THE PASTORAL LAND RESOURCES
OF AMBURLA STATION

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SUMMARY

Thirty-two land units (different types of country) have been identified and mapped on Amburla Station, which occupies 2,020 sq. km, 100 km north-west of Alice Springs. This report provides a detailed description of each land unit in terms of its landform, soil and vegetation characteristics, and indicates the possible implications of pastoral land use on both soil stability and pasture growth.

The most productive country on the station from a pastoral prospective is the mitchell grass plains at the foot of Mt Hay. The results of this survey suggest that rather than being a uniform landscape, the plains consists of several different soil types, and this diversity is reflected in the nature of the pastures. Of the remainder of the station, a large area consists of relict alluvial plains associated with the floodouts of 16-Mile, Charley and Amburla Creeks. These have sandy red earth soils supporting mulga woodlands of moderate to low pastoral productivity. In the northern part of the property, these plains merge into sandplains supporting spinifex.

The potential for soil erosion on the property is generally low. Some alluvial land units are susceptible to gullying, but the incidence of this problem is localised. Given the relatively stable nature of most landscapes, the greatest erosion hazard is associated with the inappropriate siting of graded vehicle tracks and fencelines.

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Mr Vince Powell, manager of Amburla at the time of this survey, provided full co-operation with field operations and his assistance is gratefully acknowledged. Mr Trevor Filmer provided technical support throughout the field work.
SECTION ONE: INTRODUCTION

A detailed knowledge of the different types of country on a station and their reaction to grazing is an essential precursor to good land husbandry, grazing management and property development. Most pastoralists gain a comprehensive first-hand appreciation of the land attributes of their property through living and working in that particular environment, observing the way in which stock use pastures and the response of the country to season.

A land resource inventory can complement this local knowledge by formally documenting the types of country on the station, accurately mapping their distribution, and indicating the potential productivity and land management hazards associated with each. As such it provides a tangible basis for making property management and development decisions. Besides the station manager, land resource information is especially valuable to Government advisers in the fields of soil conservation, pasture management and livestock husbandry as well as land administrators.

This land resource survey documents the pastorally different land types of Amburla Station, located 100km north-west of Alice Springs, and occupying an area of 2,020 sq.km. It was initiated by Mr Gary Dann, the lessee of Amburla, who requested information concerning the land as a basis for the planning of future development and management on the property. To meet his requirements, the station has been mapped into land units with pastorally different attributes (soil and vegetation type, grazing characteristics, stocking capacity and erosion hazard) at scales of 1:50,000 and 1:100,000. This report provides an account of the physical environment of the station and describes in detail each land unit and its pastoral management features.
SECTION TWO: THE PHYSICAL ENVIRONMENT - AMBURLA STATION

A. PREVIOUS SURVEYS

The land resources of Amburla have been previously described at a reconnaissance level only by Perry et. al. (1962), who identified six land systems at a regional mapping scale of 1:1,000,000. A land system is a descriptive grouping of related land units which define "an area, or groups of areas, throughout which there is a recurring pattern of topography, soils and vegetation" (Christian and Stewart, 1953).

The land systems mapped on Amburla in this original survey included the following:

Harts Land System - rugged mountainous terrain of crystalline rocks with sparse shrubs over spinifex, bordering the southern part of the station.

Bond Springs Land System - bold rocky hills and lower rugged terrain supporting shrubs over annual grasses, in the central part of the station.

McGrath Land System - floodplains of medium or fine-textured alluvium with sparse trees and perennial tussock grasses, mapped along Amburla Creek.

Bushy Park Land System - broad alluvial plains with red earth soils supporting mulga, throughout the central part of the station.

Undippa Land System - plains with fine-textured soils supporting mitchell grass, flanking the ranges, mainly at the foot of Mt. Hay.

Singleton Land System - sandplain supporting sparse shrubs and spinifex in the northern part of the station.

