620
Survey area average				13,621	83	11	5	1	21	37	42		

* Recommended carrying capacity over summer (if preceded by an effective winter season) 1350 dry sheep equivalents (dse).

** Original carrying capacity over summer 1620 dse.

Glen station

Lease area: 40,710 ha

Cue shire
Cue Land Conservation District
Mapsheet reference (1:250,000): Belele, Cue

Area of various reserves, freehold and vacant Crown land within managed area: 14 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (10) summary score for whole lease: 52 (survey average = 50).

Traversed assessment (125 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
93	7	0	0	44	25	31

Major (mapped) areas of severe degradation and erosion (sde): 1380 (nearest 10 ha).

Land systems of Glen station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition									Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)					
					Nil	Minor	Mod.	Severe	Good	Fair	Poor			
High pastoral potential														
Cunyu	720	1.8	158	2	100	0	0	0	0	0	100	31	103	
Mileura ⁺	20	< 0.1		0	74	19	6	1	31	37	32	2	3	
	740	1.8												
Moderate pastoral potential														
Breberle ⁺	390	1.0		0	100	0	0	0	4	41	55	25	33	
Challenge ⁺	130	0.3		0	91	7	2	0	25	50	25	9	11	
Millex ⁺	30	< 0.1		0	83	14	3	0	29	39	32	2	3	
Sherwood	3,380	8.4		9	100	0	0	0	67	33	0	258	282	
Violet	5,550	13.8		21	95	5	0	0	81	19	0	441	463	
Wiluna ⁺	430	1.1		0	96	3	1	0	25	35	40	29	36	
Yanganoo	3,160	7.9		1	100	0	0	0	100	0	0	263	263	
	10,680	26.6												
Low pastoral potential														
Gabanintha	3,440	8.6	1,221	1	100	0	0	0	0	0	100	138	172	
Jundee	12,950	32.2		57	89	11	0	0	27	21	52	504	648	
Kalli	2,390	6.0		5	100	0	0	0	80	20	0	115	120	
Norie ⁺	250	0.6		0	96	4	0	0	31	54	15	11	13	
Yarrameedie	2,270	5.7		11	100	0	0	0	18	55	27	95	114	
	23,690	59.0												
Very low pastoral potential														
Weld	5,060	12.6		13	100	0	0	0	77	23	0	169	169	
Totals														
	40,170	100.0	1,379	120	93	7	0	0	44	25	31	2,092	2,433	
Survey area average				13,621	83	11	5	1	21	37	42			

+ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 2090 dry sheep equivalents (dse).

** Original carrying capacity over summer 2430 dse.

Hy Brazil station

Mt Magnet shire
Mt Magnet Land Conservation District
Mapsheet reference (1:250,000): Cue

Lease area: 16,777 ha

Area of various reserves, freehold and vacant Crown land within managed area: 297 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (3) summary score for whole lease: Insufficient sites (survey average = 50).

Traversed assessment (49 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
70	16	10	4	8	16	76

Major (mapped) areas of severe degradation and erosion (sde): 1850 (nearest 10 ha).

Land systems of Hy Brazil station

				Traversed assessment of land resource condition										
Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	No of obs	Soil erosion (%)				Perennial vegetation (%)			Rcc* (dse)	Occ** (dse)	
					Nil	Minor	Mod.	Severe	Good	Fair	Poor			
High pastoral potential														
Austin	2,510	15.0	512	12	67	25	8	0	8	25	67	146	359	
Ero	<u>2,920</u>	<u>17.4</u>	1,212	14	44	21	21	14	0	0	100	95	417	
	5,430	32.4												
Moderate pastoral potential														
Challenge	1,140	6.8		7	57	29	14	0	0	29	71	71	95	
Millex ⁺	30	0.2		0	83	14	3	0	29	39	32	2	3	
Sherwood ⁺	30	0.2		0	71	19	9	2	26	38	36	2	3	
Violet	1,650	9.8		3	100	0	0	0	0	33	67	103	138	
Wiluna	<u>1,300</u>	<u>7.7</u>		4	100	0	0	0	75	25	0	102	108	
	4,150	24.7												
Low pastoral potential														
Gabanintha	1,690	10.1		3	100	0	0	0	0	0	100	68	85	
Jundee	3,390	20.2	128	2	100	0	0	0	0	50	50	131	170	
Kalli ⁺	130	0.8		0	98	1	0	0	40	42	18	6	7	
Woodline	<u>1,980</u>	<u>11.8</u>		4	100	0	0	0	0	0	100	79	99	
	7,190	42.9												
Totals	16,770	100.0	1,852	49	70	16	10	4	8	16	76	805	1,484	
Survey area average				13,621	83	11	5	1	21	37	42			

+ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 800 dry sheep equivalents (dse).

** Original carrying capacity over summer 1480 dse.

Innouendy station

Murchison shire
Murchison Land Conservation District
Mapsheet reference (1:250,000): Glenburgh

Lease area: 223,386 ha

Area of various reserves, freehold and vacant Crown land within managed area 5026 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (30) summary score for whole lease: 58 (survey average = 50).

Traversed assessment (287 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
90	7	2	1	27	25	48

Major (mapped) areas of severe degradation and erosion (sde): 830 (nearest 10 ha).

Land systems of Innouendy station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Beringarra	3,200	1.5		5	100	0	0	0	20	80	0	304	457
Cunyu	16,600	7.4		17	94	6	0	0	12	29	59	1,230	2,371
	19,800	8.9											
Moderate pastoral potential													
Belele	26,010	11.6		38	100	0	0	0	87	13	0	2,097	2,168
Bidgemia ⁺	240	0.1		0	80	16	4	0	48	40	12	17	20
Boulder	3,040	1.4		2	100	0	0	0	50	50	0	222	253
Channel	5,240	2.3		12	100	0	0	0	50	50	0	382	437
Flood	7,300	3.3		14	100	0	0	0	57	29	14	543	608
Frederick ⁺	40	< 0.1		0	100	0	0	0	0	100	0	3	3
Horseshoe ⁺	10	< 0.1		0	100	0	0	0	17	47	36	1	1
Sandiman	6,900	3.1		8	13	37	37	13	37	37	26	485	575
Yanganoo	67,850	30.4	622	105	86	10	3	1	17	21	62	4,442	5,654
	116,630	52.2											
Low pastoral potential													
Kalli ⁺	550	0.2		0	98	2	0	0	40	42	18	24	28
Koonmarra	33,650	15.1	135	53	96	2	0	2	8	26	66	1,367	1,683
Mindura	8,410	3.8		8	88	12	0	0	0	25	75	336	421
Narryer	12,990	5.8		2	100	0	0	0	0	0	100	520	650
Sandplain	7,620	3.4		2	100	0	0	0	0	50	50	305	381
Thomas ⁺	1,560	0.7		0	100	0	0	0	29	39	32	67	78
Yandil	19,660	8.8	69	19	79	16	5	0	11	21	68	805	983
Yarrameedie ⁺	420	0.2		0	96	4	0	0	22	43	35	18	21
	84,860	38.0											
Very low pastoral potential													
Agamemnon	470	0.2		2	100	0	0	0	0	0	100	16	16
Augustus ⁺	1,630	0.7		0	100	0	0	0	0	100	0	54	54
	2,100	0.9											
Totals	223,390	100.0	826	287	90	7	2	1	27	25	48	13,238	16,862
Survey area average				13,621	83	11	5	1	21	37	42		

+ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* **Recommended carrying capacity over summer (if preceded by an effective winter season)** 13,240 dry sheep equivalents (dse).

** **Original carrying capacity over summer** 16,860 dse.

Jingemarra station

Lease area: 110,462 ha

Yalgoo shire
Yalgoo Land Conservation District
Mapsheet reference (1:250,000): Murgoo

Area of various reserves, freehold and vacant Crown land within managed area: 0 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (21) summary score for whole lease: 52 (survey average = 50).

Traversed assessment (227 observations at 1 km intervals):

Nil	Soil erosion (%)			Very good/good	Perennial vegetation (%)	
	Minor	Moderate	Severe		Fair	Poor/very poor
88	9	3	0	32	43	25

Major (mapped) areas of severe degradation and erosion (sde): 300 (nearest 10 ha).

Land systems of Jingemarra station

Land systems of Jingemarra station														
Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition									Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)					
					Nil	Minor	Mod.	Severe	Good	Fair	Poor			
Moderate pastoral potential														
Challenge	28,010	25.4	304	45	89	9	2	0	40	40	20	1,984	2,334	
Tindalarra	27,210	24.6		87	76	18	6	0	14	46	40	1,761	2,268	
Yanganoo	3,300	3.0		8	100	0	0	0	25	62	13	224	275	
	58,520	53.0												
Low pastoral potential														
Kalli	23,620	21.4		50	100	0	0	0	58	30	12	1,082	1,181	
Norie	14,600	13.2		9	100	0	0	0	33	67	0	632	730	
Waguin	13,720	12.4		28	96	4	0	0	29	50	21	589	686	
	51,940	47.0												
Totals	110,460	100.0	304	227	88	9	3	0	32	43	25	6,272	7,474	
Survey area average				13,621	83	11	5	1	21	37	42			

* Recommended carrying capacity over summer (if preceded by an effective winter season) 6270 dry sheep equivalents (dse).

** Original carrying capacity over summer 7470 dse.

Kalli station

Murchison shire
Murchison Land Conservation District
Mapsheet reference (1:250,000): Belele, Byro

Lease area: 85,322 ha

Area of various reserves, freehold and vacant Crown land within managed area: 0 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (11) summary score for whole lease: 58 (survey average = 50).

Traversed assessment (147 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
78	13	9	0	15	38	47

Major (mapped) areas of severe degradation and erosion (sde): 1800 (nearest 10 ha).

Land systems of Kalli station

Traversed assessment of land resource condition													
Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	No of obs	Soil erosion (%)				Perennial vegetation (%)			Rcc* (dse)	Occ** (dse)
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Ero	7,810	9.2	1,443	15	34	33	33	0	0	27	73	411	1,116
Moderate pastoral potential													
Challenge	8,940	10.5	306	15	100	0	0	0	0	40	60	559	745
Sherwood	34,550	40.5		66	79	15	6	0	23	36	41	2,306	2,879
Yanganoo	<u>20,520</u>	<u>24.0</u>		23	92	4	4	0	13	58	29	1,338	1,710
	64,010	75.0											
Low pastoral potential													
Kalli	4,540	5.3	48	5	100	0	0	0	29	14	57	195	227
Millrose	250	0.3		12	83	17	0	0	8	50	42	10	13
Norie ⁺	2,510	2.9		0	96	4	0	0	31	54	15	108	126
Yandil	<u>6,200</u>	<u>7.3</u>		11	64	9	27	0	0	18	82	246	310
	13,500	15.8											
Totals	85,320	100.0	1,797	147	78	13	9	0	15	38	47	5,173	7,126
Survey area average				13,621	83	11	5	1	21	37	42		

+ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* **Recommended carrying capacity over summer (if preceded by an effective winter season)** 5170 dry sheep equivalents (dse).

** **Original carrying capacity over summer** 7130 dse.

Karbar station

Cue shire

Cue Land Conservation District

Mapsheet reference (1:250,000): Cue, Belele

Lease area: 116,314 ha

Area of various reserves, freehold and vacant Crown land within managed area: 10,376 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (17) summary score for whole lease: 44 (survey average = 50).

Traversed assessment (301 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
85	9	6	0	19	27	54

Major (mapped) areas of severe degradation and erosion (sde): 3040 (nearest 10 ha).

Land systems of Karbar station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Cunyu	2,080	1.8		17	94	6	0	0	0	6	94	119	297
Moderate pastoral potential													
Challenge	520	0.5		5	80	20	0	0	0	0	100	33	43
Sherwood	10,960	9.4	413	28	64	25	11	0	29	35	36	732	913
Millex	5,690	4.9	316	16	81	13	6	0	0	50	50	330	474
Trillbar	2,020	1.7	589	7	57	14	29	0	0	0	100	90	168
Violet	6,910	5.9		18	94	6	0	0	61	28	11	519	575
Wiluna	8,530	7.3		15	100	0	0	0	40	20	40	605	711
Yanganoo	26,850	23.1	37	49	80	8	12	0	10	29	61	1,731	2,237
	61,480	52.8											
Low pastoral potential													
Gabanintha	10,690	9.2		36	89	8	3	0	17	33	50	446	534
Jundee	11,460	9.9	481	41	91	5	2	2	17	12	71	459	573
Kalli	6,150	5.3		10	100	0	0	0	50	50	0	277	308
Koonmarra	1,840	1.6		12	100	0	0	0	50	25	25	83	92
Mindura	1,350	1.2		2	100	0	0	0	100	0	0	68	68
Millrose	310	0.2		6	34	33	33	0	0	0	100	12	15
Norie ⁺	2,120	1.8		0	96	4	0	0	31	54	15	91	106
Woodline	2,650	2.3		5	100	0	0	0	0	100	0	106	133
Yandil	15,890	13.7	1,201	34	88	9	3	0	3	26	71	592	795
	52,460	45.2											
Very low pastoral potential													
Yagahong ⁺	290	0.2		0	100	0	0	0	0	62	38	10	10
Totals													
	116,310	100.0	3,037	301	85	9	6	0	19	27	54	6,303	8,052
Survey area average													
				13,621	83	11	5	1	21	37	42		

+ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* **Recommended carrying capacity over summer (if preceded by an effective winter season)** 6300 dry sheep equivalents (dse).

** **Original carrying capacity over summer** 8050 dse.

Koonmarra station

Lease area: 138,352 ha

Area of various reserves, freehold and vacant Crown land within managed area: 7 ha.

Meekatharra shire
Meekatharra Land Conservation District
Mapsheet reference (1:250,000): Belele

Soil and vegetation condition summary data (1986-87)

Condition sites (22) summary score for whole lease: 45 (survey average = 50).

Traversed assessment (199 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
83	12	4	1	19	34	47

Major (mapped) areas of severe degradation and erosion (sde): 1560 (nearest 10 ha).

Land systems of Koonmarra station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Ero	280	0.2		1	0	0	100	0	0	0	100	16	41
Moderate pastoral potential													
Belele	7,510	5.4		6	100	0	0	0	17	66	17	470	626
Sherwood	35,150	25.4	565	53	72	17	9	2	30	51	19	2,381	2,929
Violet ⁺	1,080	0.8		0	92	6	2	0	26	43	31	74	90
Wiluna	16,730	12.1		20	100	0	0	0	15	15	70	1,098	1,394
Yanganoo	9,430	6.8		20	84	16	0	0	58	42	0	704	786
	69,900	50.5											
Low pastoral potential													
Gabanintha ⁺	520	0.4		0	92	7	1	0	22	36	42	22	26
Jundee	4,200	3.0	736	4	75	25	0	0	0	25	75	139	210
Kalli	9,760	7.1		10	100	0	0	0	40	60	0	429	488
Koonmarra	18,890	13.7		32	91	9	0	0	0	22	78	755	944
Millrose	2,070	1.5	84	2	100	0	0	0	0	100	0	79	103
Mindura	16,720	12.1		28	82	18	0	0	0	21	79	699	836
Norie	5,980	4.3		4	100	0	0	0	0	25	75	239	299
Yandil	10,030	7.3	176	20	80	10	5	5	15	30	55	409	502
	68,170	49.3											
Totals	138,350	100.0	1,561	199	83	12	4	1	19	34	47	7,514	9,274
Survey area average				13,621	83	11	5	1	21	37	42		

⁺ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 7510 dry sheep equivalents (dse).

** Original carrying capacity over summer 9270 dse.

Lakeside station

Cue shire
Cue Land Conservation District
Mapsheet reference (1:250,000): Cue

Lease area: 51,528 ha

Area of various reserves, freehold and vacant Crown land within managed area: 4587 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (4) summary score for whole lease: Insufficient sites (survey average = 50).

Traversed assessment (85 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
96	4	0	0	47	44	9

Major (mapped) areas of severe degradation and erosion (sde): 0 (nearest 10 ha).

Land systems of Lakeside station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Carnegie	4,215	8.2		17	94	6	0	0	88	6	6	565	602
Cunyu	260	0.5		1	100	0	0	0	0	0	100	14	37
	4,475	8.7											
Moderate pastoral potential													
Challenge	1,960	3.8		5	80	20	0	0	0	80	20	122	163
Millex	420	0.8		1	100	0	0	0	0	100	0	29	35
Sherwood	4,620	9.0		8	100	0	0	0	0	50	50	288	385
Yanganoo	70	0.1		2	100	0	0	0	0	100	0	5	6
	7,070	13.7											
Low pastoral potential													
Gabarintha +	250	0.5		0	92	7	1	0	22	36	42	11	13
Jundee	1,100	2.1		0	91	7	2	0	16	34	50	46	55
Kalli	12,070	23.4		18	100	0	0	0	28	66	6	517	604
Norie	2,330	4.5		6	100	0	0	0	33	67	0	101	117
Waguin +	840	1.6		0	92	8	0	0	22	46	32	35	42
Woodline	2,800	5.5		8	100	0	0	0	38	62	0	122	140
Yarrameedie	1,790	3.5		5	80	20	0	0	60	40	0	82	90
	21,180	41.1											
Very low pastoral potential													
Farmer	1,230	2.4		14	100	0	0	0	86	14	0	41	41
No pastoral potential													
Bare lakebed	17,575	34.1											
Totals	51,530	100.0		85	96	4	0	0	47	44	9	1,978	2,330
Survey area average				13,621	83	11	5	1	21	37	42		

+ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 1980 dry sheep equivalents (dse).

** Original carrying capacity over summer 2330 dse.

Madoonga station

Cue shire
Cue Land Conservation District
Mapsheet reference (1:250,000): Bebele, Cue

Lease area: 113,925 ha

Area of various reserves, freehold and vacant crown land within managed area: 0 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (18) summary score for whole lease: 58 (survey average = 50).

Traversed assessment (201 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
89	9	2	0	26	48	26

Major (mapped) areas of severe degradation and erosion (sde): 1540 (nearest 10 ha).

Land systems of Madoonga station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Cunyu	210	0.2		1	100	0	0	0	100	0	0	30	30
Mileura	3,800	3.3		22	100	0	0	0	68	18	14	455	543
	4010	3.5											
Moderate pastoral potential													
Breberle	260	0.2	168	2	100	0	0	0	0	100	0	16	22
Sherwood	23,760	20.9	1,065	52	65	25	8	2	2	50	48	1,428	1,980
Tindalarra	1,180	1.1		11	73	27	0	0	18	82	0	78	98
Violet+	710	0.6		0	92	6	2	0	26	43	31	48	59
Yanganoo	22,110	19.4	307	52	94	4	2	0	35	48	17	1,524	1,843
	48,020	42.2											
Low pastoral potential													
Gabanintha+	800	0.7		0	92	7	1	0	22	36	42	34	40
Jundee	4,940	4.3		13	100	0	0	0	0	31	69	198	247
Kalli	40,890	35.9		42	98	2	0	0	34	47	19	1,771	2,045
Koonmarra+	490	0.4		0	96	4	0	0	10	32	58	20	25
Millrose	1,160	1.0		1	100	0	0	0	100	0	0	58	58
Yarrameedie	5,540	4.9		5	89	9	2	0	26	48	26	233	277
	53,820	47.2											
Very low pastoral potential													
Weld+	7,200	6.3		0	100	0	0	0	59	36	5	240	240
Yagahong+	870	0.8		0	100	0	0	0	0	0	100	29	29
	8070	7.1											
Totals	113,920	100.0	1,540	201	89	9	2	0	26	48	26	6,162	7,536
Survey area average				13,621	83	11	5	1	21	37	42		

+ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 6160 dry sheep equivalents (dse).

** Original carrying capacity over summer 7540 dse.

Meeberrie station

Murchison shire
Murchison Land Conservation District
Mapsheet reference (1:250,000): Byro, Murgoo

Lease area: 185,211 ha

Area of various reserves, freehold and vacant crown land within managed area: 11,775ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (28) summary score for whole lease: 33 (survey average = 50).

Traversed assessment (298 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
65	22	10	3	11	23	66

Major (mapped) areas of severe degradation and erosion (sde): 5800 (nearest 10 ha).

Land systems of Meeberrie station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Bayou	4,850	2.6	1,279	8	25	50	25	0	38	62	0	514	693
Beringarra	12,280	6.6	1,510	61	13	48	31	8	2	10	88	654	1,754
Cunyu ⁺	920	0.5		0	79	16	4	0	13	29	58	69	131
Mileura	2,560	1.4		2	50	50	0	0	0	100	10	213	366
Roderick ⁺	2,880	1.6		0	30	37	32	1	8	22	70	198	411
Wongong	1,190	0.6		8	100	0	0	0	62	38	0	143	170
	24,680	13.3											
Moderate pastoral potential													
Boulder	1,040	0.6		5	100	0	0	0	100	0	0	87	87
Challenge	8,580	4.6		20	90	10	0	0	0	20	80	536	715
Sherwood	36,410	19.6	1,892	43	67	19	9	5	2	28	70	2,173	3,034
Yanganoo	66,410	35.9	1,111	88	77	17	6	0	1	22	77	4,095	5,535
	112,440	60.7											
Low pastoral potential													
Badgeradda	580	0.3		1	100	0	0	0	100	0	0	29	29
Kalli	13,210	7.1	4	15	100	0	0	0	27	40	33	564	661
Koonmarra	4,500	2.4		7	86	0	0	14	14	58	28	186	225
Millrose	4,940	2.7	3	10	90	10	0	0	10	10	80	203	247
Narryer	9,760	5.3	5	16	62	38	0	0	6	25	69	396	488
Norie ⁺	1,170	0.6		0	96	4	0	0	31	54	15	51	59
Sandplain	4,540	2.5		7	100	0	0	0	86	14	0	211	227
Waguin	6,260	3.4		4	100	0	0	0	25	0	75	266	313
	44,960	24.3											
Very low pastoral potential													
Agamemnon ⁺	1,970	1.1		0	100	0	0	0	0	0	100	66	66
Woodrarrung	1,160	0.6		3	100	0	0	0	0	100	0	39	39
	3,130	1.7											
Totals	185,210	100.0	5,804	298	65	22	10	3	11	23	66	10,703	15,250
Survey area average				13,621	83	11	5	1	21	37	42		

⁺ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 10,700 dry sheep equivalents (dse).

** Original carrying capacity over summer 15,250 dse.

Meka station

Yalgoo and Murchison shires
Murchison Land Conservation District
Mapsheet reference (1:250,000): Murgoo, Cue, Byro

Lease area: 364,905 ha

Area of various reserves, freehold and vacant crown land within managed area: 226 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (47) summary score for whole lease: 57 (survey average = 50).