While the land system mapping is of a suitable scale and degree of resolution for the purposes of regional planning and assessment, it provides insufficient detail to assist with pastoral management, and was not intended for this application. Land systems, by definition, are compound map units, each encompassing several unmapped types of country. For station management purposes, mapping at a larger scale, based on simple land units, each with uniform pastoral characteristics, provides a more appropriate level of detail (Gunn et. al., 1988).

B. GEOLOGY

The bedrock geology of Amburla has been described at a reconnaissance scale by Quinlan and Forman (1968), and mapped with more detail by Glikson and Green (1983). The latter described the Proterozoic rocks that outcrop on hilly or mountainous terrain on the station as mafic granulites, provisionally named the Mt Hay Basic Granulite, Mt Chapple Granulite and Mt Hay Anorthosite. Granulite is a coarse granular rock formed at high pressure and temperature, consisting of even-sized interlocking mineral grains, whereas anorthosite is a plutonic igneous rock composed almost entirely of plagioclase feldspar (Gary et. al. 1974).

However, the Cainozoic geology (60 million years ago-present) is of greatest relevance in considering those parts of the station used for pastoral purposes, but is not documented in the available literature.
During the Tertiary period (60m.y.a.-2m.y.a.), the landscape was subjected to warm, humid climates conducive to the deep weathering and leaching of surface rocks. As a result, surfaces developed a laterite weathering profile, consisting of a cemented capping of lateritic nodules (ironstone gravel) overlying a pallid zone of kaolinized material, which grades into bleached bedrock at a variable depth, up to tens of metres. The laterite profile occurs throughout most of Amburla, but is buried by extensive alluvial deposits, and locally stripped or dissected where erosion processes have been most active.

Chalcedonic limestone overlying sandstone, mudstone and siltstone buries the laterite near the foot of Mt Hay. This material is similar to that of the Waite Formation, a lacustrine (lakebed) deposit documented north-east of Alice Springs, which is of Pliocene age (5-7m.y.o.). The sediments were probably laid down on the floor of a shallow lake which existed along the range frontage, and later developed a silcrete crust of chalcedonic limestone and calcified as late Tertiary climates tended towards increasing aridity and the lake dried out.

Calcretes occur locally at the base of Mt Hay, particularly south-east of Valley Bore. These would have developed with the precipitation of carbonates from shallow groundwaters in response to the trend to increasing aridity during the Pleistocene.

Depositional material of several types and origins is present on the station. Fine-textured alluvium and cobble-sized colluvium, probably of Pleistocene age (2m.y.a.-10,000y.a.), derived from the granulites of the Mt Hay and Mt Chapple ranges, occur as large piedmont (range frontage) fans. Floodouts of gravelly coarse-textured alluvium, probably of Holocene age (10,000y.a.-present), have also originated from the granulites. However, the plains of coarse-textured alluvium that occur throughout the central and northern parts of the station are of mixed origin, having been transported from an extensive area of crystalline rocks included in the catchments of 16-Mile, Charley and Amburla Creeks. This material has been weathered to form red earthy soils and is probably of Pleistocene age (Mabbutt, 1967).

C. LANDFORMS

The topography of Amburla is dominated by the Mt Hay range and hilly or mountainous terrain extending westwards from near Karanji Bore towards Mt Chapple, rising up to 600m above an essentially featureless plain. The plain has an overall fall of about 1 metre per kilometre from the south-east to the north-west, consistent with regional drainage towards Lake Lewis on Napperby. The floodout of 16-Mile Creek, largely a relict feature on Amburla, drainage from the northern catchments of Mt Hay, as well as Amburla and Charley Creeks, both with extensive catchments south of Mt Hay, all drain into a depression in the north-western part of the station, which is partly buried by sandplain.

The landforms of central Australia have largely been inherited from a peneplain—a featureless, nearly level erosional surface—which developed during the long cycle of geologic erosion that occurred in the Tertiary period (60-2m.y.a.). This old land surface, characterised by deeply-weathered rocks and a laterite profile, has been partly stripped or dissected, and which have been partly buried by sediments, during subsequent cycles of erosion and deposition driven by marked changes in climate (Mabbutt, 1967).
On Amburla, the peneplain has been extensively buried by more recent alluvial and aeolian deposits, and only comprises the present land surface in limited areas. It features deep medium-textured red earth soils which overlie pisolitic laterite gravels.

Close to range or outcrop areas, where the slope of the plain increases slightly, the laterite profile has usually been stripped off to reveal the underlying, freshly-weathered rock as a bedrock plain, termed a pediment. Pediments are usually partly veneered with alluvium, such as near Spring Dam, and are productive pastoral lands.

The mitchell grass plains that are a feature of the range frontage beneath Mt Hay have developed through two processes.

Low platforms of chalcedonic limestone occur with extensive areas of gilgaied clays in the northern part of the mitchell grass plains near Limestone Bore. The platforms are remnants of the Pliocene lakebed floor, resistant to erosion due to its silicified capping, which has nevertheless been extensively dissected. The disintegration of the silicreted crust of the chalcedonic limestone has exposed large areas of the underlying calcareous sediments to soil forming processes, and gilgaied red clays have consequently developed.

The southern part of the mitchell grass plains, such as in the Valley Bore area, consists of dissected fans of colluvium and alluvium transported from catchments in the ranges. The subdued relief of the plains disguises the original form of the fans, which is only evident as remnant benches with gently-sloping planar gilgaied surfaces in some areas, the terraces flanking the range south of Valley Bore. Most of the landscape consists of stripped areas with gravelly surfaces lacking gilgai, and tracts of fine-textured alluvium.

Relict alluvial plains, probably of Pleistocene age, cover a major part of the study area. They originated as sandy floodout deposits from the 16-Mile, Amburla, and Charley creeks as well as the northern catchment of Mt Hay, as a time when drainage was more active than at present, probably due to a wetter climate. Individual floodout lobes occur as sinuous low banks up to 500m in width and several metres in height, but mostly the alluvium forms a complete cover as a sandplain.

In the northern part of the station, this alluvial sandplain has been modified by wind action during the arid climatic phases of the late Pleistocene, the most recent of which occurred 16-18,000 years ago. The effect of successive phases of aeolian activity, in response to fluctuating climate, has been to produce corresponding landforms and soils with increasing degrees of particle-size sorting, supporting differing vegetation types. Some of the original floodout features remain visible on aerial photography, and the north-west trend of landforms is inherited from the general direction of prior drainage rather than that of aeolian movement according to a prevailing wind influence. The isolated dunes that do occur trend to the west north-west, at an angle to the general orientation of rises and depressions in the sandplain.

Presently the most active parts of the landscape are the sandy fans and floodouts of grey-brown coarse-textured alluvium deposited where small creeks exit the ranges. These are probably of Holocene age (10,000 years or less). The terminal floodout of Charley Creek, the broad depression passing through Karanjii Bore, and the lower reaches of 16-Mile Creek carry mainly fine-textured sediments and exhibit little evidence of recent geomorphic activity.
The Holocene alluvial fans often partly bury low rises of calcrete with relief of up to 3 m. These are likely to be remnants of older alluvial fans, which were calcified then eroded and dissected prior to the current phase of fan development.

D. SOILS

Soil characteristics reflect the geology of the parent material from which a particular soil was formed, the landform on which it occurs, and the climatic regime that prevailed during its period of development. Many soils on Amburla developed from highly-weathered materials and consequently have a low abundance of the freshly-weathered minerals that confer soil fertility. They developed in a relatively moist climate which prevailed before the onset of increasing aridity and sand movement 25,000 years ago.

In this report, the soils of Amburla are described in terms of their texture, colour, pH, fabric and structure, and are classified according to their Australian Great Soil Group (Stace et. al., 1968) and Principle Profile Form (Northcote, 1979).