Traversed assessment (539 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
73	19	7	1	26	44	30

Major (mapped) areas of severe degradation and erosion (sde): 5030 (nearest 10 ha).

Land systems of Meka station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Beringarra	8,070	2.2	3,147	28	29	42	29	0	14	32	54	618	1,153
Cunyu	3,110	0.9		22	59	36	5	0	14	45	41	249	444
Ero	21,860	6.0		76	32	33	32	3	5	21	74	1,262	3,123
Mileura	<u>7,390</u>	<u>2.0</u>		26	38	58	4	0	23	31	46	623	1,056
	40,430	11.1											
Moderate pastoral potential													
Belele	2,420	0.7	43	6	100	0	0	0	67	33	0	185	202
Bunny	1,100	0.3		2	100	0	0	0	0	100	0	69	92
Challenge	78,700	21.6		91	92	8	0	0	27	59	14	5,362	6,558
Millex	5,320	1.4		6	50	33	17	0	33	50	17	368	443
Sherwood	35,280	9.7	528	44	78	20	2	0	41	45	14	2,473	2,940
Tindalarra	16,130	4.4	505	36	72	22	3	0	33	40	27	1,088	1,344
Violet	3,190	0.9	683	5	100	0	0	0	80	20	0	253	266
Wiluna	1,450	0.4		2	100	0	0	0	100	0	0	121	121
Yanganoo	<u>120,970</u>	<u>33.2</u>		144	91	9	0	0	17	55	28	7,946	10,081
	264,560	72.6											
Low pastoral potential													
Gabanintha	2,610	0.7	126	6	100	0	0	0	17	83	0	109	131
Jundee	5,960	1.6		6	100	0	0	0	33	67	0	258	298
Kalli	32,200	8.8		28	100	0	0	0	71	18	11	1,517	1,610
Norie	13,140	3.6		4	100	0	0	0	75	0	25	624	657
Waguin	4,070	1.1	126	4	100	0	0	0	25	75	0	204	204
Yandil	<u>930</u>	<u>0.2</u>		3	67	0	33	0	67	33	0	38	47
	58,910	16.0											
Very low pastoral potential													
Farmer ⁺	690	0.2		0	100	0	0	0	63	32	5	23	23
Weld ⁺	<u>320</u>	<u>0.1</u>		0	100	0	0	0	59	36	5	11	11
	1,010	0.3											
Totals	364,910	100.0	5032	539	73	19	7	1	26	44	30	23,401	30,804
Survey area average				13,621	83	11	5	1	21	37	42		

⁺ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 23,400 dry sheep equivalents (dse).

** Original carrying capacity over summer 30,800 dse.

Melangata station

Yalgoo shire

Yalgoo Land Conservation District

Mapsheet reference (1:250,000): Murgoo, Cue

Lease area: 45,122 ha

Area of various reserves, freehold and vacant crown land within managed area: 0 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (9) summary score for whole lease: Insufficient sites (survey average = 50).

Traversed assessment (119 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
92	6	2	0	11	63	26

Major (mapped) areas of severe degradation and erosion (sde): 0 (nearest 10 ha).

Land systems of Melangata station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition							Rcc* (dse)	Occ** (dse)	
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair			Poor
Moderate pastoral potential													
Challenge	9,380	20.8		18	89	11	0	0	28	66	6	641	782
Sherwood	260	0.6		4	75	25	0	0	0	100	0	16	22
Tindalarra	10,300	22.8		51	92	6	2	0	12	57	31	670	858
Yanganoo	180	0.4		1	100	0	0	0	0	100	0	11	15
	20,120	44.6											
Low pastoral potential													
Kalli	9,860	21.8		28	92	4	4	0	0	57	43	394	493
Norie	12,210	27.1		16	100	0	0	0	13	81	6	504	611
Waguin	2,920	6.5		1	100	0	0	0	0	100	0	117	146
Woodline ⁺	10	≤ 0.1		0	96	3	1	0	23	52	25	0	0
	25,000	55.4											
Totals	45,120	100.0		119	92	6	2	0	11	63	26	2,353	2,927
Survey area average				13,621	83	11	5	1	21	37	42		

⁺ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* **Recommended carrying capacity over summer (if preceded by an effective winter season)** 2350 dry sheep equivalents (dse).

** **Original carrying capacity over summer** 2930 dse.

Mileura station

Lease area: 25,051 ha

Area of various reserves, freehold and vacant crown land within managed area: 0 ha.

Murchison shire
Murchison Land Conservation District
Mapsheet reference (1:250,000): Belele

Soil and vegetation condition summary data (1986-87)

Condition sites (36) summary score for whole lease: 41 (survey average = 50).

Traversed assessment (401 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
79	13	8	0	11	41	48

Major (mapped) areas of severe degradation and erosion (sde): 5890 (nearest 10 ha).

Land systems of Mileura station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition									Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)					
					Nil	Minor	Mod.	Severe	Good	Fair	Poor			
High pastoral potential														
Beringarra	19,200	7.7	3,938	56	43	25	30	2	4	34	62	1,096	2,743	
Ero	23,110	9.2	1,686	52	38	35	27	0	10	21	69	1,526	3,302	
Mileura	1,160	0.7		3	100	0	0	0	0	67	33	123	237	
	43,970	17.6												
Moderate pastoral potential														
Belele	42,810	17.1		81	96	4	0	0	19	42	39	2,845	3,568	
Sherwood	26,520	10.6	262	29	87	10	3	0	14	79	7	1,719	2,210	
Tindalarra ⁺	1,840	0.7		0	80	16	4	0	10	46	44	119	153	
Yanganoo	84,470	33.7	4	98	92	8	0	0	12	37	51	5,490	7,039	
	155,640	62.1												
Low pastoral potential														
Kalli	1,500	0.6		4	100	0	0	0	0	100	0	60	75	
Koonmarra	21,950	8.8	2	31	81	16	3	0	0	32	68	878	1,098	
Millrose	8,710	3.5		8	87	0	13	0	0	38	62	348	436	
Mindura	6,000	2.4		6	100	0	0	0	0	50	50	240	300	
Norie	1,030	0.4		1	100	0	0	0	0	0	100	41	52	
Yarrameedie	6,530	2.6		9	100	0	0	0	0	67	33	261	327	
	45,720	18.3												
Very low pastoral potential														
Weld	5,180	2.0		23	100	0	0	0	26	61	13	173	173	
Totals	250,510	100.0	5,892	401	79	13	8	0	11	41	48	14,919	21,713	
Survey area average				13,621	83	11	5	1	21	37	42			

⁺ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* **Recommended carrying capacity over summer (if preceded by an effective winter season)** 14,920 dry sheep equivalents (dse).

** **Original carrying capacity over summer** 21,710 dse.

Milly Milly station

Lease area: 308,580 ha

Murchison shire
Murchison Land Conservation District
Mapsheet reference (1:250,000): Byro, Glenburgh,
Robinson Range

Area of various reserves, freehold and vacant crown land within managed area: 5799 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (37) summary score for whole lease: 44 (survey average = 50).

Traversed assessment (351 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
86	7	5	2	21	28	51

Major (mapped) areas of severe degradation and erosion (sde): 8730 (nearest 10 ha).

Land systems of Milly Milly station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Beringarra	16,240	5.3	8,015	41	12	29	42	17	0	10	90	502	2,320
Cunyu ⁺	370	0.1		0	79	16	4	1	13	29	58	28	53
	16,610	5.4											
Moderate pastoral potential													
Belele	62,120	20.1	233	113	93	6	1	0	19	29	52	3,728	5,177
Cole	710	0.2		1	100	0	0	0	0	100	0	44	59
Frederick	830	0.3		2	100	0	0	0	0	100	0	52	69
Horseshoe	9,290	3.0		7	100	0	0	0	29	71	0	637	774
Yanganoo	9,660	3.1		24	96	4	0	0	25	42	33	654	805
	82,610	26.7											
Low pastoral potential													
Beasley	1,620	0.5	233	1	100	0	0	0	0	100	0	65	81
Kalli ⁺	390	0.1		0	99	1	0	0	40	42	18	17	20
Koonmarra	80,370	26.1		93	95	5	0	0	13	28	59	3,310	4,019
Mindura	60,870	19.7		34	97	3	0	0	47	32	21	2,721	3,044
Millrose ⁺	120	< 0.1		0	85	11	4	0	15	39	46	5	6
Narryer	25,080	8.1		10	100	0	0	0	100	0	0	1,254	1,254
Thomas ⁺	12,110	3.9		0	97	0	3	0	0	100	0	484	606
Yandil	26,060	8.5	482	24	100	0	0	0	29	41	30	1,098	1,303
	206,620	67.0											
Very low pastoral potential													
Agamemnon	2,450	0.8		1	100	0	0	0	0	0	100	82	82
Peak Hill ⁺	290	0.1		0	100	0	0	0	0	0	100	10	10
	2,740	0.9											
Totals	308,580	100.0	8,730	351	86	7	5	2	21	28	51	14,691	19,682
Survey area average				13,621	83	11	5	1	21	37	42		

⁺ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* **Recommended carrying capacity over summer (if preceded by an effective winter season)** 14,690 dry sheep equivalents (dse).

** **Original carrying capacity over summer** 19,680 dse.

Moorarie station

Lease area: 137,450 ha

Meekatharra shire
Meekatharra Land Conservation District
Mapsheet reference (1:250,000): Robinson Range, Belele

Area of various reserves, freehold and vacant crown land within managed area: 11,273ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (18) summary score for whole lease: 40 (survey average = 50).

Traversed assessment (217 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
75	11	9	5	13	32	55

Major (mapped) areas of severe degradation and erosion (sde): 5490 (nearest 10 ha).

Land systems of Moorarie station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition									Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)					
					Nil	Minor	Mod.	Severe	Good	Fair	Poor			
High pastoral potential														
Beringarra	22,120	16.1	4,970	70	42	17	27	14	19	19	62	1,436	3,160	
Cunyu	1,310	0.9		3	100	0	0	0	0	33	67	85	187	
Mileura	<u>5,030</u>	<u>3.7</u>	420	6	83	0	0	17	0	33	67	302	719	
	28,460	20.7												
Moderate pastoral potential														
Belele	36,740	26.7		55	100	0	0	0	20	49	31	2,449	3,062	
Cole	13,760	10.0		10	100	0	0	0	0	50	50	860	1,147	
Flood	15,290	11.1		23	83	17	0	0	4	17	79	969	1,274	
Yanganoo ⁺	<u>210</u>	<u>0.2</u>		0	91	7	2	0	20	40	40	14	18	
	66,000	48.0												
Low pastoral potential														
Gabanintha ⁺	110	0.1		0	92	7	1	0	22	36	42	5	5	
Koonmarra	17,440	12.7		7	100	0	0	0	14	57	29	722	872	
Mindura	2,840	2.1		5	100	0	0	0	0	40	60	113	142	
Yandil	20,800	15.1		35	80	20	0	0	3	23	74	838	1,040	
Yarrameedie	<u>1,270</u>	<u>0.9</u>		3	100	0	0	0	0	100	0	51	64	
	42,460	30.9												
Very low pastoral potential														
Agamemnon ⁺	530	0.4		0	100	0	0	0	0	0	100	18	18	
Totals	137,450	100.0	5,486	217	75	11	9	5	13	32	55	7,862	11,708	
Survey area average				13,621	83	11	5	1	21	37	42			

⁺ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 7860 dry sheep equivalents (dse).

** Original carrying capacity over summer 11,710 dse.

Mt Farmer station

Mt Magnet shire
Mt Magnet Land Conservation District
Mapsheet reference (1:250,000): Cue

Lease area: 62,732 ha

Area of various reserves, freehold and vacant crown land within managed area: 0 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (7) summary score for whole lease: Insufficient sites (survey average = 50).

Traversed assessment (145 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
97	2	1	0	43	38	19

Major (mapped) areas of severe degradation and erosion (sde): 0 (nearest 10 ha).

Land systems of Mt Farmer station

Traversed assessment of land resource condition													
Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	No of obs	Soil erosion (%)				Perennial vegetation (%)			Rcc* (dse)	Occ** (dse)
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
Moderate pastoral potential													
Challenge	4,900	7.8		7	100	0	0	0	43	57	0	350	408
Sherwood	7,190	11.5		25	88	8	4	0	12	52	36	468	599
Violet	770	1.2		7	100	0	0	0	29	57	14	53	64
Wiluna ⁺	80	0.1		0	100	0	0	0	25	35	40	5	7
	12,940	20.6											
Low pastoral potential													
Jundee	3,360	5.4		70	91	9	0	0	18	55	27	140	168
Kalli	35,480	56.6		70	100	0	0	0	61	30	9	1,636	1,774
Norie ⁺	300	0.5		0	96	4	0	0	31	54	15	13	15
Woodline	9,940	15.8		22	100	0	0	0	41	23	36	438	497
Yarrameedie	250	0.4		2	100	0	0	0	0	50	50	10	13
	49,330	78.7											
Very low pastoral potential													
Farmer	460	0.7		1	100	0	0	0	0	100	0	15	15
Totals													
Totals	62,730	100.0		145	97	2	1	0	43	38	19	3,128	3,560
Survey area average													
				13,621	83	11	5	1	21	37	42		

⁺ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 3130 dry sheep equivalents (dse).

** Original carrying capacity over summer 3560 dse.

Mt Gould station (part)

Meekathara shire
Meekathara Land Conservation District
Mapsheet reference (1:250,000): Robinson Range

Lease area: 200,730 ha (part)

Area of various reserves, freehold and vacant crown land within managed area: 5058 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (24) summary score for whole lease: 29 (survey average = 50).

Traversed assessment (248 observations at 1 km intervals):

Nil	Soil erosion (%)				Perennial vegetation (%)		
	Minor	Moderate	Severe		Very good/good	Fair	Poor/very poor
88	7	4	1		2	20	78

Major (mapped) areas of severe degradation and erosion (sde): 4380 (nearest 10 ha).

Land systems of part of Mt Gould station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Beringarra	15,530	7.7	4,200	28	18	39	36	7	0	0	100	629	2,219
Mileura ⁺	<u>1,340</u>	<u>0.7</u>	180	0	74	19	6	1	31	37	32	114	191
	16,870	8.4											
Moderate pastoral potential													
Belele	1,800	0.9		8	100	0	0	0	0	62	38	113	150
Cole	39,990	20.0		44	93	7	0	0	0	9	91	2,499	3,333
Horseshoe	2,230	1.1		8	100	0	0	0	0	38	62	139	186
Trillbar	<u>6,300</u>	<u>3.1</u>		24	96	4	0	0	0	21	79	394	525
	50,320	25.1											
Low pastoral potential													
Gabanintha ⁺	840	0.4		0	92	7	1	0	22	36	42	35	42
Koonmarra	45,440	22.6		70	100	0	0	0	6	29	65	1,845	2,272
Millrose	1,650	0.8		4	100	0	0	0	0	50	50	66	83
Mindura	52,330	26.1		47	100	0	0	0	4	17	79	2,114	2,617
Thomas ⁺	5,570	2.8		0	97	0	3	0	29	39	32	239	279
Yandil	11,890	5.9		15	87	13	0	0	0	13	87	476	595
Yarrameedie ⁺	<u>140</u>	<u>0.4</u>		0	96	4	0	0	22	44	34	6	7
	117,860	58.7											
Very low pastoral potential													
Agamemnon ⁺	12,170	6.1		0	100	0	0	0	0	0	100	406	406
Peak Hill ⁺	2,840	1.4		0	100	0	0	0	0	0	100	95	95
Weld ⁺	<u>670</u>	<u>0.3</u>		0	100	0	0	0	59	36	5	22	22
	15,680	7.8											
Totals	200,730	100.0	4,380	248	88	7	4	1	2	20	78	9,192	13,022
Survey area average				13,621	83	11	5	1	21	37	42		

⁺ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* **Recommended carrying capacity over summer (if preceded by an effective winter season)** 9190 dry sheep equivalents (dse).

** **Original carrying capacity over summer** 13,020 dse.

Mt Hale station

Meekatharra shire
Meekatharra Land Conservation District
Mapsheet reference (1:250,000): Belele

Lease area: 97,173 ha

Area of various reserves, freehold and vacant crown land within managed area: 0 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (20) summary score for whole lease: 41 (survey average = 50).

Traversed assessment (199 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
98	2	0	0	12	31	57

Major (mapped) areas of severe degradation and erosion (sde): 0 (nearest 10 ha).

Land systems of Mt Hale station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
Moderate pastoral potential													
Belele	23,420	24.1		67	100	0	0	0	4	46	50	1,483	1,951
Flood ⁺	460	0.5		0	93	7	0	0	27	31	42	32	38
Wiluna	570	0.6		5	100	0	0	0	0	60	40	36	48
Yanganoo	5,090	5.2		19	100	0	0	0	5	26	69	324	424
	29,540	30.4											
Low pastoral potential													
Koonmarra	33,110	34.1		59	97	3	0	0	7	22	71	1,348	1,656
Mindura	17,380	17.9		12	92	8	0	0	0	17	83	695	869
Norie	870	0.9		1	100	0	0	0	0	0	100	35	44
Yandil	6,460	6.6		15	100	0	0	0	0	20	20	258	323
Yarrameedie	2,930	3.0		4	100	0	0	0	0	50	50	117	146
	60,750	62.5											
Very low pastoral potential													
Agamemnon ⁺	290	0.3		0	100	0	0	0	0	0	100	10	10
Weld	6,590	6.8		17	100	0	0	0	88	12	0	220	220
	6,880	7.1											
Totals	97,170	100.0		199	98	2	0	0	12	31	57	4,558	5,729
Survey area average				13,621	83	11	15	1	21	37	42		

⁺ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 4560 dry sheep equivalents (dse).

** Original carrying capacity over summer 5730 dse.

Mt Narryer station

Lease area: 193,403 ha

Murchison shire
Murchison Land Conservation District
Mapsheet reference (1:250,000): Byro

Area of various reserves, freehold and vacant crown land within managed area: 5546 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (30) summary score for whole lease: 40 (survey average = 50).

Traversed assessment (252 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
86	12	2	0	9	44	47

Major (mapped) areas of severe degradation and erosion (sde): 250 ha.

Land systems of Mt Narryer station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Beringarra ⁺	50	< 0.1	248	0	31	33	31	6	7	17	76	3	6
Cunyu	5,380	2.8		20	85	10	5	0	0	25	75	322	769
Ero ⁺	720	0.4		0	38	35	24	3	13	29	58	54	103
Wongong	19,230	9.9		30	87	13	0	0	7	40	53	1,399	2,747
	25,380	13.1											
Moderate pastoral potential													
Boulder	12,540	6.5		19	84	16	0	0	11	68	21	813	1,045
Breberle	3,400	1.8		8	100	0	0	0	13	38	49	222	283
Challenge	10,280	5.3		7	57	29	14	0	0	0	100	643	857
Liver	15,820	8.2		25	64	32	4	0	24	52	24	1,055	1,318
Sherwood	4,010	2.1		4	100	0	0	0	0	100	0	250	334
Yanganoo	19,970	10.3		49	98	2	0	0	8	45	47	1,281	1,664
	66,020	34.2											
Low pastoral potential													
Kalli	18,680	9.7		13	92	8	0	0	0	85	15	747	934
Millrose	5,630	2.9		11	100	0	0	0	27	46	27	241	282
Mindura ⁺	3,850	2.0		0	96	4	0	0	13	29	58	159	193
Narryer	38,810	20.1		42	81	14	5	0	5	33	62	1,572	1,941
Sandplain	18,440	9.5		1	100	0	0	0	0	100	0	738	922
Thomas ⁺	1,670	0.9		0	0	100	0	0	29	39	32	72	83
Waguin	5,910	3.0		9	78	22	0	0	22	33	45	249	296
Yandil	8,910	4.6		14	86	7	7	0	0	36	64	356	446
	101,900	52.7											
Very low pastoral potential													
Agamemnon ⁺	110	< 0.1		0	100	0	0	0	0	0	100	4	4
Totals	193,410	100.0	248	252	86	12	2	0	9	44	47	10,180	14,227
Survey area average				13,621	83	11	5	1	21	37	42		

⁺ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* **Recommended carrying capacity over summer (if preceded by an effective winter season)** 10,180 dry sheep equivalents (dse).

** **Original carrying capacity over summer** 14,230 dse.

Mt Padbury station (part)

Meekatharra shire

Meekatharra Land Conservation District

Lease area: 142,099 ha (part)

Mapsheet reference (1:250,000): Robinson Range, Belele

Area of various reserves, freehold and vacant crown land within managed area: 10,288 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (17) summary score for whole lease: 40 (survey average = 50).

Traversed assessment (189 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
91	7	1	1	18	31	51

Major (mapped) areas of severe degradation and erosion (sde): 2410 (nearest 10 ha).

Land systems of part of Mt Padbury station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Beringarra	1,240	0.9		1	100	0	0	0	0	100	0	103	177
Cunyu	3,740	2.6		5	80	20	0	0	0	20	80	228	534
	4,980	3.5											
Moderate pastoral potential													
Belele	2,080	1.5	2,411	5	100	0	0	0	40	60	0	148	173
Cole	1,810	1.3		12	75	25	0	0	0	0	100	113	151
Horseshoe	8,050	5.7		15	100	0	0	0	20	60	20	537	671
Trillbar	3,320	2.3		9	89	11	0	0	0	11	89	207	276
Violet ⁺	3,020	2.1		0	92	6	2	0	26	43	31	205	252
Wiluna ⁺	990	0.7		0	96	3	1	0	25	35	40	67	83
	19,270	13.6											
Low pastoral potential													
Beasley	7,880	5.5	2,411	3	100	0	0	0	67	33	0	368	394
Gabanintha ⁺	1,290	0.9		0	92	7	1	0	22	36	42	55	65
Jundee ⁺	210	0.1		0	91	7	2	0	16	33	51	9	11
Koonmarra	32,020	22.5		18	94	6	0	0	60	28	12	1,476	1,601
Millrose	4,480	3.2		8	75	25	0	0	0	75	25	179	224
Mindura	33,340	23.5		32	100	0	0	0	9	47	44	1,364	1,667
Yandil	19,230	13.5		61	86	8	3	3	8	18	74	688	962
Yarrameedie	13,160	9.3		20	95	5	0	0	40	25	35	579	658
	111,610	78.5											
Very low pastoral potential													
Peak Hill ⁺	6,240	4.4		0	100	0	0	0	0	0	100	208	208
Totals	142,100	100.0	2,411	189	91	7	1	1	18	31	51	6,534	8,107
Survey area average				13,621	83	11	5	1	21	37	42		

⁺ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 6530 dry sheep equivalents (dse).