(i) Soil Characteristics

Texture is a property determined by the proportion of sand, silt and clay particles within the soil matrix, and is indicated by the behavior of a moistened soil sample. Because most soils on Amburla are derived from highly-weathered parent materials, they have a very low silt content (less than 10%). The range of soil textures found on the property include sands (5-10% clay), sandy loams (10-15% clay), sandy clay loams (20-30% clay), sandy clays (35-40% clay), light clays (35-40% clay), light medium clays (40-45% clay), medium clays (45-55% clay), and heavy clays (greater than 50% clay sized particles).

Texture determines soil permeability and moisture-holding capacity, and influences fertility, as most plant nutrients are bound to clay minerals. It is a major determinant of the type of pasture that grows on a particular area.

Soil colour is assessed in the field using a moist sample and a standard Munsell colour chart, which forms the basis of the colour names used in this report. The soils of Amburla predominantly red due to pigmentation by haematite, an iron oxide derived from the weathering of iron-rich clay minerals.

Soil 

Soil pH indicates the acidity or alkalinity of the soil. A neutral soil has a pH value of 7.0, and a lower pH indicates acidity, a higher pH alkalinity. Most soils on Amburla have a neutral reaction trend, with a surface value of between pH 6.0 and pH 7.5, and a deep subsoil value between pH 6.5 and pH 8.0.

Soil fabric refers to arrangement of individual particles within the soil material. An earthy fabric is characterised by a porous, dusty appearance of the soil matrix and the absence of peds (soil aggregates which are distinctly separate). A sandy fabric has closely-packed sand grains, also with few if any peds. When peds are present, they may have a porous, rough-faced fabric, or smooth, lustrous surfaces.

Soil structure is determined by the size, shape and abundance of peds. Coherent soils with no distinct peds are considered to have massive structure, while highly pedal soils such as the cracking clays of bluebush swamps are
strongly structured.

(ii) Soil Types

The following Australian Great Soil Groups (Stace et. al., 1968) were recorded on the station:

Red earths - the most widespread soil type on the station, are usually medium-textured gradational soils (with a gradual increase in clay content with depth) characterised by their red colour, massive structure and earthy fabric. On highly-weathered substrates such as laterite, these soils are of low chemical fertility, but where they have developed directly on granite or gneiss, nutrient levels are higher and this is reflected in the growth of more productive pastures.

Red and brown clays - are deep, fine-textured soils with strongly-developed pedality and occur on calcareous siltstones, colluvium and alluvium on Amburla. On erosional landforms they usually have gilgai micro-relief, whereas in alluvial situations gilgai are absent but a well-developed seasonal cracking pattern is evident. In the study area these clays are usually slightly alkaline and sometimes calcareous.

Red calcareous soils - are of minor occurrence in the study area. They are shallow, medium-textured soils, massive and earthy and with a strongly alkaline reaction trend, developing directly from underlying calcrete. Finely-divided calcium carbonate and carbonate nodules are present throughout the soil profile.

Alluvial soils - are present on active floodplains and range frontage fans and consist of layered sediments, often interbedded with lenses of creek gravels. The nature of the sediments varies according to their source, but those derived from the crystalline basement rocks on Amburla are predominantly slightly alkaline red-brown sandy loams.

Lithosols - are shallow, gravelly soils with limited profile development, present on slopes in excess of about 3% where natural erosion is active enough to limit soil development. They often consist of only pockets of soil amongst rock outcrop.

Earthy sands - are similar to red earths, but are coarse-textured with deep uniform profiles, having developed from alluvial and aeolian sediments on sandplain areas. Texture generally ranges from a loamy sand to a sandy loam, and the soil material is red in colour with massive structure and an earthy fabric.

Siliceous sands - are dune soils of predominantly sand-sized particles and are of limited occurrence on Amburla. They are loose soils, red in colour, with single grain structure and a sandy fabric.

The Principle Profile Form (Northcote, 1979) is a notation derived from a key based solely on the physical characteristics of the soil profile. The main divisions and subdivisions of the key are:

Uniform soils - profiles with uniform texture throughout.

\[ \text{Uc} - \text{course textured} \]
\[ \text{Um} - \text{medium textured} \]
Uf - fine textured, non-cracking
Ug - fine textured, cracking

Gradational soils - profiles with increasingly finer (more clayey) texture with depth.