** Original carrying capacity over summer 8110 dse.

Mt Wittenoom station

Yalgoo and Murchison shire
Murchison Land Conservation District
Mapsheet reference (1:250,000): Murgoo

Lease area: 79,053 ha

Area of various reserves, freehold and vacant crown land within managed area: 0 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (14) summary score for whole lease: 45 (survey average = 50).

Traversed assessment (140 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
80	16	4	0	19	43	38

Major (mapped) areas of severe degradation and erosion (sde): 250 (nearest 10 ha).

Land systems of Mt Wittenoom station

Land systems of the Macintyre catchment													
Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Beringarra	990	1.2	250	4	25	75	0	0	25	75	0	97	141
Ero ⁺	230	0.3		0	38	35	24	3	10	25	65	16	33
	1,220	1.5											
Moderate pastoral potential													
Challenge	33,870	42.9	250	49	86	10	4	0	26	45	29	2,300	2,823
Sherwood	340	0.4		2	50	50	0	0	0	0	100	21	28
Tindalarra	11,630	14.7		39	82	13	5	0	21	53	26	762	969
Yanganoo	16,140	20.4		43	79	19	2	0	7	79	14	1,032	1,345
	61,980	78.4											
Low pastoral potential													
Kalli ⁺	1,720	2.2	250	0	99	1	0	0	40	42	18	76	86
Norie	14,130	17.9		3	100	0	0	0	67	33	0	660	707
	15,850	20.1											
Totals	79,050	100.0	250	140	79	19	2	0	7	30	63	4,964	6,132
Survey area average				13,621	83	11	5	1	21	37	42		

⁺ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* **Recommended carrying capacity over summer (if preceded by an effective winter season)** 4960 dry sheep equivalents (dse).

** **Original carrying capacity over summer** 6130 dse.

Muggon station

Murchison shire
Murchison Land Conservation District
Mapsheet reference (1:250,000): Byro

Lease area: 182,743 ha

Area of various reserves, freehold and vacant crown land within managed area: 0 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (19) summary score for whole lease: 77 (survey average = 50).

Traversed assessment (229 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
95	4	1	0	62	31	7

Major (mapped) areas of severe degradation and erosion (sde): 0 (nearest 10 ha).

Land systems of Muggon station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Holmwood	2,810	1.6		1	100	0	0	0	100	0	0	401	401
Weenyung	14,630	8.0		29	100	0	0	0	86	14	0	1,968	2,090
Wolarry	21,440	11.7		32	88	12	0	0	50	31	19	2,311	3,063
Wongong ⁺	<u>2,340</u>	<u>1.3</u>		0	77	18	5	0	13	32	55	177	334
	41,220	22.6											
Moderate pastoral potential													
Boulder	17,020	9.3		37	97	3	0	0	30	70	0	1,170	1,418
Liver	14,690	8.0		11	73	27	0	0	45	46	9	1,056	1,224
Mongolia	<u>7,920</u>	<u>4.3</u>		18	94	6	0	0	72	28	0	614	660
	39,630	21.6											
Low pastoral potential													
Badgeradda	7,740	4.3		12	75	8	17	0	42	25	33	342	387
Sandplain	<u>92,530</u>	<u>50.6</u>		89	100	0	0	0	75	21	4	4,395	4,627
	100,270	54.9											
Very low pastoral potential													
Woodrarrung ⁺	1,620	0.9		0	100	0	0	0	40	40	20	54	54
Totals	182,740	100.0		229	95	4	1	0	62	31	7	12,488	14,258
Survey area average				13,621	83	11	5	1	21	37	42		

⁺ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 12,490 dry sheep equivalents (dse).

** Original carrying capacity over summer 14,260 dse.

Murgoo station

Lease area: 208,017 ha

Area of various reserves, freehold and vacant crown land within managed area: 203 ha.

Murchison shire
Murchison Land Conservation District
Mapsheet reference (1:250,000): Murgoo

Soil and vegetation condition summary data (1986-87)

Condition sites (28) summary score for whole lease: 59 (survey average = 50).

Traversed assessment (452 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
79	15	6	0	14	47	39

Major (mapped) areas of severe degradation and erosion (sde): 8700 (nearest 10 ha).

Land systems of Murgoo station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Beringarra	28,440	13.7	6431	76	36	34	29	1	10	18	72	1,615	4,063
Ero	6,050	2.9	1,713	34	29	59	9	3	0	24	76	281	864
Yewin	7,100	3.4		17	88	12	0	0	82	12	6	926	1,014
	41,590	20.0											
Moderate pastoral potential													
Challenge	49,970	24.0		79	92	8	0	0	18	59	23	3,310	4,164
Sherwood	1,920	0.9		5	100	0	0	0	20	80	0	128	160
Tindalarra	17,840	8.6	518	59	82	15	3	0	15	49	36	1,139	1,487
Yanganoo	73,190	35.2	43	158	79	15	6	0	11	54	35	4,739	6,099
	142,920	68.7											
Low pastoral potential													
Gabanintha ⁺	60	< 0.1		0	92	7	1	0	22	36	42	2	3
Jundee	380	0.2		3	100	0	0	0	0	100	0	15	19
Kalli	15,120	7.3		12	100	0	0	0	8	59	33	617	756
Norie	5,440	2.6		3	67	33	0	0	67	33	0	254	272
Waguin	2,260	1.1		6	83	17	0	0	0	67	33	91	113
Yarrameedie ⁺	250	0.1		0	96	4	0	0	22	43	35	10	12
	23,510	11.3											
Totals	208,020	100.0	8,705	452	79	15	6	0	14	47	39	13,127	19,026
Survey area average				13,621	83	11	5	1	21	37	42		

⁺ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 13,130 dry sheep equivalents (dse).

** Original carrying capacity over summer 19,030 dse.

Nallan station

Lease area: 98,886 ha

Area of various reserves, freehold and vacant crown land within managed area: 181 ha.

Cue shire

Cue Land Conservation District

Mapsheet reference (1:250,000): Cue

Soil and vegetation condition summary data (1986-87)

Condition sites (17) summary score for whole lease: 45 (survey average = 50).

Traversed assessment (178 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
84	11	4	1	13	42	45

Major (mapped) areas of severe degradation and erosion (sde): 1200 (nearest 10 ha).

Land systems of Nallan station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Cunyu	3,970	4.0		14	93	0	7	0	21	50	29	348	567
Moderate pastoral potential													
Millex	3,790	3.8	186	11	91	0	9	0	0	64	36	225	316
Sherwood	7,000	7.1	716	11	18	64	9	9	9	36	55	406	584
Violet	2,600	2.6		16	100	0	0	0	6	50	44	166	217
Wiluna	3,280	3.3		7	86	14	0	0	14	72	14	215	273
Yandil	5,900	6.0	189	26	66	19	15	0	0	0	100	357	491
Yanganoo	15,250	15.5	109	33	82	15	3	0	6	49	45	965	1,271
	31,920	32.3											
Low pastoral potential													
Gabanintha ⁺	1,310	1.3		0	92	7	1	0	22	36	42	55	65
Jundee	3,890	3.9		15	100	0	0	0	0	33	67	156	195
Kalli	31,690	32.0		23	100	0	0	0	43	57	0	1,404	1,585
Koonmarra	6,420	6.5		7	86	14	0	0	0	29	71	257	321
Mindura	1,040	1.1		1	100	0	0	0	0	0	100	42	52
Waguin ⁺	710	0.7		0	92	8	0	0	22	46	32	30	36
Woodline	12,040	12.2		14	100	0	0	0	43	50	7	533	602
	63,000	63.7											
Totals	98,890	100.0	1,200	178	84	11	4	1	13	42	45	5,159	6,575
Survey area average				13,621	83	11	5	1	21	37	42		

⁺ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 5160 dry sheep equivalents (dse).

** Original carrying capacity over summer 6570 dse.

Narloo station

Lease area: 14,998 ha

Yalgoo shire
Yalgoo Land Conservation District
Mapsheet reference (1:250,000): Murgoo

Area of various reserves, freehold and vacant crown land within managed area: 0 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (4) summary score for whole lease: Insufficient sites (survey average = 50).

Traversed assessment (22 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
95	0	0	0	0	14	86

Major (mapped) areas of severe degradation and erosion (sde): 0 (nearest 10 ha).

Land systems of Narloo station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
Moderate pastoral potential													
Challenge	7,630	50.9		8	100	0	0	0	0	12	88	477	636
Tindalarra	3,200	21.3		12	77	23	0	0	8	25	67	205	267
	10,830	72.2											
Low pastoral potential													
Kalli	2,970	19.8		2	100	0	0	0	0	50	50	119	149
Norie ⁺	750	5.0		0	96	4	0	0	31	54	17	32	38
Waguin ⁺	450	3.0		0	83	17	0	0	17	66	17	19	23
	4,170	27.8											
Totals	15,000	100.0		22	95	5	0	0	0	14	86	852	1,113
Survey area average				13,621	83	11	5	1	21	37	42		

⁺ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* **Recommended carrying capacity over summer (if preceded by an effective winter season)** 850 dry sheep equivalents (dse).

** **Original carrying capacity over summer** 1110 dse.

New Forest station

Lease area: 93,175 ha

Area of various reserves, freehold and vacant crown land within managed area: 0 ha.

Murchison shire

Murchison Land Conservation District

Mapsheet reference (1:250,000): Murgoo

Soil and vegetation condition summary data (1986-87)

Condition sites (11) summary score for whole lease: 33 (survey average = 50).

Traversed assessment (196 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
87	10	2	1	19	42	39

Major (mapped) areas of severe degradation and erosion (sde): 380 (nearest 10 ha).

Land systems of New Forest station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Coolabulla ⁺	260	0.3		0	92	8	0	0	0	8	92	15	37
Moderate pastoral potential													
Bunny	2,550	2.7		14	100	0	0	0	36	43	21	179	213
Mongolia	3,970	4.3		15	100	0	0	0	27	46	27	270	331
Outcamp ⁺	10	< 0.1		0	8	42	42	8	0	17	83	1	1
Tindalarra	<u>1,400</u>	<u>15.0</u>	381	61	82	15	3	0	0	46	54	851	1,167
	20,530	22.0											
Low pastoral potential													
Gabanintha ⁺	230	0.2		0	92	7	1	0	22	36	42	10	12
Kalli	7,900	8.5		14	100	0	0	0	0	36	64	316	395
Mindura ⁺	1,540	1.7		0	96	4	0	0	13	29	58	64	77
Narryer	19,980	21.5		43	76	19	5	0	9	44	47	817	999
Nerramyne	8,780	9.4		13	84	8	0	8	0	62	38	351	439
Sandplain	14,680	15.7		11	100	0	0	0	82	18	0	708	734
Waguin ⁺	270	0.3		0	92	8	0	0	22	46	32	11	14
Yalbalgo	<u>6,320</u>	<u>6.8</u>		16	94	6	0	0	56	38	6	288	316
	59,700	64.1											
Very low pastoral potential													
Woodrarrang	12,680	13.6		9	100	0	0	0	67	22	11	423	423
Totals	93,170	100.0	381	196	87	10	2	1	19	42	39	4,304	5,158
Survey area average				13,621	83	11	5	1	21	37	42		

⁺ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 4300 dry sheep equivalents (dse).

** Original carrying capacity over summer 5160 dse.

Nookawarra station

Lease area: 243,884 ha

Area of various reserves, freehold and vacant crown land within managed area: 162 ha.

Murchison shire
Murchison Land Conservation District
Mapsheet reference (1:250,000): Belele, Byro

Soil and vegetation condition summary data (1986-87)

Condition sites (30) summary score for whole lease: 37 (survey average = 50).

Traversed assessment (348 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
67	20	10	3	7	16	77

Major (mapped) areas of severe degradation and erosion (sde): 9380 (nearest 10 ha).

Land systems of Nookawarra station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Beringarra	12,310	5.0	4737	5	60	20	20	0	0	0	100	421	1,759
Cunyu ⁺	960	0.4		0	79	16	4	1	13	29	58	72	137
Ero	12,420	5.1	896	21	71	19	5	5	0	14	86	689	1,775
Mileura	4,890	2.0		22	55	27	18	0	0	5	95	279	699
Roderick ⁺	390	0.2		0	30	37	32	1	8	22	70	27	56
	30,970	12.7											
Moderate pastoral potential													
Belele	53,070	21.8	1,477	121	65	19	11	5	2	17	81	3,247	4,423
Sherwood	49,260	20.2	1,394	58	60	21	16	3	5	21	74	3,043	4,105
Yanganoo	31,330	12.8	873	70	67	23	9	1	19	21	60	2,028	2,611
	133,660	54.9											
Low pastoral potential													
Kalli	3,730	1.5		1	100	0	0	0	0	0	100	149	187
Koonmarra	39,700	16.3	5	27	85	15	0	0	0	4	96	1,588	1,985
Millrose	10,390	4.3		14	93	0	7	0	43	36	21	460	520
Mindura	10,550	4.3	1	2	0	100	0	0	0	0	100	422	528
Norie ⁺	9,330	3.8		0	96	4	0	0	31	54	15	402	467
Waguin ⁺	420	0.2		0	92	8	0	0	22	46	32	18	21
Yandil ⁺	80	< 0.1		0	84	11	4	1	7	21	60	3	4
Yarrameedie	3,270	1.3		7	100	0	0	0	0	0	100	131	164
	77,470	31.7											
Very low pastoral potential													
Weld ⁺	1,790	0.7		0	100	0	0	0	59	36	5	60	60
Totals	243,890	100.0	9,383	348	67	20	10	3	7	16	77	13,039	19,501
Survey area average				13,621	83	11	15	1	21	37	42		

⁺ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 13,040 dry sheep equivalents (dse).

** Original carrying capacity over summer 19,500 dse.

Norie station

Meekatharra shire
Meekatharra Land Conservation District
Mapsheet reference (1:250,000): Belele

Lease area: 22,703 ha

Area of various reserves, freehold and vacant crown land within managed area: 466 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (9) summary score for whole lease: Insufficient sites (survey average = 50).

Traversed assessment (61 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
87	13	0	0	0	11	89

Major (mapped) areas of severe degradation and erosion (sde): 660 (nearest 10 ha).

Land systems of Norie station

Traversed assessment of land resource condition													
Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	No of obs	Soil erosion (%)				Perennial vegetation (%)			Rcc* (dse)	Occ** (dse)
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Mileura ⁺	170	0.7		0	74	19	6	1	31	37	32	16	24
Moderate pastoral potential													
Belele ⁺	30	0.1		0	89	7	3	1	20	35	45	2	3
Sherwood	3,080	13.6	46	5	100	0	0	0	0	40	60	190	257
Violet	3,040	13.4		3	100	0	0	0	0	0	100	190	253
Wiluna	<u>810</u>	<u>3.6</u>		7	86	14	0	0	0	0	100	51	68
	6,960	30.7											
Low pastoral potential													
Gabanintha	2,610	11.5		14	93	7	0	0	0	21	79	104	130
Jundee	2,510	11.1	240	8	62	38	0	0	0	12	88	91	126
Koonmarra	1,280	5.7		6	67	33	0	0	0	0	100	51	64
Mindura	1,570	6.9		3	100	0	0	0	0	0	100	63	79
Norie	440	1.9		2	100	0	0	0	0	0	100	18	22
Yandil	<u>2,980</u>	<u>13.1</u>	370	12	92	8	0	0	0	8	92	104	149
	11,390	50.2											
Very low pastoral potential													
Yagahong	4,180	18.4		1	100	0	0	0	0	0	100	139	139
Totals	22,700	100.0	656	61	87	13	0	0	0	11	89	1,019	1,314
Survey area average				13,621	83	11	5	1	21	37	42		

⁺ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* **Recommended carrying capacity over summer (if preceded by an effective winter season)** 1020 dry sheep equivalents (dse).

** **Original carrying capacity over summer** 1310 dse.

Pinegrove station

Mullewa shire
Murchison Land Conservation District
Mapsheet reference (1:250,000): Murgoo

Lease area: 59,804 ha

Area of various reserves, freehold and vacant crown land within managed area: 5309 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (10) summary score for whole lease: 56 (survey average = 50).

Traversed assessment (131 observations at 1 km intervals):

Nil	Soil erosion (%)			Very good/good	Perennial vegetation (%)	
	Minor	Moderate	Severe		Fair	Poor/very poor
83	12	5	0	27	65	8

Major (mapped) areas of severe degradation and erosion (sde): 460 (nearest 10 ha).

Land systems of Pinegrove station

Traversed assessment of land resource condition													
Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	No of obs	Soil erosion (%)				Perennial vegetation (%)			Rcc* (dse)	Occ** (dse)
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Wolary	4,820	8.1	120	21	43	43	14	0	14	81	5	428	689
Moderate pastoral potential													
Boulder	860	1.4	310	3	100	0	0	0	0	100	0	54	72
Breberle	290	0.5		1	100	0	0	0	0	0	100	18	24
Challenge	1,190	2.0		5	100	0	0	0	0	80	20	74	99
Tindalarra	<u>7,680</u>	<u>12.8</u>		35	80	14	6	0	6	83	11	470	640
	10,020	16.7											
Low pastoral potential													
Kalli	17,680	29.6	30	24	100	0	0	0	71	29	0	833	884
Nerramyne	15,770	26.4		32	92	3	5	0	16	70	14	655	789
Nerren	<u>11,130</u>	<u>18.6</u>		5	100	0	0	0	100	0	0	557	557
	44,580	74.6											
Very low pastoral potential													
Eurardy	380	0.6		5	100	0	0	0	60	40	0	13	13
Totals	59,800	100.0	460	131	83	12	5	0	27	65	8	3,102	3,767
Survey area average				13,621	83	11	5	1	21	37	42		

+ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* **Recommended carrying capacity over summer (if preceded by an effective winter season)** 3100 dry sheep equivalents (dse).

** **Original carrying capacity over summer** 3770 dse.

Polelle station

Meekatharra shire
Meekatharra Land Conservation District
Mapsheet reference (1:250,000): Belele

Lease area: 90,173 ha

Area of various reserves, freehold and vacant crown land within managed area: 2785 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (18) summary score for whole lease: 49 (survey average = 50).

Traversed assessment (211 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
89	9	2	0	31	43	26

Major (mapped) areas of severe degradation and erosion (sde): 1340 (nearest 10 ha).

Land systems of Polelle station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Carnegie	1,780	2.0	324	14	93	7	0	0	93	7	0	246	254
Cunyu +	2,220	2.5		0	79	16	4	1	73	29	58	166	317
Ero	1,870	2.0		6	17	66	17	0	17	0	83	114	267
Mileura	<u>9,720</u>	<u>10.8</u>		31	90	10	0	0	35	52	13	978	1,389
	15,590	17.3											
Moderate pastoral potential													
Belele	1,030	1.1	586	4	100	0	0	0	25	75	0	70	86
Trillbar	1,260	1.4		7	71	29	0	0	71	29	0	97	105
Violet	3,920	4.3		13	77	15	8	0	31	23	46	270	326
Wiluna	16,110	17.9		53	96	4	0	0	32	49	19	1,114	1,343
Yanganoo	<u>12,160</u>	<u>13.5</u>		26	96	4	0	0	27	65	8	828	1,013
	34,480	38.2											
Low pastoral potential													
Gabanintha	14,020	15.6	586	8	88	12	0	0	13	38	49	579	701
Jundee	9,690	10.8		21	95	5	0	0	24	48	28	387	485
Koonmarra	550	0.6		1	100	0	0	0	0	100	0	22	28
Yandil	<u>8,840</u>	<u>9.8</u>		27	89	4	7	0	0	33	67	337	442
	33,100	36.8											
Very low pastoral potential													
Yagahong +	20	< 0.1		0	100	0	0	0	0	0	100	1	1
No pastoral potential													
Bare lakebed	6,980	7.7											
Totals	90,170	100.0	1,338	211	89	9	2	0	31	43	26	5,209	6,757
Survey area average				13,621	83	11	5	1	21	37	42		

+ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 5210 dry sheep equivalents (dse).

** Original carrying capacity over summer 6760 dse.

Twin Peaks station

Lease area: 132,415 ha

Murchison shire
Murchison Land Conservation District
Mapsheet reference (1:250,000): Murgoo

Area of various reserves, freehold and vacant crown land within managed area: 800 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (28) summary score for whole lease: 50 (survey average = 50).

Traversed assessment (observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
79	17	4	0	15	39	46

Major (mapped) areas of severe degradation and erosion (sde): 480 (nearest 10 ha).

Land systems of Twin Peaks station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Bayou	1,610	1.2	399	3	34	33	33	0	34	33	33	152	230
Cunyu	110	0.1		1	100	0	0	0	100	0	0	16	16
Ero	7,030	5.3		33	43	42	15	0	9	21	70	465	1,004
Roderick	3,520	2.7		9	56	44	0	0	11	33	56	262	503
Yewin	9,700	7.3	82	16	75	25	0	0	69	19	12	1,170	1,386
	21,970	16.6											
Moderate pastoral potential													
Bunny	1,650	1.3		7	71	29	0	0	0	14	86	103	138
Challenge	27,710	20.9		29	97	0	3	0	21	51	28	1,853	2,309
Tindalarra	23,190	17.5		66	74	23	3	0	6	44	50	1,478	1,933
Violet ⁺	910	0.7		0	92	6	2	0	26	42	32	62	76
Yanganoo	27,080	20.5		57	98	2	0	0	7	49	44	1,732	2,257
	80,540	60.9											
Low pastoral potential													
Gabanintha	1,390	1.0		2	100	0	0	0	0	50	50	56	70
Jundee ⁺	960	0.7		0	91	7	2	0	16	34	50	40	48
Kalli	16,050	12.1		14	100	0	0	0	36	43	21	700	803
Narryer	2,930	2.2		4	100	0	0	0	50	25	25	132	147
Norie ⁺	10	< 0.1		0	96	4	0	0	31	54	15	1	1
Waguin	8,570	6.5		16	87	13	0	0	6	31	63	355	429
	29,910	22.5											
Totals	132,420	100.0	481	257	79	17	4	0	15	39	46	8,577	11,350
Survey area average				13,621	83	11	5	1	21	37	42		

⁺ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* **Recommended carrying capacity over summer (if preceded by an effective winter season)** 8580 dry sheep equivalents (dse).

** **Original carrying capacity over summer** 11,350 dse.

Wanarie station

Mt Magnet shire
Mt Magnet Land Conservation District
Mapsheet reference (1:250,000): Cue

Lease area: 112,983 ha

Area of various reserves, freehold and vacant crown land within managed area: 869 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (19) summary score for whole lease: 48 (survey average = 50).

Traversed assessment (202 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
88	7	4	1	22	41	37

Major (mapped) areas of severe degradation and erosion (sde): 600 (nearest 10 ha).

Land systems of Wanarie station

Traversed assessment of land resource condition													
Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	No of obs	Soil erosion (%)				Perennial vegetation (%)			Rcc* (dse)	Occ** (dse)
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Austin	2,520	2.2	171	6	100	0	0	0	67	33	0	310	360
Carnegie	3,850	3.4		1	100	0	0	0	100	0	0	550	550
Cunyu +	560	0.5		0	79	16	4	1	13	29	58	42	80
Mileura	2,900	2.6		9	89	11	0	0	44	56	0	308	414
	9,830	8.7											
Moderate pastoral potential													
Challenge	12,730	11.3	100	29	86	7	7	0	14	69	17	827	1,061
Millex +	3,130	2.8	331	0	83	14	3	0	29	39	32	215	261
Sherwood	10,010	8.8		29	45	31	17	7	28	38	34	663	834
Violet	6,150	5.4		12	100	0	0	0	25	33	42	416	513
Wiluna	9,580	5.8		9	100	0	0	0	11	22	67	621	798
	41,600	36.8											
Low pastoral potential													
Gabanintha	4,680	4.2		9	100	0	0	0	56	22	22	213	234
Jundee	10,280	9.1		26	100	0	0	0	0	8	92	411	514
Kalli	8,400	7.4		11	100	0	0	0	45	46	9	374	420
Woodline	31,730	28.1		57	96	2	2	0	14	47	39	1,314	1,587
Yandil	1,150	1.0		4	100	0	0	0	25	75	0	49	58
	56,240	49.8											
No pastoral potential													
Bare lakebed	5,310	4.7											
Totals	112,980	100.0	602	202	88	7	4	1	22	41	37	6,313	7,684
Survey area average				13,621	83	11	5	1	21	37	42		

+ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 6310 dry sheep equivalents (dse).

** Original carrying capacity over summer 7680 dse.

Wondinong station

Mt Magnet and Cue shire
Mt Magnet Land Conservation District
Mapsheet reference (1:250,000): Cue

Lease area: 77,200 ha

Area of various reserves, freehold and vacant crown land within managed area: 260 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (12) summary score for whole lease: 60 (survey average = 50).

Traversed assessment (168 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
89	10	1	0	39	45	16

Major (mapped) areas of severe degradation and erosion (sde): 220 (nearest 10 ha).

Land systems of Wondinong station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
Very high pastoral potential													
Merbla	4,990	6.5	220	14	71	29	0	0	43	50	7	702	998
High pastoral potential													
Austin	190	0.2		3	67	33	0	0	33	67	0	20	27
Carnegie	5,925	7.7		10	90	10	0	0	70	20	10	724	846
Cunyu	810	1.1		3	100	0	0	0	0	33	67	40	116
Ero	1,420	1.8		3	0	67	33	0	0	34	66	92	203
Mileura	<u>12,870</u>	<u>16.7</u>	33	82	18	0	0	55	39	6	1,473	1,839	
	21,215	27.5											
Moderate pastoral potential													
Challenge	3,030	3.9		8	100	0	0	0	38	13	49	213	253
Millex	4,700	6.0		7	86	14	0	0	29	29	42	322	392
Sherwood	2,680	3.5		4	75	25	0	0	100	0	0	223	223
Yanganoo +	<u>1,460</u>	<u>1.9</u>		0	91	7	2	0	20	40	40	97	122
	11,870	15.3											
Low pastoral potential													
Kalli +	1,040	1.3		0	99	1	0	0	40	42	18	46	52
Naluthanna	2,410	3.1		10	100	0	0	0	80	20	0	116	121
Woodline	<u>30,230</u>	<u>39.2</u>		65	98	2	0	0	14	69	17	1,252	1,511
	33,680	43.6											
Very low pastoral potential													
Bullimore	3,850	5.0		8	100	0	0	0	87	13	0	128	128
No pastoral potential													
Bare lakebed	1,595	2.1											
Totals	77,200	100.0	220	168	89	10	1	0	39	45	16	5,448	6,831
Survey area average				13,621	83	11	5	1	21	37	42		

+ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 5450 dry sheep equivalents (dse).

** Original carrying capacity over summer 6830 dse.

Wooleen station

Murchison shire

Murchison Land Conservation District

Mapsheet reference (1:250,000): Murgoo, Byro

Lease area: 188,355 ha

Area of various reserves, freehold and vacant crown land within managed area: 3973 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (25) summary score for whole lease: 50 (survey average = 50).

Traversed assessment (280 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
74	13	10	3	26	36	38

Major (mapped) areas of severe degradation and erosion (sde): 1390 (nearest 10 ha).

Land systems of Wooleen station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Bayou	3,830	2.0	306	19	57	11	21	11	58	5	37	412	547
Beringarra	3,020	1.6		10	60	10	30	0	30	20	50	264	431
Cunyu	820	0.4		3	33	67	0	0	0	33	67	53	117
Ero	2,390	1.3		7	57	29	14	0	14	72	14	192	341
Roderick	15,640	8.3		35	29	31	40	0	6	26	68	1,064	2,234
Wooleen	5,500	2.9		11	91	9	0	0	45	46	9	592	786
Yewin ⁺	30	<u>≤ 0.1</u>	0	68	21	10	1	47	23	30	3	4	
	31,230	16.6											
Moderate pastoral potential													
Challenge	47,870	25.4	1	53	94	6	0	0	32	43	25	3,311	3,989
Sherwood	14,870	7.9	904	19	47	16	21	16	26	37	37	954	1,239
Tindalarra	80	< 0.1		3	100	0	0	0	67	0	33	6	7
Violet	3,850	2.0		6	100	0	0	0	66	17	17	294	321
Wiluna ⁺	1,260	0.7		0	96	3	1	0	25	35	40	85	105
Yanganoo	48,350	25.7	102	95	85	11	2	2	18	42	40	3,197	4,029
	116,280	61.7											
Low pastoral potential													
Gabanintha	1,070	0.6		1	100	0	0	0	100	0	0	54	54
Jundee	590	0.3		4	100	0	0	0	0	75	25	24	30
Kalli	16,600	8.8	2	5	100	0	0	0	60	40	0	763	830
Narryer ⁺	6,700	3.6	77	0	88	9	3	0	11	35	54	272	335
Norie	3,870	2.1		1	100	0	0	0	0	0	100	155	194
Sandplain ⁺	2,430	1.3		0	99	0	1	0	65	29	6	113	122
Waguin	3,430	1.8		6	100	0	0	0	0	33	67	137	172
Yarrameedie	430	<u>0.2</u>		2	100	0	0	0	50	50	0	19	22
	35,120	18.7											
Very low pastoral potential													
Woodrarrung ⁺	5,730	3.0		0	100	0	0	0	40	40	20	191	191
Totals	188,360	100.0	1,392	280	74	13	10	3	26	36	38	12,155	16,100
Survey area average				13,621	83	11	5	1	21	37	42		

⁺ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 12,150 dry sheep equivalents (dse).

** Original carrying capacity over summer 16,100 dse.

Woolgorong station

Mullewa shire
Murchison Land Conservation District
Mapsheet reference (1:250,000): Murgoo

Lease area: 115,974 ha

Area of various reserves, freehold and vacant crown land within managed area: 2518 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (21) summary score for whole lease: 52 (survey average = 50).

Traversed assessment (225 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
86	11	3	0	20	43	37

Major (mapped) areas of severe degradation and erosion (sde): 810 (nearest 10 ha).

Land systems of Woolgorong station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Coolabulla	3,750	3.2		12	92	8	0	0	0	8	92	217	536
Moderate pastoral potential													
Bunny	1,080	0.9	808	8	100	0	0	0	0	62	38	67	90
Challenge	18,750	16.2		29	97	3	0	0	3	49	48	1,184	1,563
Tindalarra	32,320	27.9		82	71	22	7	0	8	40	52	2,024	2,693
Violet	1,090	0.9		1	100	0	0	0	0	100	0	68	91
Yanganoo	6,320	5.5		16	81	19	0	0	25	50	25	428	527
	59,560	51.4											
Low pastoral potential													
Gabanintha ⁺	60	0.1		0	92	7	1	0	22	36	42	2	3
Kalli	19,910	17.2		33	100	0	0	0	52	36	12	900	996
Narryer ⁺	5,720	4.9		36	88	9	3	0	11	35	54	235	286
Nerramyne	19,890	17.1		0	97	3	0	0	36	50	14	867	995
Norie ⁺	780	0.7		0	96	4	0	0	31	54	15	33	39
Waguin	4,980	4.3		8	100	0	0	0	38	62	0	218	249
	51,340	44.3											
Very low pastoral potential													
Yagahong ⁺	1,320	1.1		0	100	0	0	0	0	0	100	44	44
Totals	115,970	100.0	808	225	86	11	3	0	20	43	37	6,287	8,112
Survey area average				13,621	83	11	5	1	21	37	42		

⁺ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 6290 dry sheep equivalents (dse).

** Original carrying capacity over summer 8110 dse.

Wynyangoo station

Mt Magnet and Cue shires
Mt Magnet Land Conservation District
Mapsheet reference (1:250,000): Cue

Lease area: 163,684 ha

Area of various reserves, freehold and vacant crown land within managed area: 0 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (27) summary score for whole lease: 67 (survey average = 50).

Traversed assessment (266 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
94	5	1	0	34	48	18

Major (mapped) areas of severe degradation and erosion (sde): 0 (nearest 10 ha).

Land systems of Wynyangoo station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
Very high pastoral potential													
Merbla	2,620	1.6		5	80	20	0	0	100	0	0	524	524
High pastoral potential													
Carnegie +	13,340	8.2		0	93	7	0	0	78	18	4	1,716	1,906
Mileura +	70	<0.1		0	74	19	6	1	31	37	32	7	10
	13,410	8.2											
Moderate pastoral potential													
Challenge	2,960	1.8		3	67	33	0	0	0	100	0	185	247
Millex	13,270	8.1		17	94	6	0	0	41	47	12	943	1,106
Sherwood	20,850	12.7		40	72	20	8	0	49	35	16	1,520	1,738
Violet +	10	<0.1		0	92	6	2	0	26	43	31	1	1
Wiluna +	580	0.4		0	96	3	1	0	25	35	40	39	48
Yanganoo +	3,850	2.4		0	91	7	2	0	20	40	40	257	321
	41,520	25.4											
Low pastoral potential													
Gabanintha +	280	0.2		0	92	7	1	0	22	36	42	12	14
Kalli	18,590	11.3		26	100	0	0	0	35	27	38	809	930
Naluthanna +	170	0.1		0	100	0	0	0	80	20	0	8	8
Waguin +	850	0.5		0	92	8	0	0	22	46	32	36	43
Woodline	69,450	42.4		162	99	1	0	0	24	58	18	2,938	3,473
	89,340	54.5											
Very low pastoral potential													
Bullimore	2,880	1.8		13	100	0	0	0	92	8	0	96	96
No pastoral potential													
Bare lakebed	13,910	8.5											
Totals	163,680	100.0		266	94	5	1	0	34	48	18	9,091	10,465
Survey area average				13,621	83	11	5	1	21	37	42		

+ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 9090 dry sheep equivalents (dse).

** Original carrying capacity over summer 10,460 dse.

Yallalong station

Lease area: 270,804 ha

Northampton and Murchison shires
Murchison Land Conservation District
Mapsheet reference (1:250,000): Murgoo, Byro

Area of various reserves, freehold and vacant crown land within managed area: 11,226 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (32) summary score for whole lease: 65 (survey average = 50).

Traversed assessment (373 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
78	14	7	1	29	42	29

Major (mapped) areas of severe degradation and erosion (sde): 4080 (nearest 10 ha).

Land systems of Yallalong station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition									Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)					
					Nil	Minor	Mod.	Severe	Good	Fair	Poor			
High pastoral potential														
Bayou	12,230	4.5	2,566	49	22	48	24	6	10	31	59	753	1,747	
Coolabulla +	440	0.2		0	92	8	0	0	0	8	92	25	63	
Cunyu	670	0.2		1	100	0	0	0	0	0	100	37	96	
Ero	1,090	0.4	181	3	0	33	67	0	0	0	100	51	156	
Holmwood	32,650	12.1	160	26	84	12	4	0	58	19	23	3,631	4,664	
Mileura	640	0.2		1	100	0	0	0	100	0	0	91	91	
Roderick	2,940	1.1		2	50	50	0	0	0	100	0	245	420	
Siberia	4,440	1.6		19	68	21	11	0	42	32	26	449	634	
Weenyung	610	0.2		4	100	0	0	0	100	0	0	87	87	
Wolarry	8,560	3.2		16	69	31	0	0	13	56	31	706	1,223	
Wongong +	2,110	0.8		0	77	18	5	0	13	32	55	160	301	
	66,380	24.5												
Moderate pastoral potential														
Boulder	5,360	2.0		9	89	11	0	0	22	34	44	360	447	
Bunny	14,470	5.3		38	97	3	0	0	26	61	13	983	1,206	
Liver	2,580	1.0		3	67	0	33	0	0	33	67	161	215	
Mongolia	33,320	12.3		39	94	3	3	0	28	41	31	2,277	2,777	
Outcamp	4,520	1.7	1,111	12	8	42	42	8	0	25	75	215	377	
Tindalarra	10,060	3.7		40	85	15	0	0	18	54	28	667	838	
Yanganoo	14,450	5.3		25	100	0	0	0	44	44	12	1,036	1,204	
	84,760	31.3												
Low pastoral potential														
Badgeradda	1,950	0.7		3	100	0	0	0	0	33	67	78	98	
Kalli	9,750	3.6		5	100	0	0	0	60	20	20	449	488	
Mindura +	3,020	1.1		0	96	4	0	0	13	29	58	125	151	
Narryer	11,530	4.3		13	100	0	0	0	15	62	23	478	577	
Nerramyne	10,870	4.0	62	21	95	5	0	0	24	71	5	458	544	
Nerren +	11,410	4.2		0	100	0	0	0	38	40	22	500	571	
Sandplain	53,220	19.7		43	95	0	5	0	51	40	9	2,400	2,661	
Yalbalgo +	3,080	1.1		0	94	6	0	0	56	38	6	140	154	
	104,830	38.7												
Very low pastoral potential														
Woodrarrung	14,830	5.5		1	100	0	0	0	0	100	0	494	494	
Totals	270,800	100.0	4,080	373	78	14	7	1	29	42	29	17,056	22,284	
Survey area average				13,621	83	11	5	1	21	37	42			

+ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 17,060 dry sheep equivalents (dse).

** Original carrying capacity over summer 22,280 dse.

Yarlarweelor station (part)

Meekatharra shire

Meekatharra Land Conservation District

Mapsheet reference (1:250,000): Robinson Range

Lease area: 157,792 ha (part)

Area of various reserves, freehold and vacant crown land within managed area: 9295 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (21) summary score for whole lease: 49 (survey average = 50).

Traversed assessment (184 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
95	5	0	0	9	26	65

Major (mapped) areas of severe degradation and erosion (sde): 920 (nearest 10 ha).

Land systems of part of Yarlarweelor station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition									Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)					
					Nil	Minor	Mod.	Severe	Good	Fair	Poor			
High pastoral potential														
Beringarra	6,930	4.4	621	5	40	60	0	0	0	0	100	351	990	
Moderate pastoral potential														
Belele	8,680	5.5	295	8	75	25	0	0	0	37	63	543	723	
Cole	43,320	27.5		50	98	2	0	0	6	14	80	2,743	3,610	
Trillbar	<u>6,330</u> 58,380	<u>4.0</u> 37.0		17	94	6	0	0	0	35	65	395	528	
Low pastoral potential														
Beasley	150	0.1		4	100	0	0	0	0	100	0	6	8	
Gabanintha +	1,320	0.8		0	92	7	1	0	22	36	42	56	66	
Koonmarra	36,030	22.8		42	100	0	0	0	10	28	62	1,477	1,802	
Mindura	46,700	29.6		48	96	4	0	0	15	22	63	1,938	2,335	
Thomas	2,140	1.4		4	100	0	0	0	75	25	0	101	107	
Yandil +	50	< 0.1		0	84	11	4	1	7	30	63	2	3	
Yarrameedie	<u>2,300</u> 88,690	<u>1.5</u> 56.2		4	100	0	0	0	0	75	25	92	115	
Very low pastoral potential														
Peak Hill	3,840	2.4		2	100	0	0	0	0	0	100	128	128	
Totals	157,790	100.0	916	184	95	5	0	0	9	26	65	7,832	10,415	
Survey area average				13,621	83	11	5	1	21	37	42			

+ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 7830 dry sheep equivalents (dse).

** Original carrying capacity over summer 10,410 dse.

Yarraquin station

Lease area: 131,864 ha

Cue and Sandstone shire
Cue Land Conservation District
Mapsheet reference (1:250,000): Cue

Area of various reserves, freehold and vacant crown land within managed area: 54 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (16) summary score for whole lease: 55 (survey average = 50).

Traversed assessment (221 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
81	14	5	0	20	42	38

Major (mapped) areas of severe degradation and erosion (sde): 1650 (nearest 10 ha).

Land systems of Yarraquin station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)	
				No of obs	Soil erosion (%)				Perennial vegetation (%)					
					Nil	Minor	Mod.	Severe	Good	Fair	Poor			
High pastoral potential														
Austin ⁺	280	0.2	1,281	0	73	18	9	0	33	39	28	27	40	
Carnegie	7,012	5.3		11	100	0	0	0	55	36	9	796	1,002	
Mileura ⁺	500	0.4		0	74	19	6	1	31	37	32	46	71	
	7,792	5.9												
Moderate pastoral potential														
Millex	3,880	2.9	1,281	12	100	0	0	0	0	25	75	243	323	
Sherwood	23,900	18.1		42	50	38	12	0	29	33	38	1,558	1,992	
Violet	7,480	5.7		23	82	9	9	0	0	43	57	468	623	
Wiluna	2,350	1.8		1	0	100	0	0	0	0	100	147	196	
Yanganoo	6,400	4.9	371	17	64	24	12	0	24	52	24	436	533	
	44,010	33.4												
Low pastoral potential														
Gabarintha	4,980	3.8		371	5	80	20	0	0	0	0	100	199	249
Jundee	490	0.4	6		100	0	0	0	50	33	17	22	25	
Kalli	18,400	13.9	28		93	7	0	0	36	57	7	802	920	
Woodline	49,030	37.2	76		87	8	4	1	13	45	42	2,010	2,452	
	72,900	55.3												
No pastoral potential														
Bare lakebed	7,158	5.4												
Totals	131,860	100.0	1,652	221	81	14	5	0	20	42	38	6,754	8,426	
Survey area average				13,621	83	11	5	1	21	37	42			

⁺ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* **Recommended carrying capacity over summer (if preceded by an effective winter season)** 6750 dry sheep equivalents (dse).

** **Original carrying capacity over summer** 8430 dse.

Yoothapina station (part)

Meekatharra shire
Meekatharra Land Conservation District
Mapsheet reference (1:250,000): Belele

Lease area: 113,638 ha (part)

Area of various reserves, freehold and vacant crown land within managed area: 6219 ha.

Soil and vegetation condition summary data (1986-87)

Condition sites (16) summary score for whole lease: 33 (survey average = 50).

Traversed assessment (203 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
89	8	3	0	7	27	66

Major (mapped) areas of severe degradation and erosion (sde): 1120 (nearest 10 ha).

Land systems of part of Yoothapina station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)	
				No of obs	Soil erosion (%)				Perennial vegetation (%)					
					Nil	Minor	Mod.	Severe	Good	Fair	Poor			
High pastoral potential														
Austin	2,840	2.5	1	4	100	0	0	0	0	50	50	197	406	
Cunyu	800	0.7		2	50	50	0	0	0	50	50	56	114	
	3,640	3.2												
Moderate pastoral potential														
Belele	4,000	3.5	1	9	100	0	0	0	0	56	44	250	333	
Sherwood	24,450	21.5		25	80	8	12	0	4	32	64	1,549	2,038	
Violet	5,260	4.6		7	100	0	0	0	0	43	57	329	438	
Wiluna	17,210	15.2		46	98	2	0	0	4	26	70	1,090	1,434	
	50,920	44.8												
Low pastoral potential														
Gabanintha +	2,670	2.3	1,116	0	92	7	1	0	22	36	42	113	134	
Jundee	2,200	1.9		4	100	0	0	0	50	25	25	99	110	
Kalli +	80	< 0.1		0	99	1	0	0	40	42	18	4	4	
Koonmarra	11,210	9.9		12	100	0	0	0	25	42	33	476	561	
Millrose	1,120	1.0		5	80	20	0	0	0	20	80	45	56	
Mindura	11,670	10.3		18	100	0	0	0	22	17	61	492	584	
Yandil	24,050	21.2		64	100	0	0	0	3	19	78	925	1,203	
Yarrameedie	2,590	2.3		5	77	17	6	0	0	40	60	104	130	
	55,590	48.9												
Very low pastoral potential														
Yagahong	3,490	3.1		2	100	0	0	0	0	0	100	116	116	
Totals	113,640	100.0	1,117	203	89	8	3	0	7	27	66	5,845	7,661	
Survey area average				13,621	83	11	5	1	21	37	42			

+ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 5840 dry sheep equivalents (dse).

** Original carrying capacity over summer 7660 dse.

Yuin station

Lease area: 189,807 ha

Area of various reserves, freehold and vacant crown land within managed area: 1313 ha.

Murchison and Yalgoo shires
Murchison Land Conservation District
Mapsheet reference (1:250,000): Murgoo

Soil and vegetation condition summary data (1986-87)

Condition sites (34) summary score for whole lease: 53 (survey average = 50).

Traversed assessment (377 observations at 1 km intervals):

Soil erosion (%)				Perennial vegetation (%)		
Nil	Minor	Moderate	Severe	Very good/good	Fair	Poor/very poor
83	11	5	1	16	47	37

Major (mapped) areas of severe degradation and erosion (sde): 2020 (nearest 10 ha).