Gc - calcareous (limey) throughout
Gn - non-calcareous throughout

Duplex soils - profiles with an abrupt texture boundary between the A-horizon (topsoil) and B-horizon (subsoil).

Dr - red clay B-horizons
Db - brown clay B-horizons
Dy - yellow-grey clay B-horizons
Dd - dark clay B-horizons
Dg - grey clay B-horizons

Organic soils - not present in central Australia.

These notations are accompanied by a numerical code to specify diagnostic characteristics of individual soil profiles, as defined in Northcote (1979). The Principal Profile Forms recorded on Amburla include -

Uc 1.23, Uc 5.21, Uc 5.52, Um 5.51, Um 5.52, Uf 6.12, Ug 5.38, Ug 6.3, Ug 6.6, Gn 2.12, Gn 2.13, Gn 4.13, Gc 1.12.

(iii) Soil Erodibility

The potential for a soil to erode is termed its erodibility, and is influenced by the nature of its parent material and the landform on which it occurs as well as inherent soil factors. The latter may include texture, salinity, ease of dispersion (sodicity) and the presence or absence of surface crusts and gravels.

In general, only soils with textures of sandy loam or lighter are likely to experience significant wind erosion. Water erosion is unlikely to affect very light-textured porous soils or clays, but will affect sandy loam or sandy clay-loam surfaces. Saline or sodic soil materials (the latter having high levels of sodium) are susceptible to the formation of strong surface crusts (scalding) and shallow gulling.

Gulling is often initiated where sheet runoff flows are concentrated into a channel by a linear surface feature such as a grader windrow or stock pad. Deep gulling is usually restricted to alluvial landforms, while the soils of pediment or peneplain surfaces are more susceptible to sheet erosion and rilling. The soils that have developed from partially stripped deeply-weathered rocks (the pallid zone of laterite profiles) are particularly susceptible to shallow gulling or scalding, possibly as a result of slightly saline conditions.

E. VEGETATION

The distribution, composition and pastoral value of the various vegetation types on Amburla directly reflect the geology, landform and soil types of the country as outlined in the preceding pages. In particular, soil texture seems
to have a major influence on the composition of pastures through its effect on nutrient availability and moisture-holding or infiltration characteristics. Within each vegetation type, the actual species composition of pastures can vary according to the effects of fire, seasonal rainfall pattern and grazing history.

In terms of pastoral land use, the vegetation types can be categorized into several broad pasture groups as follows. Note that the common names of plants in this report are, in most cases, those proposed by Strong (1987).

(i) Annual pastures

Annual grass pastures, consisting predominately of oat, woollyoat, mulga, eight-day and five-minute grasses grow on medium-textured soils which have developed on freshly-weathered parent rocks or pallid zone clays. They have high palatability and feed value, mainly due to the abundance of oat and woollyoat grasses. Other species such as mulga grass may be quite acceptable to stock while young, but palatability and nutritional value decline with maturity. Limestone oat grass, which occurs on red calcareous soils, has poor palatability even when green.

Since these pastures attract selective grazing pressures, and their viability is subject to annual seed setting, they are susceptible to change in composition with excessive grazing use. On the other hand, they are likely to improve in vigour with spelling during the summer growing season. A grazing capacity of 2-4 head/sq.km could be anticipated in an average season.

The topfeeds associated with annual pastures are generally palatable to stock, and valuable perennial grasses, such as umbrella and curly windmill grasses, often grow as scattered tussocks beneath the tree canopy.

(ii) Kerosene grass and woollybutt pastures

Kerosene and woollybutt grasses grow on soils of low to moderate fertility and usually in association with sandy loam surface textures. On Amburla they are present on alluvial soils and also earthy sands as a recovery phase following the burning of spinifex.