Land systems of Yuin station

Land system	Area (nearest 10 ha)	% Area of lease	Mapped sde (ha)	Traversed assessment of land resource condition								Rcc* (dse)	Occ** (dse)
				No of obs	Soil erosion (%)				Perennial vegetation (%)				
					Nil	Minor	Mod.	Severe	Good	Fair	Poor		
High pastoral potential													
Ero	4,780	2.5	456	33	58	24	15	3	3	30	67	292	683
Yewin	12,190	6.4	871	37	54	24	19	3	22	32	46	971	1,741
	16,970	8.9											
Moderate pastoral potential													
Bunny	16,120	8.5	690	36	100	0	0	0	52	31	17	1,186	1,343
Challenge	41,320	21.8		76	92	7	1	0	16	63	21	2,720	3,443
Tindalarra	68,590	36.1		139	83	14	3	0	1	49	50	4,257	5,716
Violet+	700	0.4		0	92	6	2	0	26	43	31	48	58
Yanganoo+	2,440	1.3		0	91	7	2	0	20	40	40	163	203
	129,170	68.1											
Low pastoral potential													
Gabanintha	2,820	1.5		6	100	0	0	0	17	66	17	117	141
Kalli	18,210	9.6		20	100	0	0	0	30	55	15	783	911
Narryer	1,670	0.9		5	100	0	0	0	40	20	40	74	84
Norie	12,170	6.4		14	86	14	0	0	36	57	7	531	609
Waguin	8,800	4.6		11	100	0	0	0	36	37	27	384	440
	43,670	23.0											
Totals	189,810	100.0	2,017	377	83	11	5	1	16	47	37	11,526	15,372
Survey area average				13,621	83	11	5	1	21	37	42		

+ No traverse observations; erosion and vegetation condition figures are averages for the system over the whole survey area.

* Recommended carrying capacity over summer (if preceded by an effective winter season) 11,530 dry sheep equivalents (dse).

** Original carrying capacity over summer 15,370 dse.

Appendix 2.

Vascular plant species of the Murchison River catchment area

Botanical name	Collector	Type*	Common name
<i>Abutilon fraseri</i>	AAM1193	P	lantern bush
<i>Abutilon otocarpum</i>	MRS274	P	oval leaf
<i>Abutilon oxycarpum</i>	MRS1009	P	flannel weed
<i>Acacia acuminata</i>	MRS1045	P	jam
<i>Acacia andrewsii</i>	MRS467	P	
<i>Acacia aneura</i>	RJC5344	P	mulga
<i>Acacia aff. aneura</i>	RJC5345	P	mulga
<i>Acacia burkittii</i>	RJC5650	P	fine leaf jam
<i>Acacia citrinoviridis</i>	MRS71	P	
<i>Acacia colletioides</i>	MRS364	P	black mulga
<i>Acacia aff. coolgardiensis</i>	MRS111	P	sugar brother
<i>Acacia craspedocarpa</i>	RJC5235	P	hop mulga
<i>Acacia cuspidifolia</i>		P	wait-a-while
<i>Acacia cuthbertsonii</i>	MRS52	P	
<i>Acacia cyperophylla</i>	MRS58	P	
<i>Acacia daviesioides</i>	RJC5260	P	creekline miniritchie, red mulga
<i>Acacia 'demissa'</i>	MRS111	PE	Murchison willow
<i>Acacia distans</i>	RJC5310	P	black mulga
<i>Acacia eremaea</i>	MRS94	P	snakewood
<i>Acacia exocarpoides</i>	RJC5682	P	
<i>Acacia farnesiana</i>	AAM1333	P	sweet acacia, mimosa bush
<i>Acacia grasbyi</i>	RJC5159	P	miniritchie
<i>Acacia jibberdingensis</i>	RJC5259	P	
<i>Acacia kempeana</i>	RJC5333	P	witchetty bush
<i>Acacia ligulata</i>	MRS17	P	umbrella wattle, little cooba
<i>Acacia ligulata</i> X <i>tysonii</i>	RJC5406	P	
<i>Acacia linophylla</i>	RJC5432	P	bowgada
<i>Acacia longispinea</i>	RJC6076a	P	
<i>Acacia marramamba</i>	RJC5719	P	
<i>Acacia masliniana</i>	MRS	P	Maslin's wattle
<i>Acacia microcalyx</i>	RJC5375	P	
<i>Acacia murrayana</i>	RJC6091	P	sandplain wattle, fire wattle
<i>Acacia neurophylla</i>	MRS123	P	
<i>Acacia prainii</i>	MRS15	P	Prain's wattle
<i>Acacia pruinocarpa</i>	MRS	P	gidgee
<i>Acacia palustris</i>	MRS102	P	
<i>Acacia pyrifolia</i>	RJC5331	P	kanji
<i>Acacia quadrimarginea</i>	RJC5091	P	granite wattle, spreading wattle
<i>Acacia ramulosa</i>	RJC5101	P	wanyu, bowgada, horse mulga
<i>Acacia restiacea</i>	RJC5135	P	
<i>Acacia rhodophloia</i>	RJC5342	P	flat leaf miniritchie
<i>Acacia aff. rhodophloia</i>	RJC5429	P	flat leaf miniritchie
<i>Acacia roycei</i>	MRS465	P	
<i>Acacia saligna</i>	MRS247	P	golden wreath wattle
<i>Acacia scleroclada</i>	RJC6047	P	
<i>Acacia sclerophylla</i>	MRS450	P	hard leaf wattle
<i>Acacia sclerosperma</i>	RJC5573	P	limestone wattle, silver bark wattle
<i>Acacia sibina</i>	MRS16	P	
<i>Acacia stowardii</i>	MRS44	P	bastard mulga
<i>Acacia aff. subtessarogona</i>	MRS	P	
<i>Acacia tetragonophylla</i>	MRS	P	curara
<i>Acacia tysonii</i>	MRS184	P	
<i>Acacia victoriae</i>	MRS	P	prickly acacia, bardi bush,
<i>Acacia aff. xiphophylla</i>	MRS127	P	snakewood
<i>Acacia</i> sp. (P107)	MRS1024	P	
<i>Acacia</i> sp. (P48)	MRS1022	P	Speck's wattle
<i>Acacia</i> sp. (P95)	MRS95	P	
<i>Acacia</i> sp. (P59)	RJC5347	PE	Wilcox's wattle
<i>Acacia</i> sp.	MRS206	P	
<i>Acacia</i> sp.	MRS362	P	
<i>Acacia</i> sp.	RJC5365	P	
<i>Actinobole uliginosum</i>	RJC5552	A	flannel cudweed, camel dung
<i>Allocasuarina acutivalvis</i>	RJC6190	P	
<i>Alternanthera nodiflora</i>	RJC5426	A	common joyweed

Botanical name	Collector	Type*	Common name
<i>Alyogyne pinoniana</i>	RJC6230	P	sand hibiscus
<i>Amaranthus mitchellii</i>	RJC5442	A	Boggabri weed
<i>Ammannia multiflora</i>	RJC5410	A	
<i>Amphipogon strictus</i>	MRS173	P	greybeard grass
<i>Amyema benthamii</i>	RJC5204	P	
<i>Amyema fitzgeraldii</i>	RJC5175	P	pincushion mistletoe
<i>Amyema gibberulum</i> var. <i>gibberulum</i>	RJC5146	P	
<i>Amyema gibberulum</i> var. <i>tatei</i>	RJC6245	P	
<i>Amyema linophyllum</i> ssp. <i>linophyllum</i>	MRS1080	P	slender mistletoe
<i>Amyema microphyllum</i>	MRS1007	P	
<i>Amyema miquelii</i>	RJC5229	P	stalked mistletoe
<i>Amyema nestor</i>	RJC5331	P	
<i>Anagallis arvensis</i> var. <i>caerulea</i>	RJC5772	A W	blue pimpernel
<i>Angianthus connatus</i>	RJC6100	A	
<i>Angianthus milnei</i>	AAM734	A	cone spike angianthus
<i>Apium annuum</i>	RJC6234a	A	annual celery
<i>Arctotheca calendula</i>	RJC6220	A W	cape weed
<i>Aristida contorta</i>	RJC5372	A	windgrass
<i>Aristida chaetopoda</i>	RJC5974	P	
<i>Asphodelus fistulosus</i>	RJC5958	A W	onion weed
<i>Asteridea athrixoides</i>	RJC6323	A	
<i>Astroloma serratifolia</i>	MRS466	P	kondrung
<i>Atriplex amnicola</i>	RJC5112	P	river saltbush
<i>Atriplex bunburyana</i>	RJC5150	P	silver saltbush
<i>Atriplex ?cephalantha</i>	RJC5137	P	
<i>Atriplex cinerea</i>	RJC5130	P	grey saltbush
<i>Atriplex codonocarpa</i>	RJC5563	A	flat topped saltbush
<i>Atriplex holocarpa</i>	RJC6241	A	pop saltbush
<i>Atriplex hymenotheca</i>	MRS98	P	
<i>Atriplex lindleyi</i>	AAM795		
<i>Atriplex macropterocarpa</i>	RJC5976	A	
<i>Atriplex nana</i>	MRS1062	P	
<i>Atriplex paludosa</i> ssp. <i>moquiniana</i>	MRS1032	P	marsh saltbush
<i>Atriplex quinii</i>	RJC5349	P	
<i>Atriplex semilunaris</i>	RJC5203	A	annual saltbush
<i>Atriplex vesicaria</i>	RJC5973	P	bladder saltbush
<i>Baeckea cryptandroides</i>	MRS352	P	
<i>Bergia</i> aff. <i>perennis</i>	RJC5157	P	
<i>Beyeria brevifolia</i> var. <i>robustius</i>	MRS328	P	
<i>Blackallia connata</i>		P	
<i>Boerhavia coccinea</i>	RJC5303	A	tar vine
<i>Boerhavia repleta</i>	RJC5916	A	tar vine
<i>Borya nitida</i>	MRS1058	P	pincushion plant
<i>Bothriochloa ewartiana</i>	RJC5453	P	desert bluegrass
<i>Brachyachne prostrata</i>	RJC5316	A	
<i>Brachychiton gregorii</i>	MRS374	P	desert kurrajong
<i>Brachycome cheilocarpa</i>		A	
<i>Brachycome ciliocarpa</i>	RJC5501	A	ciliate fruit daisy
<i>Brachycome iberidifolia</i>	RJC5741	A	Swan River daisy
<i>Brachycome oncocarpa</i>	JGM9	A	swollen fruit daisy
<i>Brassica tournefortii</i>	MRS185	A W	Mediterranean turnip
<i>Bromus arenarius</i>	RJC6064	A	sand brome
<i>Brunonia australis</i>		A	native cornflower
<i>Brachysema aphylla</i>		P	ribbon pea
<i>Bursaria occidentalis</i>	RJC6078a	P	blackthorn
<i>Calandrinia brevipedata</i>	RJC5944	A	short stalk purslane
<i>Calandrinia creethae</i>	RJC6194	A	
<i>Calandrinia eremaea</i>	RJC5676	P	twining purslane
<i>Calandrinia polyandra</i>	RJC6223	A	parakeelya, junga
<i>Calandrinia ptychosperma</i>	RJC5946	P	
<i>Calandrinia pumila</i>	RJC5444	P	sunray
<i>Calandrinia</i> sp.	RJC6042	A	
<i>Callistemon phoeniceus</i>	MRS246	P	lesser bottlebrush
<i>Callitris columellaris</i>	RJC5661	P	native pine
<i>Callitris verrucosa</i>	RJC5574	P E	inland warted cypress
<i>Calocephalus</i> aff. <i>platycephalus</i>	RJC6271	A	billy buttons
<i>Calocephalus francisii</i>	RJC5875	A	daisy button
<i>Calocephalus knappii</i>	AAM749	A	
<i>Calocephalus multiflorus</i>	RJC6183	A	yellow-top
<i>Calothamnus kalbarriensis</i>	MRS462	P	Kalbarri bottlebrush
<i>Calotis hispidula</i>	RJC5551	A	bindii, hairy burr daisy
<i>Calotis multicaulis</i>	RJC5232	A	many stemmed burr daisy

Botanical name	Collector	Type*	Common name
<i>Calycopeplus ephedroides</i>	MRS18	P	
<i>Calytrix desolata</i>	RJC5341	P	
<i>Calytrix divergens</i>	RJC5483	P	
<i>Calytrix erosipetala</i>		P	
<i>Calytrix glutinosa</i>	MRS146	P	
<i>Calytrix aff. strigosa</i>	RJC6226	P	
<i>Calytrix verruculosa</i>		P E	
<i>Canthium attenuatum</i>	RJC5385	P	
<i>Canthium latifolium</i>	RJC5366	P	wild lemon, wild currant
<i>Canthium lineare</i>		P	native currant
<i>Carpobrotus aff. virescens</i>	MRS435	P	stout pigface
<i>Cassia artemisioides</i>	RJC6218	P	silver cassia
<i>Cassia charlesiana</i>	MRS30	P	
<i>Cassia chatelainiana</i>	RJC5647	P	green cassia
<i>Cassia desolata</i>		P	grey cassia
<i>Cassia hamersleyensis</i>	RJC5435	P	creeping cassia
<i>Cassia helmsii</i>	RJC5646	P	crinkled cassia
<i>Cassia luerssenii</i>	RJC5183	P	white cassia
<i>Cassia nemophila</i> var. <i>nemophila</i>	RJC5194	P	desert cassia
<i>Cassia nemophila</i> var. <i>platypoda</i>	RJC6102	P	
<i>Cassia oligophylla</i>		P	blood bush
<i>Cassia phyllodinea</i>	MRS204	P	banana leaf cassia
<i>Cassia pleurocarpa</i>	MRS287	P	ribfruit senna
<i>Cassia pruinosa</i>	RJC5613	P	white cassia
<i>Cassia sturtii</i>	RJC5243	P	variable cassia
<i>Cassytha aurea</i> var. <i>aurea</i>	RJC6213	P	dodder laurel
<i>Casuarina obesa</i>	RJC5142	P	sheoak, swamp oak
<i>Cenchrus ciliaris</i>	MRS	A	buffel grass
<i>Cenchrus setiger</i>		A W	Birdwood grass
<i>Centaurea melitensis</i>	RJC6144	A W	Maltese cockspur
<i>Centaureum spicatum</i>	RJC6321	A W	spike centaury
<i>Centipeda cunninghamii</i>	RJC5354	A	common sneezewood
<i>Centrolepis</i> sp.	RJC5699	A	
<i>Cephalopterum drummondii</i>	RJC5503	A	pompom head
<i>Chamaelaucium micranthum</i>	MRS1043	P	wax flower
<i>Chara</i> sp.	RJC6246	A	
<i>Chenopodium auricomum</i>	AAM1424	P	northern bluebush
<i>Chenopodium gaudichaudianum</i>	RJC5399	P	scrambling saltbush
<i>Chenopodium melanocarpum</i>	DGW3440	A	black crumbweed
<i>Chenopodium murale</i>	RJC5559	A	nettle leaf goosefoot
<i>Chenopodium nitriaceum</i>	MRS316	P	nitre goosefoot
<i>Chenopodium saxatile</i>	RJC5657	A	
<i>Cheiranthra filifolia</i> var. <i>simplicifolia</i>	MRS1059	P	
<i>Cheilanthes austrotenuifolia</i>	RJC5099	P	rock fern
<i>Cheilanthes lasiophylla</i>	RJC5659	P	woolly cloak fern
<i>Chloris</i> sp.	RJC6307	P?	
<i>Chorizema ericifolium</i>	MRS257	P	
<i>Chorizema genistoides</i>	MRS411	P	
<i>Chrysocoryne pusilla</i>	RJC6052	A	dwarf angianthus
<i>Chrysopogon fallax</i>	RJC5299	P	ribbon grass, golden beard grass
<i>Chthonocephalus pseudevax</i>	RJC5498	A	woolly groundhead
<i>Cleome oxalidea</i>	RJC5381	A	
<i>Codonocarpus cotinifolius</i>	RJC5140	P	native poplar, desert poplar
<i>Comesperma integerrimum</i>	RJC6110	P	
<i>Commicarpus australis</i>	RJC6276	P	perennial tar vine
<i>Convolvulus erubescens</i>	RJC6215	P	four black seeds
<i>Corchorus walcottii</i>	RJC5927	P	woolly corchorus
<i>Cotula australis</i>	RJC5667	A	common cotula
<i>Crassula colorata</i>	RJC5505	A	dense crassula
<i>Crassula pedicellosa</i>	RJC6160	A	
<i>Cratystylis subspinescens</i>	MRS1343	P	sage
<i>Cryptandra</i> sp.	MRS331	P	
<i>Cucumis myriocarpus</i>	RJC5441	A	paddy melon
<i>Cuphonotus andraeanus</i>	RJC5493	A	
<i>Cuscuta australis</i>	MRS181	A	Australian dodder
<i>Cynodon dactylon</i>	MRS	P	couch grass
<i>Cymbopogon ambiguus</i>	RJC5415	P	lemon scented grass
<i>Cymbopogon aff. ambiguus</i>	RJC5322	P	curly leaf scented grass
<i>Cynanchum floribundum</i>	RJC5221	P	dumara bush
<i>Cyperus alterniflorus</i>	RJC6063	P	
<i>Cyperus bifax</i>	MRS62	P	downs nutgrass
<i>Cyperus aff. concinnus</i>	RJC5852	P	

Botanical name	Collector	Type*	Common name
<i>Cyperus gymnocaulos</i>	RJC5885	P	spiny flat sedge
<i>Cyperus iria</i>	RJC5307	A	
<i>Cyperus rigidellus</i>	RJC5158	A	
<i>Cyperus squarrosus</i>	RJC5325	A	curry sedge
<i>Cyperus</i> sp.	MRS1040	A	
<i>Dactyloctenium radulans</i>	RJC5309	A	button grass
<i>Darwinia</i> aff. <i>diosmoides</i>	RJC6304	P	
<i>Darwinia capitellata</i>	MRS337	P	
<i>Daucus glochidiatus</i>	MRS143	A	Australian carrot
<i>Dianella revoluta</i>	AAM774	P	native flax lily
<i>Dicladantha forrestii</i>	RJC5427	P	
<i>Dicrastylis fulva</i>	RJC6157	P	
<i>Didymanthus roei</i>	RJC6148	P	
<i>Dielitzia tysonii</i>	RJC5497	A	
<i>Digitaria brownii</i>	MRS105	P	cotton panic grass
<i>Diplachne muelleri</i>	RJC5313	P	brown beetle grass
<i>Disphyma crassifolium</i>	MRS653	P	round leaf pigface
<i>Dissocarpus paradoxus</i>	MRS69	A	cannon balls, curious bassia
<i>Dodonaea boroniifolia</i>	MRS1035	P	
<i>Dodonaea</i> aff. <i>caespitosa</i>	MRS92	P	
<i>Dodonaea</i> aff. <i>inaequifolia</i>	MRS363	P	
<i>Dodonaea microzyga</i> var. <i>acrolobata</i>	MRS1070	P	
<i>Dodonaea microzyga</i> hybrid	RJC6149	P	
<i>Dodonaea pachyneura</i>	RJC5475	P	
<i>Dodonaea petiolaris</i>	RJC6290	P	
<i>Dodonaea piniifolia</i>	MRS1044	P	
<i>Dodonaea rigida</i>	MRS387	P	
<i>Dodonaea viscosa</i> ssp. <i>angustissima</i>	RJC5479	P	
<i>Dodonaea viscosa</i> ssp. <i>mucronata</i>	RJC6078	P	
<i>Dodonaea viscosa</i> ssp. <i>viscosa</i>	MRS273	P	sticky hopbush
<i>Drosera bulbosa</i>	RJC5075	A	red leaved sundew
<i>Drosera bulbosa</i> ssp. <i>major</i>		A	
<i>Drosera glanduligera</i>	RJC6147	P	scarlet sundew
<i>Drosera indica</i>	RJC5411	A	sundew
<i>Drosera macrantha</i>	MRS402	A	bridal rainbow
<i>Drosera macrantha</i> ssp. <i>eremaea</i>		A	
<i>Drummondita miniata</i>	MRS344	P E	
<i>Drummondita</i> sp.	AAM1542	P E	
<i>Duboisia hopwoodii</i>	RJC6076	P	pituri
<i>Dysphania glandulosa</i>	RJC5380	A E	
<i>Dysphania glomulifera</i>	RJC5581	A	
<i>Dysphania glomulifera</i> ssp. <i>eremaea</i>		A	
<i>Dysphania plantaginella</i>	RJC5357	A	
<i>Dysphania rhadinostachya</i>	RJC5236	A	
<i>Dysphania simulans</i>	RJC5980	A	
<i>Ecdeiocolea monostachya</i>	MRS449	P	
<i>Ehrharta longifolia</i>	RJC6169	A W	annual veldtgrass
<i>Elatine gratioloides</i>	RJC5477	P	waterwort
<i>Eleocharis pallens</i>	MRS293	P	pale spike rush
<i>Elytrophorus spicatus</i>	RJC5414	A	spikegrass
<i>Emex australis</i>		A W	doublegee
<i>Enchylaena tomentosa</i>	RJC5210	P	ruby saltbush
<i>Enneapogon caeruleus</i>	MRS144	A	limestone grass
<i>Enneapogon nigricans</i>	RJC5970	A	niggerhead grass
<i>Enneapogon oblongus</i>	AAM1195	P	purple head nineawn
<i>Enneapogon</i> sp.	MRS70	A	
<i>Enteropogon acicularis</i>	MRS	P	curly windmill grass, umbrella grass
<i>Eragrostis cumingii</i>	RJC5352	A	Cuming's lovegrass
<i>Eragrostis dielsii</i>		P	mallee lovegrass, lovegrass
<i>Eragrostis elongata</i>	MRS63	P	clustered lovegrass
<i>Eragrostis eriopoda</i>		P	wooly butt
<i>Eragrostis falcata</i>	MRS310	P	sickle lovegrass
<i>Eragrostis kennedyae</i>	RJC5306	P	small flower lovegrass
<i>Eragrostis lanipes</i>	MRS168	P	creeping wanderrie
<i>Eragrostis pergracilis</i>	RJC5374	P	
<i>Eragrostis setifolia</i>	RJC5454	P	neverfail
<i>Eragrostis xerophila</i>	MRS113	P	knottybutt grass
<i>Eragrostis</i> sp.	MRS45	A	
<i>Eremophea spinosa</i>	MRS163	P	
<i>Eremophila alternifolia</i>	MRS87	P	
<i>Eremophila clarkei</i>	MRS32	P	turpentine bush
<i>Eremophila compacta</i>	MRS5	P	compact poverty bush

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<i>Eremophila compacta</i> ssp. 'compacta'	MRS237	P	
<i>Eremophila compacta</i> ssp. 'fecunda'	MRS190	P	
<i>Eremophila delisseri</i>	MRS78	P	
<i>Eremophila ericalyx</i>	RJC6066	P	desert pride
<i>Eremophila exilifolia</i>	RJC5624	P	
<i>Eremophila</i> aff. <i>exilifolia</i>	RJC5205	P	
<i>Eremophila falcata</i>		P	
<i>Eremophila 'fasciata'</i>		P E	
<i>Eremophila 'flabellata'</i>	RJC5673	P E	
<i>Eremophila 'flaccida'</i>		P	
<i>Eremophila foliosissima</i>	MRS48	P E	
<i>Eremophila forrestii</i>		P	Wilcox bush
<i>Eremophila forrestii</i> ssp. <i>forrestii</i>	RJC5838	P	
<i>Eremophila forrestii</i> ssp. <i>hastieana</i>	RJC5918	P	
<i>Eremophila fraseri</i>	RJC5148	P	turpentine bush
<i>Eremophila fraseri</i> ssp. 'galeata'	RJC5911	P	
<i>Eremophila fraseri</i> ssp. 'parva'	RJC5926	P	
<i>Eremophila freelingii</i>	RJC5181	P	limestone fuchsia
<i>Eremophila georgei</i>	MRS2	P	
<i>Eremophila gibsonii</i>		P	turkey bush
<i>Eremophila gilesii</i>	MRS84	P	black fuchsia
<i>Eremophila glabra</i> ssp. <i>glabra</i>	MRS81	P	
<i>Eremophila glabra</i> group	MRS300	P	
<i>Eremophila 'glandulifera'</i>	MRS373	P	
<i>Eremophila glutinosa</i>	RJC5505	P	
<i>Eremophila granitica</i>	MRS182	P	
<i>Eremophila hughesii</i>	RJC5163	P	
<i>Eremophila 'hygrophana'</i>	RJC6313	P E	
<i>Eremophila imbricata</i>		P E	
<i>Eremophila 'jacunda'</i>	MRS404	P E	
<i>Eremophila laanii</i>		P E	
<i>Eremophila lachnocalyx</i>	MRS140	P E	woolly poverty bush
<i>Eremophila 'lanata'</i>	RJC5716	P	
<i>Eremophila latrobei</i>	RJC5672	P	warty leaf eremophila, warty fuchsia bush
<i>Eremophila latrobei</i> ssp. <i>glabra</i>	RJC5533	P	
<i>Eremophila latrobei</i> ssp. <i>latrobei</i>	RJC5152	P	
<i>Eremophila latrobei</i> X <i>forrestii</i>	MRS65	P	
<i>Eremophila linearis</i>	MRS87	P	saline fuchsia bush, harlequin fuchsia bush
<i>Eremophila longifolia</i>	RJC5305	P	berrigan, long leaved eremophila
<i>Eremophila mackinlayi</i>		P	desert pride
<i>Eremophila macmillaniana</i>	MRS50	P	grey turpentine bush
<i>Eremophila maculata</i>		P	fuchsia bush
<i>Eremophila maculata</i> ssp. <i>brevifolia</i>	RJC5600	P	
<i>Eremophila 'malacoides'</i>	MRS295	P	
<i>Eremophila</i> aff. 'malacoides'	MRS304	P	
<i>Eremophila margarethae</i>	RJC5698	P	sand bank poverty bush
<i>Eremophila miniata</i>	MRS327	P	limestone poverty bush
<i>Eremophila muelleriana</i>	MRS231	P	round leaved eremophila
<i>Eremophila oldfieldii</i>	RJC5645	P	pixie bush
<i>Eremophila oppositifolia</i> ssp. <i>angustifolia</i>	RJC5510	P	twin leaf eremophila
<i>Eremophila pantonii</i>	RJC5601	P	
<i>Eremophila phyllopoda</i> ssp. <i>phyllopoda</i>	RJC5913	P	
<i>Eremophila 'physocalyx'</i>	RJC5116	P E	
<i>Eremophila platycalyx</i>	MRS22	P	granite poverty bush
<i>Eremophila pterocarpa</i>	MRS96	P E	silver poverty bush
<i>Eremophila punctata</i>	RJC5718	P	
<i>Eremophila punicea</i>	MRS6	P	crimson eremophila
<i>Eremophila 'shonae</i> ssp. <i>diffusa'</i>	RJC5627	P E	
<i>Eremophila 'shonae</i> ssp. <i>shonae'</i>	RJC6192	P E	
<i>Eremophila 'simulans'</i>	MRS183	P	
<i>Eremophila spathulata</i>	MRS51	P E	grey poverty bush, spoon leaved eremophila
<i>Eremophila spectabilis</i>	MRS73	P E	showy eremophila
<i>Eremophila 'spuria'</i>	RJC6114	P E	
<i>Eremophila strongylophylla</i>	RJC5302	P	
<i>Eremophila willsii</i>	MRS101	P	
<i>Eremophila youngii</i> ssp. <i>youngii</i>	RJC5077	P	hook leaf poverty bush
<i>Eriachne</i> aff. <i>aristidea</i>	MRS133	P	false wanderrie
<i>Eriachne benthamii</i>	MRS292	P	swamp wanderrie
<i>Eriachne dominii</i>	RJC5338	A	
<i>Eriachne flaccida</i>	RJC5308	P	claypan grass
<i>Eriachne helmsii</i>	RJC6224	P	buck wanderrie

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<i>Eriachne mucronata</i>	RJC5177	P	mountain wanderrie
<i>Eriachne pulchella</i>	RJC6093	P	pretty wanderrie
<i>Eriochiton sclerolaenoides</i>	RJC5609	A	woolly bindii
<i>Eriostemon brucei</i> ssp. <i>brucei</i>	MRS9	P	noolburra
<i>Eriostemon brucei</i> ssp. <i>cinereus</i>	MRS175	P	
<i>Eriostemon glabra</i>	MRS21	P	
<i>Eriostemon sericeus</i>	MRS208	P	
<i>Erodium crinitum</i>	JGM148	A	corkscrew, crowsfoot
<i>Erodium cygnorum</i> ssp. <i>cygnorum</i>	RJC5704	A	blue crowsfoot
<i>Erythrina vespertilio</i>	MRS283	P	eelbia batwing coral tree
<i>Eucalyptus aspera</i>	MRS160	P	brittle range gum
<i>Eucalyptus camaldulensis</i>	RJC5177	P	river red gum
<i>Eucalyptus carnei</i>	MRS330	P	Carne's blackbutt
<i>Eucalyptus coolabah</i>	RJC5314	P	coolabah
<i>Eucalyptus dichromophloia</i>	RJC5393	P	bloodwood
<i>Eucalyptus ewartiana</i>	MRS442	P	Ewart's mallee
<i>Eucalyptus ferriticola</i>	RJC5656	P	
<i>Eucalyptus hypochlamydea</i>	MRS444	P	
<i>Eucalyptus incrassata</i>	MRS39	P	lerp mallee
<i>Eucalyptus kingsmillii</i>	MRS318	P	Kingsmill's mallee
<i>Eucalyptus lenziana</i>	RJC5393	P	narrow leaved bloodwood
<i>Eucalyptus leptopoda</i>	RJC6317	P	Tammin mallee
<i>Eucalyptus lucasii</i>	MRS334	P	Barlee box
<i>Eucalyptus obtusifolia</i>	MRS	P	Dongara mallee
<i>Eucalyptus oldfieldii</i>	MRS12	P	Oldfield's mallee
<i>Eucalyptus oleosa</i> var. <i>borealis</i>	MRS329	P	Ninghan mallee
<i>Eucalyptus petraea</i>	RJC6176	P	granite rock box
<i>Eucalyptus stenophylla</i>	AAM1332	P	
<i>Eucalyptus striatocalyx</i>	MRS299	P	kopi gum, Cue York gum
<i>Eucalyptus sublucida</i>	MRS314	P	
<i>Eulalia fulva</i>	RJC5440	P	silky brown top
<i>Euphorbia australis</i>	RJC5440	A	namana
<i>Euphorbia boophthona</i>	RJC5334	A	Gascoyne spurge
<i>Euphorbia drummondii</i>	RJC5315	A	caustic weed
<i>Euphorbia tannensis</i>	RJC5106	A	desert spurge
<i>Euphorbiaceae</i>	MRS1020	P	
<i>Exocarpos aphyllus</i>	RJC5428	P	leafless ballart, naked lady
<i>Exocarpos sparteus</i>	MRS460	P	broom ballart
<i>Fimbristylis dichotoma</i>	RJC5590	A	
<i>Fimbristylis</i> sp.	RJC5324	A	
<i>Frankenia cinerea</i>	RJC6094	P	
<i>Frankenia cordata</i>	MRS293	P	heart leaved frankenia
<i>Frankenia</i> aff. <i>desertorum</i>	MRS267	P	
<i>Frankenia</i> aff. <i>interioris</i> var. <i>interioris</i>	MRS256	P	
<i>Frankenia irregularis</i>	RJC6260	P	
<i>Frankenia magnifica</i>	MRS124	P	
<i>Frankenia pauciflora</i>	RJC5124	P	seaheath
<i>Frankenia setosa</i>	RJC5268	P	bristly frankenia
<i>Galium</i> sp.	RJC6132	A	
<i>Gastrolobium laytonii</i>	RJC5258	P	kite leaf poison, breelya
<i>Gilruthia osbornei</i>	RJC6067	A	
<i>Glossostigma diandrum</i>	RJC6327	A	
<i>Glossostigma</i> aff. <i>drummondii</i>	RJC5587	A	mudmat
<i>Glossostigma</i> sp.	RJC5477	A	
<i>Glycine clandestina</i>	RJC5588	P	twining glycine
<i>Glycine tabacina</i>	AAM1196	P	variable glycine
<i>Glycyrrhiza acanthocarpa</i>	AAM976	P	native liquorice
<i>Gnephosis burkittii</i>	RJC5496	A	
<i>Gnephosis eriocephala</i>	RJC6177	A	woolly headed gnephosis
<i>Gnephosis leptoclada</i>	AAM892	A	thin stemmed gnephosis
<i>Gnephosis skirrophora</i>	RJC6098	A	woolly gnephosis
<i>Gonocarpus nodulosus</i>	RJC5874	A	
<i>Goodenia berardiana</i>	RJC6061	A	
<i>Goodenia grandiflora</i>	RJC6024	P	large flowered goodenia
<i>Goodenia kingii</i>		P E	
<i>Goodenia occidentalis</i>	RJC6020	A	
<i>Goodenia peacockiana</i>		P	
<i>Goodenia pinnatifida</i>	RJC5156	A	cutleaf goodenia
<i>Goodenia</i> aff. <i>watsonii</i>	MRS1065	P	
<i>Goodenia</i> sp. nov.	RJC5351	P	
<i>Grevillea acacioides</i>	MRS407	P	
<i>Grevillea berryana</i>	RJC5378	P	Christmas tree

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<i>Grevillea brachystachya</i>	RJC5270	P	short styled grevillea
<i>Grevillea deflexa</i>	RJC5364	P	red grevillea
<i>Grevillea didymobotrya</i>	RJC6072	P	
<i>Grevillea dielsiana</i>	MRS455	P	
<i>Grevillea eriostachya</i>	MRS461	P	flame grevillea
<i>Grevillea aff. extorris</i>	RJC5253	P	
<i>Grevillea inconspicua</i>	MRS1028	P	Cue grevillea
<i>Grevillea juncifolia</i>	MRS406	P	honey suckle grevillea
<i>Grevillea obliquistigma</i>	MRS1	P	
<i>Grevillea paniculata</i>	RJC6171	P	
<i>Grevillea pityophylla</i>	RJC6162	P E	
<i>Grevillea sarissa</i>	RJC5086	P	wheel grevillea
<i>Grevillea stenobotrya</i>	MRS20	P	sand dune grevillea
<i>Grevillea stenostachya</i>		P	
<i>Grevillea striata</i>	MRS	P	beefwood
<i>Grevillea subtiliflora</i>		P E	
<i>Grevillea tenuiloba</i>	MRS447	P	
<i>Grevillea tetrapleura</i>		P	
<i>Grevillea sp.</i>	MRS413	P	
<i>Gunniopsis quadrifida</i>	MRS263	P	sweet samphire
<i>Gunniopsis rodwayi</i>	MRS227	A	
<i>Gunniopsis septifraga</i>	RJC6088	A	
<i>Gymnema sp.</i>	RJC5212	P	
<i>Gyrostemon ramulosus</i>	RJC5591	P	corkybark
<i>Hakea arida</i>	RJC5540	P	
<i>Hakea preissii</i>	RJC5185	P	needle bush
<i>Hakea recurva</i>	RJC5227	P	dart hakea, djarnokmurd
<i>Hakea suberea</i>	RJC5431	P	corkwood
<i>Hakea subsulcata</i>	MRS409	P	
<i>Halgania gustafsenii</i>	MRS172	P	
<i>Halgania preissiana</i>	MRS307	P	
<i>Haloragis gossei</i>	RJC6217	A	
<i>Haloragis odontocarpa</i>	RJC6038	A	mulga nettle
<i>Haloragis odontocarpa forma pterocarpa</i>	RJC6113	A	
<i>Haloragis trigonocarpa</i>	RJC5770	A	
<i>Halosarcia auriculata</i>	MRS348	P	samphire
<i>Halosarcia calyptrata</i>	MRS291	P	samphire
<i>Halosarcia doleiformis</i>	MRS270	P	samphire
<i>Halosarcia halocnemoides</i>	MRS286	P	shrubby samphire
<i>Halosarcia halocnemoides ssp. catenulata</i>	RJC1002	P E	samphire
<i>Halosarcia indica ssp. bidens</i>	MRS117	P	tall samphire
<i>Halosarcia peltata</i>	MRS262	P	samphire
<i>Halosarcia pergranulata</i>	MRS97	P	blackseed samphire
<i>Halosarcia pruinosa</i>	MRS142	P	samphire
<i>Halosarcia undulata</i>	MRS369	P	samphire
<i>Halosarcia sp. nov.</i>	MRS320	P	samphire
<i>Helichrysum ayersii</i>	RJC5778	A	
<i>Helichrysum davenportii</i>	RJC5660	A	rose-pink everlasting
<i>Heliotropium curassavicum</i>	RJC5121	A	smooth heliotrope
<i>Heliotropium europaeum</i>	RJC5224	A W	common heliotrope
<i>Heliotropium heteranthum</i>	RJC5589	P	mat heliotrope
<i>Heliotropium aff. ovalifolium</i>	RJC1026	P	
<i>Heliotropium tenuifolium</i>	RJC5320	P	mamukata
<i>Heliotropium undulatum</i>	RJC5403	P	
<i>Helipterum adpressum</i>	RJC6309	A	appressed-leaf sunray
<i>Helipterum battii</i>	RJC5922	A	
<i>Helipterum charsleyae</i>		A	
<i>Helipterum craspedioides</i>	RJC5502	A	billy buttons
<i>Helipterum floribundum</i>	RJC6255	A	large white sunray, flowery sunray
<i>Helipterum humboldtianum</i>	RJC5886	A	
<i>Helipterum manglesii</i>	RJC6158	A	pink sunray
<i>Helipterum maryonii</i>	RJC5614	A	
<i>Helipterum propinquum</i>	RJC5693	A	
<i>Helipterum pterochaetum</i>	MRS375	P	
<i>Helipterum splendidum</i>	JGM11	A	showy sunray
<i>Helipterum steriliscens</i>	RJC5602	A	infertile sunray
<i>Helipterum strictum</i>	RJC5746	A	glabrous sunray
<i>Helipterum tenellum</i>	RJC6105	A	slender sunray
<i>Helipterum venustum</i>	RJC5749	A	charming sunray
<i>Hemichroa diandra</i>	RJC5166	P	
<i>Hemigenia ?divaricata</i>		P	
<i>Hemigenia eutaxioides</i>	MRS80	P	

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<i>Hemigenia macphersonii</i>	MRS412	P	
<i>Hemigenia tysonii</i>	RJC5555	P	
<i>Hemigenia</i> sp.		P	
<i>Heterodendrum oleaefolium</i>	MRS	P	mingah bush, bullock bush, rosewood
<i>Hibiscus burtonii</i>	RJC5391	P	
<i>Hibiscus gardneri</i>		P	
<i>Hibiscus krichauffianus</i>		P	
<i>Hibiscus panduriformis</i>	MRS1018	P	yellow hibiscus
<i>Hibiscus sturtii</i>	MRS197	P	Sturt's hibiscus
<i>Hordeum leporinum</i>	RJC5738	A W	barley grass
<i>Hybanthus floribundus</i> ssp. <i>floribundus</i>	MRS400	P	
<i>Hypochaeris glabra</i>	RJC6049	A W	smooth cats ear
<i>Hypoxis occidentalis</i>	RJC5087	A	
<i>Indigofera australis</i>	RJC5164	P	Australian indigo
<i>Indigofera brevidens</i>	RJC5222	P	widji
<i>Indigofera georgei</i>	RJC5549	P	bovine indigo
<i>Indigofera</i> sp.	RJC5323	P	
<i>Ipomoea calobra</i>	RJC5300	A	weir vine
<i>Iseilema vaginiflorum</i>	AAM1189	A	red Flinders grass
<i>Iseilema</i> sp.	MRS59	A	
<i>Isoetes</i> sp.	RJC5218	A	
<i>Isoetopsis graminifolia</i>	JGM164	A	cushion grass
<i>Isolepis</i> cf. <i>congrua</i>	RJC5754	A	
<i>Isolepis inundata</i>	RJC5765	A	coarse club-rush
<i>Isotoma petraea</i>	RJC5929	A	rock isotome
<i>Ixiolaena leptolepis</i>	MRS359	P	plover daisy, stalked ixiolaena
<i>Jacksonia foliosa</i>	MRS85	P	
<i>Jacksonia</i> sp.	MRS426	P	
<i>Josephinia eugeniae</i>	AAM852	A	josephinia burr
<i>Juncus aridicola</i>	RJC6168	P	sedge
<i>Kennedia prorepens</i>		P	scarlet runner
<i>Keraudrenia nephrosperma</i>	MRS1037	P	
<i>Kippistia suaedifolia</i>	RJC5977	P	fleshy minuria
<i>Lachnostachys cliftonii</i>	MRS1076	P	big flannel plant
<i>Lamarchea hakeifolia</i>	MRS445	P	
<i>Lamarchea aurea</i>	RJC6146	A	goldentop
<i>Lawrencia chrysoderma</i>	MRS40	P	golden dunna dunna
<i>Lawrencia densiflora</i>	RJC5884	P	
<i>Lawrencia helmsii</i>		P	dunna dunna
<i>Lawrencia squamata</i>	MRS473	P	grey fan leaf
<i>Leichardtia australis</i>	RJC5238	P	cogla vine
<i>Lepidium echinatum</i>		P	
<i>Lepidium oxytrichum</i>	RJC5504	A	
<i>Lepidium platypetalum</i>	MRS317	P	slender pepper cress
<i>Lepidium scandens</i>	RJC6211	P	
<i>Lepidium xylodes</i>	MRS55	P	
<i>Lepidium</i> aff. <i>xylodes</i>	MRS1017	P	
<i>Lepidobolus preissianus</i>	MRS453	P	
<i>Leucopogon</i> sp.	MRS392	P	
<i>Levenhookia leptantha</i>	RJC6090	A	
<i>Lipocarpa microcephala</i>	RJC5326	A	
<i>Lobelia winfridae</i>	RJC6069	A	little lobelia
<i>Lophochloa pumila</i>	RJC5669	A W	rougtail
<i>Lotus australis</i>	MRS24	A	austral trefoil
<i>Lotus cruentus</i>		A	red flowered lotus
<i>Lycium australe</i>	RJC5969	P	Australian boxthorn, water bush
<i>Lysiana exocarpi</i>	RJC5458	P	harlequin mistletoe
<i>Lysiana murrayi</i>	RJC5122	P	parka parka
<i>Maireana amoena</i>	MRS23	P	five winged bluebush
<i>Maireana aphylla</i>		P	spiny bluebush
<i>Maireana appressa</i>	RJC5129	P	
<i>Maireana atkinsiana</i>	RJC5123	P	bronze bluebush, five pin bluebush
<i>Maireana carnosa</i>		P A	cottony bluebush, curious bluebush
<i>Maireana convexa</i>	RJC5407	P	mulga bluebush
<i>Maireana georgei</i>	RJC5269	P	golden bluebush, George's bluebush
<i>Maireana glomerifolia</i>		P	ball leaf bluebush
<i>Maireana integra</i>	MRS1	P	
<i>Maireana</i> aff. <i>integra</i>	MRS93	P	
<i>Maireana lobiflora</i>	MRS	P	
<i>Maireana melanocoma</i>	RJC5618	P	pussy bluebush
<i>Maireana murrayana</i>	RJC5350	P E	
<i>Maireana pentatropis</i>	RJC5953	P	