Although these species are moderately palatable when green, their acceptability and feed value declines significantly with maturity and haying off. Minor pasture components such as oat grass and herbage are selectively grazed after summer rains, and stock turn to the kerosene grass and woollybutt as other feed becomes scarce. The impact of grazing on the composition of these pastures is relatively minor and special management other than the maintenance of moderate stocking rates is not necessary. In average years, a grazing capacity of about 2 head/sq.km could be expected.

(iii) Eight-day grass pastures

Pastures consisting predominately of eight-day grass grow on certain sandy red earths on Amburla.

Eight-day grass is a 'resurrection' species which can survive long periods of drought and rapidly resprout after light rains. It is highly palatable and nutritious while green, but its value is limited by low bulk and poor persistence. The leaf material rapidly disintegrates with onset of dry conditions.
Pastures dominated by this species therefore provide only opportunistic grazing, with a moderate carrying capacity after rains, but a very low carrying capacity at other times. A grazing capacity of about 1.5 head/sq.km would be reasonable in estimating year-round productivity for average seasons.

(iv) Neverfail pastures

Neverfail usually grows as sparse tussocks in association with annual grasses, and since it is of low palatability, is only grazed when other feed is scarce. The value of this grass lies in its resilience under grazing pressure, and moderate feed value. It produces some green growth in response to being grazed short even under dry conditions. A year-round grazing capacity of about 5 head/sq.km would probably suit average seasons.

(v) Mitchell grass pastures

The mitchell grass pastures on Amburla are dominated by barley mitchell grass, but some weeping mitchell is also present. As well as producing a large quantity of dry matter these pastures are of moderate palatability and feed value, but stock seek out palatable annuals such as flinders grass, rhyncosta and verbine in the months after summer rain. The mitchell grass tussocks are mainly grazed when these other species have been fully utilized. A grazing capacity of about 8 head/sq.km would be reasonable given average seasonal conditions.

(vi) Bluebush

Northern bluebush is a highly palatable and nutritious chenopod shrub which grows on deeply cracking red clays in seasonally-flooded swamps. Palatable herbage species such as verbine commonly grown in association with the bluebush. While able to withstand periods of heavy grazing, spelling is necessary to ensure that this useful shrub is not eliminated. Given average seasonal conditions, a grazing capacity of about 8-10 head/sq.km would be desirable.

(vii) Perennial tussock grass pastures

These consist of tall growing perennial grasses such as desert bluegrass, silky browntop, Queensland bluegrass and kangaroo grass and grow on medium to heavy-textured soils, principally the brown and grey clays and some red earths, particularly on landforms where runoff collects.

The composition of these pastures remains relatively stable under grazing use. They produce a large bulk of feed which is palatable and nutritious while green and shooting, but acceptability and protein levels decline as growth becomes rank and dries off. If tussocks are maintained in a closely-cropped condition, they will continue to produce green shoots and remain attractive to stock. An average season grazing capacity of about 5-8 head/sq.km would be appropriate.

(vii) Wire grass pastures

Pastures dominated by wire, woollybutt and mulga mitchell grasses grow on relatively infertile red earths such as those developed on laterite. They have very low pastoral productivity. Wire grass is virtually inedible to stock, and the associated mulga topfeed is also unacceptable. Woollybutt and mugla mitchell grasses, which are often only minor components of the pasture,
provide sparse, opportunistic grazing. Mulga mitchell grass is reputed to decrease in abundance if subjected to selective grazing pressure. A grazing capacity of about 1 head/sq.km would apply in average seasons.

(viii) Spinifex pastures

Hummock grasslands of hard spinifex grow in association with a range of shrub and mallee communities on earthy sands and certain lithosols. They have very limited pastoral value except during seasons when parakeelya is abundant. Grazing capacities of about 1 head/sq.km can be expected in average seasons.

Grazing trials to evaluate the use of spinifex by stock were conducted on the "Desert Block" of Amburla in the late 1950's - early 1960's by the Animal Industry Branch of the N.T. Administration (Hare, 1985). These trials indicated that dry cattle could be maintained in store condition under average conditions on spinifex, but breeders could not be supported without supplementation. Stock responded favourably to phosphate supplementation, but did not provide an economic return. A breed comparison found that Brahman cross cattle performed satisfactorily but were difficult to manage. Shorthorns performed poorly on the spinifex.

Burning may induce short-term desirable changes in plant composition, including an initial phase of kerosene grass and herbage growth given suitable seasonal conditions.

(ix) Additional information

Additional information concerning the feed value and response to grazing of these pastures can be obtained from the Department of Primary Industries and Fisheries, Alice Springs.
SECTION THREE: THE LAND UNITS OF AMBURLA STATION

A. SURVEY METHODOLOGY

Amburla has been mapped into thirty-two land units at a scale of 1:100,000 on the basis of the stereo-interpretation of aerial photographs and extensive on-ground survey. The southern, more productive part of the station, has additionally been mapped at a scale of 1:50,000.

The available aerial photography included a complete coverage of black and white RC-9 contact prints flown at a scale of 1:80,000 in 1986, and a partial cover RC-9 contact prints flown at 1:50,000 scale in 1987. Tentative land unit boundaries were mapped on both scales of photography prior to the conduct of the ground survey, and suitable sites for field examination were identified according to this preliminary classification.

Field survey work occupied approximately four weeks in mid-1987, and consisted of vehicle traverses between recording sites. 102 sites were described, giving a sampling intensity of one site per 20 sq.km. Mulga regrowth restricted access to certain areas of the station, but photo-interpretation indicates that these are of uniform landform, soil and vegetation characteristics.

At each recording site, landform, soil and vegetation attributes were documented according to the criteria of McDonald et. al. (1984) and representative areas photographed. Soil profiles were examined in hand excavated pits at most sites, usually to a depth of 0.6-0.8m below which the hard and dry condition of the soil rendered further investigation impractical. A Jarret hand auger was used for soil examination in sandy country.

Final amendments to land unit boundaries were made during a comprehensive re-examination of the aerial photography subsequent to the field survey. Final map compilation involved the transfer of the land unit information from the 1:50,000 colour contact prints to 1:50,000 scale orthophotomaps. The northern most part of the station, covered only by 1:80,000 scale black and white contact prints was mapped separately onto a 1:100,000 scale map base.

B. LAND UNITS

Each land unit described in this report delineates areas with relatively uniform landform, soil and vegetation attributes. These are reflected in its stocking capacity, response to grazing, attraction to cattle and erosion potential. Slight variability will be evident within each unit, consistent with the degree of resolution possible at mapping scales of 1:50,000 and 1:100,000. By convention, maps of these scales will have a minimum resolution of 5 hectares and 20 hectares respectively (Gunn et. al. 1988).

The land units identified on Amburla have been grouped according to the following landform categories:

1. Mountainous and hilly terrain
2. Pedeplain (surfaces formed on laterite)
3. Pediment (bedrock plains)
4. Piedmont fans (range frontage plains)
5. Limestone plains
6. Floodplains and floodouts
7. Relict alluvial plains
8. Sandplain.

The description of each unit is structured according to the following format:

GENERAL DESCRIPTION - a brief statement of the main features of the landscape.

GEOLOGY - an indication of surface geology.

LANDFORM - a description of the terrain in terms of the landform pattern (eg. floodplain, dunefield) and its relief, slope and drainage features.

SOILS - includes Great Soil Group classification (Stace et. al., 1968) and Principal Profile Form (Northcote, 1979). The profile description covers field texture, pH, Munsell colour name and notation of the moist soil, horizon boundaries, structure, fabric, the presence or absence of calcium carbonate or other segregations, the occurrence of gravel and presence of surface features.

VEGETATION - the structure of the vegetation community (eg. open woodland, grassland) with a listing of the main species present. Where the original vegetation has been altered, both the existing and former components are indicated.