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<i>Maireana planifolia</i>	MRS201	P	flat leaved bluebush, low bluebush
<i>Maireana platycarpa</i>	RJC5726	P	shy bluebush
<i>Maireana polypterygia</i>	RJC5724	P	Gascoyne bluebush
<i>Maireana pyramidata</i>		P	sago bush
<i>Maireana suedifolia</i>		P	
<i>Maireana thesioides</i>	MRS4	P	lax bluebush
<i>Maireana tomentosa</i>	MRS131	P	felty bluebush
<i>Maireana tomentosa</i> X <i>villosa</i>	MRS75	P	
<i>Maireana trichoptera</i>	MRS152	P	pink seeded bluebush
<i>Maireana triptera</i>	RJC5132	P	three-winged bluebush
<i>Maireana villosa</i>	RJC5373	P	
<i>Maireana villosa</i> X <i>planifolia</i>	MRS290	P	
<i>Malacocera tricornis</i>	AAM1229	P	soft horns
<i>Malva parviflora</i>	RJC5737	A	marshmallow
<i>Marsilea drummondii</i>	RJC5586	A	nardoo
<i>Marsilea</i> sp.	RJC5439	A	
<i>Medicago polymorpha</i>	MRS226	A W	burr clover
<i>Melaleuca cordata</i>		P	
<i>Melaleuca eleuterostachya</i>	RJC6186	P	
<i>Melaleuca glomerata</i>	MRS46	P	
<i>Melaleuca lanceolata</i>	MRS86	P	Rottnest Island teatree
<i>Melaleuca</i> aff. <i>pauperiflora</i>	MRS1005	P	boree
<i>Melaleuca uncinata</i>	MRS37	P	broom bush
<i>Melaleuca</i> aff. <i>uncinata</i>	MRS305	P	
<i>Melaleuca</i> sp.	MRS1074	P	
<i>Melaleuca</i> sp.	MRS482	P	
<i>Menkea australis</i>	RJC5872	A	fairy spectacles
<i>Menkea villosula</i>	RJC5495	A	
<i>Mesembryanthemum crystallinum</i>	RJC6239	A	ice plant
<i>Micromyrtus racemosa</i>	RJC5067	P	
<i>Micromyrtus sulphurea</i>	RJC6070	P	
<i>Microtis parviflora</i>	RJC6155	A	slender mignonette orchid
<i>Minuria cunninghamii</i>	MRS266	P	bush minuria
<i>Minuria gardneri</i>	RJC5956	P	
<i>Minuria leptophylla</i>	RJC6108	P	minnie daisy
<i>Mirbelia microphylla</i>	AAM833	P	
<i>Mirbelia ramulosa</i>	AAM1072	P	
<i>Mirbelia rhagodioides</i>	MRS	P	
<i>Mirbelia spinosa</i>	MRS34	P	
<i>Mirbelia viminalis</i>	MRS366	P	
<i>Mirbelia</i> aff. <i>viminalis</i>	MRS341	P	
<i>Mirbelia</i> sp. nov.	RJC5256	P	
<i>Monachather paradoxa</i>	MRS	P	broad-leaved wanderrie
<i>Morgania floribunda</i>	RJC5408	P	blue rod
<i>Muehlenbeckia adpressa</i>	RJC6198	P	climbing lignum
<i>Muehlenbeckia cunninghamii</i>		P	lignum
<i>Muelleranthus trifoliolatus</i>	RJC5335	A	
<i>Murchisonia volubilis</i>	RJC5897	A	
<i>Myoporum acuminatum</i>	RJC5651	P	native myrtle
<i>Myoporum deserti</i>	RJC5968	P	turkey bush, dogwood
<i>Myriocephalus guerinae</i>	RJC5829	A	
<i>Myriocephalus nudus</i>	RJC6129	A	
<i>Najas</i> sp.	RJC5561	A	water nymph
<i>Neurachne minor</i>	RJC5721	P	
<i>Nicotiana cavicola</i>	RJC5836	A	talara
<i>Nicotiana glauca</i>	MRS66	P W	tree tobacco
<i>Nicotiana rosulata</i> ssp. <i>rosulata</i>	RJC5319	P	rosetted tobacco
<i>Nicotiana</i> aff. <i>rotundifolia</i>	RJC5261	A	round-leaved tobacco
<i>Olearia humilis</i>	MRS377	P	
<i>Olearia muelleri</i>	MRS384	P	Goldfields daisy
<i>Olearia pimelioides</i>	MRS19	P	burrobunga
<i>Olearia stuartii</i>	RJC5681	P	
<i>Olearia</i> sp. nov.	RJC6279	P	
<i>Omphalolappula concava</i>	RJC5777	A	burr stickseed
<i>Opercularia vaginata</i>	RJC6156	P	stinkweed
<i>Ophioglossum</i> sp.	RJC5664	A	
<i>Osteospermum clandestinum</i>	RJC6060	A	stinking roger
<i>Paraneurachne muelleri</i>	MRS	P	northern mulga grass
<i>Parentucellia latifolia</i>	RJC6054	A	common bartsia
<i>Parietaria debilis</i>	RJC5605	A	pellitory
<i>Paspalidium clementii</i>	RJC5266	A	Clement's paspalidium
<i>Pentaschistis airoides</i>	RJC6039	A	false hairgrass

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<i>Peplidium maritimum</i>	RJC5228	A	
<i>Peplidium muelleri</i>	RJC5301	A	
<i>Peplidium</i> sp.	RJC5755	A	
<i>Petrophile conifera</i>	MRS209	P	
<i>Petrophile</i> sp.	RJC6191	P ?E	
<i>Philotheca</i> sp. nov.	RJC7665	PE	
<i>Phyllanthus lacunellus</i>	RJC5358	A	lagoon spurge
<i>Phyllanthus</i> sp.	RJC5176	P ?E	
<i>Pileanthus</i> sp.	MRS147	P	
<i>Pimelea forrestiana</i>	RJC5215	P	
<i>Pimelea holroydii</i>	MRS294	P	
<i>Pimelea imbricatus</i> ssp. <i>villifera</i>	MRS1049	P	
<i>Pimelea microcephala</i>	RJC5423	P	shrubby rice flower
<i>Pimelea trichostachya</i>	AAM1286	A	spiked pimelea
<i>Pittosporum phylliraeoides</i>	MRS	P	native willow, weeping pittosporum, desert willow
<i>Pityrodia paniculata</i>	MRS114	P	
<i>Pityrodia</i> sp.	MRS459	P	
<i>Plantago debilis</i>	RJC5857	A	
<i>Plantago drummondii</i>	RJC6322	A	sago weed
<i>Plectrachne</i> aff. <i>danthonioides</i>	MRS443	P	
<i>Plectrachne melvillei</i>	MRS340	P	
<i>Pluchea dentex</i>	RJC5262	P	
<i>Pluchea rubelliflora</i>	RJC5402	P	
<i>Pluchea squarrosa</i>	RJC5329	P	squarrose bracted pluchea
<i>Pluchea</i> sp.	RJC5480	P	
<i>Podolepis canescens</i>	RJC6008	A	grey podolepis
<i>Podolepis capillaris</i>	RJC5084	A	wiry podolepis
<i>Podolepis gardneri</i>	MRS	A	
<i>Podolepis rugata</i>	RJC6109	A	pleated podolepis
<i>Podotrochea gnaphalioides</i>	RJC6302	A	golden long heads
<i>Pogonolepis stricta</i>	RJC5903	A	
<i>Polycarpaea corymbosa</i>	RJC5353	A	
<i>Polycarpon tetraphyllum</i>	RJC6243	A W	four leaf allseed
<i>Polypogon monspeliensis</i>	RJC5234	A W	annual beardgrass
<i>Porana sericea</i>	MRS	P	
<i>Portulaca cyclophylla</i>	RJC5328	A	goat's droppings
<i>Portulaca oleracea</i>	MRS	A	pig weed
<i>Potamogeton</i> aff. <i>drummondii</i>	RJC5578	P	pond weed
<i>Prasophyllum macrostachyum</i> var. <i>ringens</i>	MRS1057	A	laughing leek orchid
<i>Prostanthera albiflora</i>	MRS342	P	
<i>Prostanthera althoferi</i>	RJC6152	P	
<i>Prostanthera baxteri</i> var. <i>crassiflora</i>	RJC6073	P	
<i>Prostanthera campbellii</i>	MRS480	P	
<i>Prostanthera grylloana</i>	RJC6188	P	
<i>Prostanthera patens</i>	MRS11	PE	
<i>Prostanthera petrophila</i>	MRS	PE	
<i>Prostanthera tysoniana</i>	MRS107	PE	Murchison mint bush
<i>Prostanthera wilkieana</i>	MRS333	P	
<i>Prostanthera</i> sp.	MRS233	P	
<i>Psammomoya choretroides</i>	MRS408	P	
<i>Pseudanthus</i> sp.	RJC6002	PE	
<i>Psoralea cinerea</i>	RJC6261	A	annual verbine
<i>Ptilotus aervoides</i>	RJC6134	P	
<i>Ptilotus albidus</i>	RJC6001	P	
<i>Ptilotus astralasius</i>	AAM1402	P	
<i>Ptilotus beardii</i>	MRS56	PE	low mulla-mulla
<i>Ptilotus chamaecladus</i>		P	
<i>Ptilotus chipendalei</i>	AAM1045	P	
<i>Ptilotus divaricatus</i>	MRS272	P	climbing mulla-mulla
<i>Ptilotus drummondii</i>	RJC6185	P	narrow leaf mulla-mulla
<i>Ptilotus exaltatus</i>	RJC6139	A	tall mulla-mulla
<i>Ptilotus gaudichaudii</i> var. <i>gaudichaudii</i>	MRS	A	
<i>Ptilotus gomphrenoides</i>	RJC5436	A	
<i>Ptilotus grandiflorus</i> var. <i>grandiflorus</i>	RJC6301	A	
<i>Ptilotus helipteroides</i>	MRS	A	hairy mulla-mulla
<i>Ptilotus lazarides</i>	AAM978	P	saline mulla-mulla
<i>Ptilotus macrocephalus</i>	RJC6137	A	large green pussy tails
<i>Ptilotus murrayi</i> var. <i>murrayi</i>	RJC5538	A	
<i>Ptilotus obovatus</i>	RJC5538	P	cotton bush
<i>Ptilotus polakii</i>	RJC6197	P	Gascoyne mulla mulla
<i>Ptilotus polystachyus</i>	MRS	A	green mulla mulla, bottle washers

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<i>Ptilotus roei</i>	RJC5339	P	
<i>Ptilotus rotundifolius</i>	RJC5729	P	royal mulla mulla
<i>Ptilotus schwartzii</i>	RJC5340	P	horse mulla mulla
<i>Ptilotus aff. schwartzii</i>	MRS353	P	
<i>Quinqueremulus linearis</i>	RJC5832	A	
<i>Rhagodia drummondii</i>	MRS430	P	lake-fringe rhagodia, low rhagodia
<i>Rhagodia eremaea</i>	RJC5379	P	rhagodia, tall saltbush, thorny saltbush
<i>Rhyncharrhena linearis</i>	RJC5868	A	bush bean
<i>Ricinocarpos muricatus</i>	AAM928	P	
<i>Rulingia kempeana</i>	RJC5706	P	
<i>Rulingia loxophylla</i>	RJC5392	P	
<i>Rumex vesicarius</i>	ASG931	A W	ruby dock
<i>Ruppia megacarpa</i>	RJC6248	P	
<i>Ruppia</i> sp.	RJC5580	P	
<i>Salsola kali</i>	MRS	A	rolypoly
<i>Samolus junceus</i>	MRS434	P	
<i>Samolus repens</i>	RJC6142	P	salvinia
<i>Santalum spicatum</i>	RJC5317	P	sandalwood
<i>Santalum acuminatum</i>	RJC5421	P	quandong, nganungu
<i>Sarcostemma australe</i>	MRS	P	caustic vine
<i>Sarajusticia kempeana</i>	MRS1025	A	
<i>Sauropus crassifolius</i>		P	
<i>Sauropus</i> sp.	MRS1051	P	
<i>Scaevola collaris</i>	RJC5985	P	
<i>Scaevola parvifolia</i> ssp. <i>acuminata</i>	MRS	P	camel weed
<i>Scaevola spinescens</i>	RJC5312	P	currant bush, maroon bush
<i>Scaevola thesioides</i>	MRS215	P	
<i>Scaevola tomentosa</i>	AAM788	P	ragged leaf scaevola, felted scaevola
<i>Schismus barbatus</i>	RJC5742	A	Arabian grass, kelch grass
<i>Schoenia cassiniana</i>	MRS242	A	schoenia daisy
<i>Schoenus aff. nitens</i>	RJC5859	P	shiny bog rush
<i>Schoenus odontocarpus</i>	RJC5932	P	
<i>Schoenus</i> sp.	RJC5446	P	
<i>Sclerolaena burbridgeae</i>	RJC6103	P	
<i>Sclerolaena clelandii</i>	RJC5983	P	
<i>Sclerolaena cornishiana</i>	AAM1151	P	cartwheel burr
<i>Sclerolaena costata</i>	RJC6327	P	
<i>Sclerolaena cuneata</i>	RJC5171	P	yellow bindii
<i>Sclerolaena densiflora</i>	MRS249	P	
<i>Sclerolaena deserticola</i>	RJC5856	P	
<i>Sclerolaena diacantha</i>	RJC5202	P	grey copper burr
<i>Sclerolaena eriacantha</i>	RJC5837	P	silky bindii
<i>Sclerolaena eurotioides</i>	RJC6284	P	fluffy bindii
<i>Sclerolaena fimbriolata</i>	MRS309	A	kopi bindii
<i>Sclerolaena gardneri</i>	MRS198	P	
<i>Sclerolaena lanicuspis</i>	MRS298	P	spinach burr, copper burr
<i>Sclerolaena longicuspis</i>	RJC5566	P	
<i>Sclerolaena obliquicuspis</i>	MRS322	A	limestone bindii
<i>Sclerolaena patenticuspis</i>	RJC5632	P	spear fruit saltbush
<i>Sclerolaena recurvicuspis</i>	RJC6251	P	
<i>Sclerolaena tridens</i>	RJC5201	A	
<i>Scyphocoronis incurva</i>	RJC5995	A	
<i>Senecio glossanthus</i>	RJC5508	A	slender groundsel
<i>Senecio gregorii</i>	RJC5959	A	grey groundsel
<i>Senecio lautus</i>	RJC5999	A	variable groundsel
<i>Setaria dielsii</i>		A	Diel's pigeon grass
<i>Sida calyxthymenia</i>	RJC5105	P	tall sida
<i>Sida cardiophylla</i>	MRS275	P	
<i>Sida corrugata</i>	RJC5388	P	prostrate sida, dwarf sida
<i>Sida cryphiopetala</i>	RJC6143	P	
<i>Sida filiformis</i>	RJC5482	P	
<i>Sida physocalyx</i>	AAM1210	P	
<i>Silene gallica</i>	RJC6199	A W	French catchfly
<i>Siloxerus pygmaeus</i>	RJC5516	A	
<i>Sisymbrium erysimoides</i>	RJC5237	A W	smooth mustard
<i>Sisymbrium irio</i>	RJC5736	A W	London rocket
<i>Sisymbrium orientale</i>	RJC5735	A W	Indian hedge mustard
<i>Solanum ashbyae</i>	RJC5330	P	greater flannel bush
<i>Solanum horridum</i>	MRS10	P	
<i>Solanum lasiophyllum</i>	MRS29	P	flannel bush
<i>Solanum nigrum</i>	MRS	P W	blackberry night-shade
<i>Solanum orbiculatum</i>	MRS3	P	wild tomato

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<i>Solanum orbiculatum</i>	MRS3	P	wild tomato
<i>Solanum sturtianum</i>	RJC5639	P	Thargomindah night-shade
<i>Solanum</i> sp.	RJC5304	P	
<i>Sonchus oleraceus</i>		A W	common sowthistle
<i>Sonchus tenerimus</i>	RJC5740	A W	clammy sowthistle
<i>Spartothamnella puberula</i>		P	
<i>Spartothamnella teucriflora</i>	RJC5384	P	mulga broombush
<i>Spergularia diandra</i>	RJC5318	A W	lesser sand spurry
<i>Spergularia rubra</i>	AAM1272	A W	sand spurry
<i>Spergularia salina</i>	RJC5560	A W	salt sand spurry
<i>Sporobolus actinocladius</i>	RJC5398	A	katoora
<i>Sporobolus mitchellii</i>	RJC5452	A	rats tail couch
<i>Sporobolus virginicus</i>	MRS	P	salt water couch, marine couch
<i>Spyridium complicatum</i>	RJC5678	P	
<i>Spyridium</i> sp.	MRS174	P	
<i>Stackhousia dielsii</i>		P	yellow stackhousia
<i>Stackhousia huegelii</i>	RJC5220	P	
<i>Stackhousia viminea</i>	RJC6058	P	slender stackhousia
<i>Stackhousia</i> sp.	RJC5138	P	
<i>Stemodia viscosa</i>	RJC6201	P	pagurda
<i>Stenopetalum anfractum</i>	RJC5925	A	
<i>Stenopetalum lineare</i>	RJC5604	A	narrow thread petal
<i>Stenopetalum pedicellare</i>	RJC5576	A	
<i>Stipa elegantissima</i>	MRS203	P	feather speargrass
<i>Stipa nitida</i>	MRS379	A	Balcarra grass
<i>Stipa scabra</i> ssp. <i>scabra</i>	MRS236	A	rough speargrass
<i>Stipa tenuifolia</i>	RJC6050	P	
<i>Stipa</i> sp.	RJC6175		
<i>Streptoglossa cylindriceps</i>	MRS88	P	
<i>Streptoglossa liatroides</i>	CAG1265	P	
<i>Stylidium dielsianum</i>	RJC6305	P	tangled trigger plant
<i>Stylidium longibracteatum</i>		P	long bracted trigger plant
<i>Stylidium</i> sp.	MRS150	P	
<i>Stylobasium australe</i>	RJC6212	P	
<i>Stylobasium spathulatum</i>	RJC5863	P	pebble bush
<i>Swainsona cyclocarpa</i>	RJC5975	A	
<i>Swainsona elegans</i>	RJC5914	A	
<i>Swainsona microphylla</i>	RJC5899	A	small leaf swainsona
<i>Swainsona oliveri</i>		A	
<i>Swainsona pterostylis</i>	RJC5582	A	
<i>Swainsona rostellata</i>		A	
<i>Symphyobasis macroplectra</i>	RJC7667	A	spurred symphyobasis
<i>Synaptantha tillaeacea</i>	RJC5371	A	
<i>Tecticornia arborea</i>	MRS129	P	bulli bulli
<i>Tecticornia verrucosa</i>	MRS141	P	
<i>Tetragonia cristata</i>	RJC5528	A E	
<i>Teucrium racemosum</i>	MRS360	P	grey germander
<i>Thelymitra macmillanii</i>	RJC6161	A	salmon sun orchid
<i>Themeda australis</i>	RJC5448	P	kangaroo grass
<i>Themeda avenacea</i>	RJC5449	P	tall oat
<i>Thryptomene aspera</i>	MRS177	P	
<i>Thryptomene decussata</i>	MRS109	P	
<i>Thryptomene maisonneuvei</i>	MRS64	P	desert thryptomene
<i>Thryptomene mucronulata</i>	MRS446	P	granite thryptomene
<i>Thyridolepis multiculmis</i>	MRS116	P	soft wandarrie
<i>Thysanotus exiliflorus</i>	AAM1041	A	
<i>Thysanotus manglesianus</i>	MRS90	A	
<i>Thysanotus speckii</i>	RJC5525	A	
<i>Toxanthes perpusillus</i>	RJC5834	A	tiny bow flower
<i>Trachymene</i> aff. <i>caerulea</i>	RJC5919	A	blue lace flower, Rottnest daisy
<i>Trachymene cyanopetala</i>	RJC5941	A	
<i>Trachymene ornata</i>	RJC5939	A	sponge fruit
<i>Tragus australianus</i>		A	small burrgrass
<i>Trianthema glossostigma</i>	AAM1220		
<i>Trianthema oxycalyptra</i> var. <i>oxycalyptra</i>	RJC5396	A	star pigweed
<i>Tribulus astrocarpus</i>	RJC5915	A	
<i>Tribulus macrocarpus</i>	RJC5127	A	
<i>Tribulus platypterus</i>	RJC5641	P	fish poison, corky bark caltrop
<i>Trichodesma zeylanicum</i>	RJC5920	P	cattle bush, camel bush
<i>Triglochin calceitrapa</i>		A	spurred arrowgrass
<i>Triglochin centrocarpa</i>	RJC6006	A	dwarf arrowgrass
<i>Triglochin mucronata</i>	RJC5882	A	prickly arrowgrass

Botanical name	Collector	Type*	Common name
<i>Triodia lanata</i>		P	slender spinifex
<i>Triodia longiceps</i>	RJC5397	P	giant grey spinifex, porcupine grass
<i>Triodia pungens</i>		P	soft spinifex, gummy spinifex
<i>Triodia</i> sp.	MRS1044	P	
<i>Tripogon loliiformis</i>	RJC5219	A	five minute grass
<i>Urospermum picroides</i>	RJC6216	A W	false hawkbit
<i>Velleia cynopotamica</i>	RJC5934	A	
<i>Velleia glabrata</i>		A	pee the bed
<i>Velleia hispidula</i>	RJC5615	A	hispid velleia
<i>Velleia rosea</i>	RJC6041	A	rosy velleia
<i>Verticordia jamiesonii</i>	RJC6189	P	
<i>Vulpia myuros</i>	RJC6129	A W	rats tail fescue
<i>Wahlenbergia</i> sp. nov.	RJC5109	A	blue bell
<i>Wahlenbergia</i> sp.	RJC5359	A	
<i>Waitzia acuminata</i>	RJC5831	A	orange immortelle
<i>Waitzia citrina</i>	RJC5138	A	
<i>Wurmbea densiflora</i>	RJC5119	A	
<i>Wurmbea tenella</i>	RJC5094	A	eight nancy
<i>Zygophyllum aurantiacum</i>	MRS1030	P	shrubby twinleaf
<i>Zygophyllum compressum</i>	AAM1047	A	
<i>Zygophyllum eremaeum</i>	MRS396	A	
<i>Zygophyllum glaucum</i>	RJC5957	A	pale twinleaf
<i>Zygophyllum kochii</i>	RJC5541	A	
<i>Zygophyllum ovatum</i>	RJC5952	A	dwarf twinleaf

Collectors: code and name

RJC = R.J. Cranfield
AAM = A.A. Mitchell
MRS = Murchison Rangeland Survey

CAG = C.A. Gardner
JGM = J.G. Morrissey

ASG = A.S. George
DGW = D.G. Wilcox

* Life cycle type and species distribution

P = Perennial

A = Annual

E = Endemic

W = Weed/exotic

Species endemic to the Murchison area with possible conservation value

Species	Status**	Location
<i>Calytrix verruculosa</i>	P1	Tuckanarra Creek
<i>Drummondita miniata</i>	P3	Not recorded
<i>Eremophila fasciata</i>	P1	Gabarintha Hill
<i>Eremophila hygrophana</i>	P1	Near Meekatharra
<i>Eremophila imbricata</i>	P1	Yarlaweelor station
<i>Eremophila lanata</i>	P1	3 km SSW of Mt Fraser
<i>Eremophila physocalyx</i>	P1	Woolgorong & Twin Peaks stations
<i>Eremophila 'prolata'</i>	P1	Not recorded
<i>Grevillea subtiliflora</i>	P1	Not recorded
<i>Maireana murrayana</i>	P3	Not recorded
<i>Prostanthera tysoniana</i>	P6	Curbur station

** Conservation status.

- P1 = Very high risk taxa Species which are known from one or a few localities on lands under immediate threat.
- P3 = Vulnerable taxa Species which are known from several localities, some of which are on lands not under immediate threat.
- P6 = Poorly collected taxa Taxa which may be endangered and which require further survey, because of a paucity of information concerning their distribution and abundance.

Appendix 3.

Distribution by land type of common perennial species recorded at 679 inventory sites

Botanical name	Common name	Land type class. (Species occurrence: 'C'=common 'p'=present)																			No of sites observed at
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Aizoaceae																					
<i>Gunnopsis quadrifida</i>	sweet samphire					p									p		p	p			11
Number of Aizoaceae: 1 species																					
Amaranthaceae																					
<i>Ptilotus beardii</i>	low mulla mulla	p	p	p	C	p	p		p				p			p	p				30
<i>Ptilotus divaricatus</i>	climbing mulla mulla				p	p	p	p						p	p	p	C	p	p		49
<i>Ptilotus lazaridis</i>	saline mulla mulla					p									p	p	p	C			20
<i>Ptilotus obovatus</i>	cotton bush	C	C	C	C	C	p	C	C	p	p	p	p	C	C	C	C	C	p		408
<i>Ptilotus polakii</i>	Gascoyne mulla mulla		p			p	p		p				p								14
<i>Ptilotus roei</i>		p	p	p	p	p		p	p						p	p	p				17
<i>Ptilotus rotundifolius</i>	royal mulla mulla	C	p	C	p			p							p						36
<i>Ptilotus schwartzii</i>	horse mulla mulla	C	p	C	C	p	p	C	p	p	C	p		p	C	p					124
Number of Amaranthaceae: 8 species																					
Asclepiadaceae																					
<i>Leichardtia australis</i>	cogla vine			p				p	p		p				p	p	p				12
Number of Asclepiadaceae: 1 species																					
Asteraceae																					
<i>Cratystylis subspinescens</i>	sage					p		p					p		p	C	C	p			50
Number of Asteraceae: 1 species																					
Caesalpiniaceae																					
<i>Cassia charlesiana</i>			p		p		p								p						5
<i>Cassia chatelainiana</i>	green cassia	p	p		p	p	p	p	p		p		p		p	p	C	p	p		55
<i>Cassia desolata</i>	grey cassia	p	p	C	C	C	p	p	p		p		p	p	p	C	C	C	p		148
<i>Cassia helmsii</i>	crinkled cassia	C	p	C	C	p	p	p	p		p		p	p	C	C	p	C	p		178
<i>Cassia nemophila</i>	desert cassia	p	p	p	C	p	p	p		p	p		p	p	C	C	p	p	p		109
<i>Cassia oligophylla</i>	blood bush	p		p												p	p				9
<i>Cassia phyllodinea</i>	banana leaf cassia	p	p	p	C	p	p	p	p				p	p	p	p	C	p			99
<i>Cassia sturtii</i>	variable cassia	C	p	p	C	p	p	p		p	p		p	p	C	p	C				93
Number of Caesalpiniaceae: 8 species																					
Chenopodiaceae																					
<i>Atriplex amnicola</i>	river saltbush					p		p					p		p	C	C	p	p	p	56
<i>Atriplex bunburyana</i>	silver saltbush		p		p	p	p	p	p						p	p	p	C	p	p	47
<i>Atriplex vesicaria</i>	bladder saltbush		p		p	p	p		p				p		p	p	p	p	p		34
<i>Chenopodium gaudichaudianum</i>	scrambling saltbush	p	p		p				p				p		p	p	C	p			50
<i>Enchylaena tomentosa</i>	ruby saltbush	p	p	p	C	C	p	p	p		p	p	p	p	C	C	C	C	p		161
<i>Halosarcia doleiformis</i>	samphire												p				p	p		p	7
<i>Halosarcia indica</i>	tall samphire												p			p	p	p		p	15
<i>Halosarcia pergranulata</i>	black seed samphire								p							p					5
<i>Maireana aff. planifolia</i>						p		p							p						7
<i>Maireana amoena</i>	five winged bluebush				p	p							p			p	p	p			16
<i>Maireana aphylla</i>	spiny bluebush					p	p	p													5
<i>Maireana atkinsiana</i>	bronze bluebush				p	p			p				p		p	p	p	p	p		21
<i>Maireana convexa</i>	mulga bluebush	p	p	p	C	p	p	p	p	p				p	C	p	p	p	p	p	99
<i>Maireana georgei</i>	golden bluebush	p	p	p	C	p	p	p	p	p					p	p	p	p	p		92
<i>Maireana glomerifolia</i>	ball leaf bluebush	p		p	C	p	p	p	p				p			p	p	p	p		36
<i>Maireana integra</i>			p	p	p	p	p	p	p				p			p	p	p			21
<i>Maireana melanocoma</i>	pussy bluebush	p	p	p	p	p	p	p	p												29
<i>Maireana planifolia</i>	flat leaved bluebush	p	p	C	C	p	p	p	p	p	p			p	C	p	p	p			123
<i>Maireana platycarpa</i>	shy bluebush				p	p	p	p	p				p		p		p	p			37
<i>Maireana suaedifolia</i>		p																p			5
<i>Maireana thesioides</i>	lax bluebush	p	p	p	C		p	C			p			p	p	p	p	p			61
<i>Maireana tomentosa</i>	felt bluebush		p	p	p	p		p	p		p		p		p	p	p	p			39
<i>Maireana trichoptera</i>	pink seeded bluebush			p	p				p							p				p	8
<i>Maireana triptera</i>	3 winged bluebush	p	p	p	C	C	p	p	p		p			p	p	p	p	p	p	p	106
<i>Maireana villosa</i>		p	p	p	p	p	p	p		p	p			p	C	p	p	p	p		62
<i>Rhagodia drummondii</i>	low rhagodia		p		p	p	p	p									p	p			14
<i>Rhagodia eremaea</i>	tall saltbush	C	C	C	C	C	p	C	p	p	C		p	p	C	C	C	p	p		342
Number of Chenopodiaceae: 27 species																					
Chloanthaceae																					
<i>Spartothamnella teucriflora</i>	mulga broombush	p	p	p	p	p	p	p	p		p				p	C	p	p			76
Number of Chloanthaceae: 1 species																					
Frankeniaceae																					
<i>Frankenia magnifica</i>		p		p		p		p	p				p		p		p	p			14
<i>Frankenia pauciflora</i>	sea heath					p			p				p								9
<i>Frankenia setosa</i>	bristly frankenia				p	p		p	p						p	p	p	p			26
Number of Frankeniaceae: 3 species																					
Goodeniaceae																					
<i>Scaevola spinescens</i>	currant bush	p	p	p	C	C	p	C	p		p		p	p	C	C	C	p	p		190
<i>Scaevola tomentosa</i>	ragged leaf scaevola		p	p		p					p		p			p	p	p			20
Number of Goodeniaceae: 2 species																					

Botanical name	Common name	Land type class. (Species occurrence: 'C'=common 'p'=present)																		No of sites observed at
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Gyrostemonaceae																				
<i>Codonocarpus cotinifolius</i>	native poplar										p					p		p	p	9
Number of Gyrostemonaceae: 1 species																				
Lamiaceae																				
<i>Prostanthera patens</i>		p						p			p									5
Number of Lamiaceae: 1 species																				
Malvaceae																				
<i>Hibiscus burtonii</i>		p	p		p						p		p							5
<i>Sida calyxhymenia</i>	tall sida	p	p	C	C	p	p	C	p		p			p	C	p	p	p		118
<i>Sida cardiophylla</i>		p	p					p			p			p						7
<i>Sida aff. rohlenae</i>		p	p	p	C	p		p	p	p	p		p	p	C	p	p	p		75
Number of Malvaceae: 4 species																				
Mimosaceae																				
<i>Acacia 'masliniana'</i>	Maslin's wattle			p	p	p					p				p	p	p	p		21
<i>Acacia acuminata</i>	jam			p			p				p	p								5
<i>Acacia aneura</i>	mulga	C	C	C	C	C	p	C	C	p	C			C	C	C	C	p	p	430
<i>Acacia burkittii</i>	fine leaf jam	p	p	p	C	p		p			p			p	C	p	p	p		61
<i>Acacia citrinoviridis</i>	black mulga	p	p	p	p	p	p				p			p	p					19
<i>Acacia coolgardiensis</i>	sugar brother				p						p			p						7
<i>Acacia craspedocarpa</i>	hop mulga	p	p	p	C	p		p	p		p			p	C	p				66
<i>Acacia cuspidifolia</i>	wait-a-while	p	p	p		C	p		p				p		p					25
<i>Acacia cuthbertsonii</i>		p	p	C	C	p	p	p						p	p	p	p			66
<i>Acacia demissa</i>	Murchison willow	p		p	p	p	p	p						p						14
<i>Acacia distans</i>	black mulga												p		p	p	C			16
<i>Acacia grasbyi</i>	miniritchi	p	p	p	C	p	p	C	p		p			p	C	p	p	p	p	118
<i>Acacia kempeana</i>	witchetty bush			p	p	p			p		p			p	C	p	p	p	p	42
<i>Acacia ligulata</i>	umbrella wattle		p						p		p					p	p	p	p	15
<i>Acacia microcalyx</i>			p			p			p							p	p	p	p	22
<i>Acacia murrayana</i>	sandplain wattle	p				p			p	p		p	p	p	p			p		21
<i>Acacia palustris</i>				p	p				p						p		p			8
<i>Acacia pruinocarpa</i>	gidgee	p	p	C	p	p		C	p		p			p	C	p				76
<i>Acacia quadrimarginea</i>	granite wattle	p	p	p	p	p	p	p	p		p			p	p		p			40
<i>Acacia ramulosa</i>	wanyu	C	p	p	C	p	p	C	p	p	C	p	p	C	C	p	p	p		138
<i>Acacia rhodophloia</i>	flat leaf miniritchi	p	p	p				p							p					11
<i>Acacia sclerosperma</i>	limestone wattle	p	p	p	C	p	p	p	p		p	p	p		p	C	C	p		128
<i>Acacia stowardii</i>	bastard mulga																p	p	p	9
<i>Acacia tetragonophylla</i>	curara	C	C	C	C	C	p	C	C	p	p	p	p	C	C	C	C	p	p	408
<i>Acacia tysonii</i>															p	C	p			16
<i>Acacia victoriae</i>	prickly acacia	p	p	p	C	C	p	p	p		p		p	p	p	C	C	p	p	174
<i>Acacia wiseana</i>		p				p	p		p		p	p	p							6
<i>Acacia xiphophylla</i>	snakewood	p	p	p	p	p	p	p	p					p	p	p	C	p		79
Number of Mimosaceae: 28 species																				
Myoporaceae																				
<i>Eremophila aff. 'malacoides'</i>		p	p	p	p		p				p				p					7
<i>Eremophila aff. compacta</i>				p	p		p				p						p			12
<i>Eremophila aff. forrestii</i>					p						p	p		p	p					12
<i>Eremophila clarkei</i>	turpentine bush	p							p					p	p				p	8
<i>Eremophila compacta</i>	compact poverty bush	p	p	p	C	p	p	p	p		p				p	p	p	p		73
<i>Eremophila exilifolia</i>		p	p	p	p	p	p	p												23
<i>Eremophila forrestii</i>	Wilcox bush	C	p	C	C	C	p	C	p	p	C	p		C	C	p	C	p	p	196
<i>Eremophila fraseri</i>	turpentine bush	p	p	C	C	p	p	p	p		p			p	C	p	p			93
<i>Eremophila freelingii</i>	limestone fuchsia	p	p	C	p	p			p					p		p				39
<i>Eremophila georgei</i>		p	p	p	p	p		p	p					p	p	p				48
<i>Eremophila gilesii</i>	turkey bush	p						p			p				p					11
<i>Eremophila glabra</i>	yellow saline									p						p	p	p		8
<i>Eremophila glutinosa</i>		p	p	p	p		p				p				p	p	p			16
<i>Eremophila granitica</i>		p		p	p	p		p		p	p	p		p	C	p	p	p		39
<i>Eremophila lachnocalyx</i>	woolly poverty bush		p	p	p	p	p		p											14
<i>Eremophila lanata</i>			p			p											C			17
<i>Eremophila latrobei</i>	warty fuchsia bush	C	p	C	C	p	p	C	p		p	p		p	C	p	p			141
<i>Eremophila linearis</i>	saline fuchsia bush	p	p	p		p		p								p	p	p		10
<i>Eremophila longifolia</i>	berrigan	p	p	p	p	p			p						p	C	p			37
<i>Eremophila macmillaniana</i>	grey turpentine bush	p	p	p	p	p														26
<i>Eremophila maculata</i>	fuchsia bush					p			p				p	p	p	C	C		p	62
<i>Eremophila margarethae</i>	sandbank poverty bush			p						p				p	p	p	p	p	p	17
<i>Eremophila miniata</i>	limestone poverty bush								p							p	p	p	p	9
<i>Eremophila oppositifolia</i>	twin leaf eremophila	p	p	p	p	p									p	p	p	p		13
<i>Eremophila pantonii</i>			p			p									p	p	p	p	p	21
<i>Eremophila platycalyx</i>	granite poverty bush	p	p	p	C	p	p	p	p		p			p	p	p	p	p	p	51
<i>Eremophila pterocarpa</i>	silver poverty bush	p			p	p	p	p	p				p		p	p	p	C	p	44
<i>Eremophila punicea</i>	crimson eremophila	p	p	p	p	p	p		p					p	C	p		p		31
<i>Eremophila spathulata</i>	grey poverty bush	p	p	p	p			p												28
<i>Eremophila willsii</i>			p	p	p						p				p					13
<i>Eremophila youngii</i>	hook leaf poverty bush	p	p		p				p						p	p	p			16
Number of Myoporaceae: 31 species																				
Myrtaceae																				
<i>Eucalyptus coolabah</i>	coolabah				p						p		p	p	p	p	C	p		44
<i>Eucalyptus striatocalyx</i>	kopi gum															p	p	p		6
<i>Melaleuca glomerata</i>																p	p	p	p	5
<i>Melaleuca uncinata</i>	broom bush, ti tree												p		p	p	p	p		24
<i>Thryptomene decussata</i>		p	p		p			p			p				p					17
Number of Myrtaceae: 5 species																				
Papilionaceae																				
<i>Mirbelia spinosa</i>		p		p	p	p		p			p			p	p		p	p		26
Number of Papilionaceae: 1 species																				

Botanical name	Common name	Land type class. (Species occurrence: 'C'=common 'p'=present)																		No of sites observed at	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		19
Phormiaceae																					
<i>Dianella revoluta</i>	native flax lily	p		p	p			p			p	p		p	C	p	p	p			32
Number of Phormiaceae: 1 species																					
Pittosporaceae																					
<i>Pittosporum phylliraeoides</i>	native willow	p		p		p									p	p	p	p			16
Number of Pittosporaceae: 1 species																					
Poaceae																					
<i>Chrysopogon fallax</i>	ribbon grass			p	p									p	p		p				6
<i>Cymbopogon ambiguus</i>	lemon scented grass	p															p	p			5
<i>Enteropogon acicularis</i>	curly windmill grass		p		p	p			p		p				p	p	p				20
<i>Eragrostis dielsii</i>	mallee lovegrass							p					p			p	p				6
<i>Eragrostis eriopoda</i>	woollybutt	p	p	p	p	p		p		p	p		p	p	C		p	p			57
<i>Eragrostis falcata</i>	sickle lovegrass																p		p		5
<i>Eragrostis lanipes</i>	creeping wanderrie	p	p	p	p	p	p	p		p	C		p	p	p	p	p	p			53
<i>Eragrostis setifolia</i>	neverfail			p					p						p	p	p	p		p	16
<i>Eriachne flaccida</i>	claypan grass					p								p	p	p	p		p	p	18
<i>Eriachne helmsii</i>	buck wanderrie	p		p	p	p		p		p	C		p	C	C		p	p			62
<i>Eriachne mucronata</i>	mountain wanderrie	p	p	p	p																10
<i>Monachather paradoxa</i>	broad leaved wanderrie	p		p	p	p	p	p		p	C	p	p	C	C	p	p	p			112
<i>Stipa elegantissima</i>	feather spear grass	p	p		p	p	p	p		p	p			p	p	C	C	p			59
<i>Stipa scabra</i>	rough spear grass						p				p				p	p					7
<i>Thyridolepis multiculmis</i>	soft wanderrie										p		p								6
Number of Poaceae: 15 species																					
Polygonaceae																					
<i>Muehlenbeckia cunninghamii</i>	lignum															p	p	p	p		11
Number of Polygonaceae: 1 species																					
Proteaceae																					
<i>Grevillea aff. didymobotrya</i>		p	p	p	p	p	p	p			p	p		p	p	p	p	p			48
<i>Grevillea aff. stenobotrya</i>		p						p			p			p		p					11
<i>Grevillea deflexa</i>	red grevillea	p		p	p	p			p					p	C	p	p				32
<i>Grevillea stenobotrya</i>	sand dune grevillea			p	p	p				p			p	p	p	p	p				16
<i>Grevillea striata</i>	beefwood			p											p	p	p				21
<i>Hakea arida</i>		p	p		p	p		p						p	p	p	p	p			30
<i>Hakea preissii</i>	needle bush		p	p	p	p	p	p	p				p		p	p	C	p			88
<i>Hakea recurva</i>	dart hakea	p			p			p							p	p					9
<i>Hakea suberea</i>	corkwood	p		p	p	p		p						p	p	p	p				30
Number of Proteaceae: 9 species																					
Rubiaceae																					
<i>Canthium latifolium</i>	wild lemon	p		p	p	p		p			p				p						30
<i>Canthium lineare</i>	native currant	p	p	p	p	p		p			p			p	C						53
Number of Rubiaceae: 2 species																					
Santalaceae																					
<i>Exocarpos aphyllus</i>	leafless ballart	p	p	p		p	p	p			p	p		p	p	p	p	p			40
<i>Santalum acuminatum</i>	quandong	p			p	p		p	p		p				p	p	p				19
<i>Santalum spicatum</i>	sandalwood	p	p	p	p	p		p	p		p				p	p	p	p			43
Number of Santalaceae: 3 species																					
Sapindaceae																					
<i>Dodonaea viscosa</i>	sticky hopbush	p	p								p										6
<i>Heterodendrum oleaefolium</i>	mingah					p	p						p				p	p			9
Number of Sapindaceae: 2 species																					
Solanaceae																					
<i>Lycium australe</i>	water bush			p		p		p							p	p	p				18
<i>Solanum ashbyae</i>	greater flannel bush	p	p	p	p			p							p						20
<i>Solanum lasiophyllum</i>	flannel bush	C	C	C	C	C	C	C	p	C	p	p	p	p	C	C	C	p	p		409
<i>Solanum orbiculatum</i>	wild tomato	p	p		p	p		p	p	p	p	p	p	p	p	p	p	p			42
Number of Solanaceae: 4 species																					
Surianaceae																					
<i>Stylobasium spathulatum</i>	pebble bush		p		p	p		p			p	p	p			p	C	p			29
Number of Surianaceae: 1 species																					
Thymelaeaceae																					
<i>Pimelea microcephala</i>	shrubby rice flower	p	p	p							p	p	p	p	p	C	C	p			49
Number of Thymelaeaceae: 1 species																					

Number of families: 27; Number of genera: 47; Number of species: 163.

Key to land type classes

1. Rough hills with scattered acacia shrublands
2. Stony hills and plains (saline in parts) with acacia-halophyte shrublands
3. Low hills and quartz strewn plains with mulga shrublands
4. Breakaways and stony, granitic plains with mulga and halophytic shrublands
5. Complex stony and alluvial plains with mulga-snake-wood-halophyte shrublands
6. Permian stony plains with patchy shrublands
7. Irregular plains of laterite and parent rock with acacia-bowgada-halophytic shrublands
8. Saline stony plains with halophytic shrublands
9. Sand plains with acacia-mallee shrublands and hard spinifex
10. Sand plains with grassy bowgada shrublands
11. Sand plains with mallee-acacia shrublands
12. Sandplain and drainage floors with grassy and halophytic shrublands
13. Hardpan plains and sandy banks with mulga-wanderrie shrubland
14. Wash plains on hardpan with mulga shrublands
15. Calcreted river plains with grassy mixed halophyte shrublands
16. Alluvial river plains with saltbush, bluebush and other shrublands
17. Salt lakes and alluvial plains with halophytic shrublands
18. Clay gilgai plains with bluebush-saltbush shrublands and grasslands
19. Lake beds with halophytic shrublands and grasslands

⑧ CHENOPOD
STEPPE

[illegible]

④ MULGA COMMUNITIES

SITE		Nº	
1	2	3	4

⑤ PERENNIAL
GRASSLANDS

SPECIES										RANK	
5	6	7	8	9	10	11	12				

GENERAL

A. P. R.																												COND
MAP SHEET		YEAR	RUN		NUMBER		STATION	LAND SYSTEM		LAND UNIT	PASTURE																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27		
PADDOCK		QUADRANT		TRAVERSE N°		SITE N°		EOTE TECHNIQUE		EROSION T.I.		DISTANCE FROM WATER		PFC (SHRUBS)		PFC (GRASSES)		COVER CLASS (GRASSES)										
28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56

QUADRANT AREA		EASTINGS		NORTHINGS												
57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73

A. M. G.

Tree > 2m

T. Shrub > 2m

M. Shrub 1-2m

L. Shrub > 1m

P. Grass

SPECIES																COVER RANK																																																																																																														
74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200

Notes

INVENTORY SITE

Notes

GENERAL / GEOMORPHOLOGY

A. P. R.										A. M. G.																													
MAP SHEET		YEAR	R/W	NUMBER							EASTINGS					NORTHINGS					SLOPE	UNIT	RELIEF	GEOLOGY	SITE GEOL.	PROG- RELIEF													
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40

MANTLE OUTCROP						EROSION		PHOTO BEARING	
A	Sh	Si	TY	A	TY	AG	TI	DATE	BEARING
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68		

VEGETATION

PEC	TREE				RANK HT				T. SHRUB				RANK HT				M. SHRUB				RANK				L. SHRUB				RANK				P. GRASS				RANK				DENSITY		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44

PASTURE				FORM				Sp 1				Sp 2				Sp 3				Sp 4				Sp 5				Sp 6															
45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88

Sp 7 Sp 8 Sp 9 Sp 10 Sp 11 Sp 12 Sp 13

89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130
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Sp 14 Sp 15 Sp 16 Sp 17 Sp 18 Sp 19 Sp 20

0.31 1.32 1.33 1.34 1.35 1.36 1.37 1.38 1.39 1.40 1.41 1.42 1.43 1.44 1.45 1.46 1.47 1.48 1.49 1.50 1.51 1.52 1.53 1.54 1.55 1.56 1.57 1.58 1.59 1.60 1.61 1.62 1.63 1.64 1.65 1.66 1.67 1.68 1.69 1.70 1.71 1.72

SOILS

[illegible]

LS

1	2	3

LU

4	5	6

Stn

7	8	9

QP N

10	11	12	13

430