LAND USE IMPLICATIONS - a comment on any land management problems likely to be encountered with pastoral use of the land unit, including susceptibility to erosion and pasture degradation, and its grazing potential. Desirable land management practices are indicated where applicable.
1. MOUNTAINOUS AND HILLY TERRAIN

These land units are characterized by moderate to strong relief, slopes of greater than 5% and a shallow soil cover. Run off rates are high, but the erosion potential is negated by the stoniness of the land surface.

**LAND UNIT 1.1**

*Mountainous or hilly terrain with limited soil cover, supporting hard spinifex (foreground) with scattered blue mallee (centre distance).*

**GENERAL DESCRIPTION**

Mountainous or hilly terrain; gravelly medium-textured lithosols; a mid-high sparse hummock grassland of hard spinifex with scattered blue mallee.

**GEOLOGY**

Mafic granulites (provisionally Mt Hay Basic Granulite and Mt Chapple Granulite).

**LANDFORM**

Ranging from mountainous terrain with relief to 600m and slopes of 15-20% (eg. Mt. Hay) to low hills with relief to 20m. Peaks and spur ridge crests are broad and rounded, with slopes drained by a widely-spaced tributary network of narrow watercourses. Slopes have a smooth profile with only minor projecting outcrop, but surfaces are strewn with large cobbles and coarse calcified gravels.
SOILS
Gravelly lithosols (Um 5.51). They consist of a non-calcareous dark reddish brown (5.0YR3/3) sandy clay loam, pH 9.0 with an earthy fabric and very weak consistence, overlying bedrock at a depth of 0.1m. 90% of the material consists of coarse calcified gravels.

VEGETATION
A mid-high sparse hummock grassland of hard spinifex with scattered blue mallee, and isolated ghost gums or long-leaved corkwood. Sparse low shrubs, including curry wattle and holly grevillea, are usually present.

LAND USE IMPLICATIONS
The unit has no pastoral value but areas of strong relief may deter the movement of cattle.

Since surfaces are very stony and unlikely to be subjected to disturbance, the erosion risk is negligible despite the high potential for rapid runoff. However cleared lines may scour to expose the white calcified bedrock material.
Low hills with boulder-covered slopes supporting cypress pines, mulga and annual grasses.

GENERAL DESCRIPTION

Hilly terrain with boulder-stream slopes; sandy lithosols; a low open woodland of mulga and cypress pine with native fuschia and green-leaf cassia over woollyoat grass and mountain wanderrie.

GEOLOGY

Anorthosite, a plagioclase feldspar plutonic rock (provisionally named Mt Hay Anorthosite).

LANDFORM

Hilly terrain with moderately inclined slopes of approximately 15% and relief to about 60m. The slopes are characterised by the abundance of rounded boulders and areas of sheet rock. Drainage systems are usually absent, but where present are poorly developed consisting of widely-spaced narrow watercourses.

SOILS

Lithosols (Uc 5.21). Pockets of soil amongst rock outcrop, usually only 0.1m deep and including up to 30% medium gravel. The soil material is dark reddish brown (5.0YR3/3), sandy loam in texture, pH 8.5, slightly calcareous with an earthy fabric and moderately weak consistence.
VEGETATION

A low open woodland of mulga and cypress pine with occasional bloodwood, witchetty bush, dead finish and wild orange, over blue-leaf and silver cassias and native fuschia.

The ground cover consists mainly of woollyoat grass with scattered tussocks of mulga and kangaroo grasses, copperburr and mulla mulla. Mountain wanderrie occupies rock crevices.

LAND USE IMPLICATIONS

This land unit supports grasses palatable to stock, but in a limited quantity and with difficult access. Cattle are likely to use only the most accessible areas.

The erosion risk associated with this unit is negligible. On areas trafficked by stock, pads may initiate minor rilling.

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2. PENEPLAIN SURFACES

A peneplain is a featureless, level or very slightly undulating land surface with a poorly defined drainage pattern, runoff usually dispersing as a sheet flow over large areas. In Central Australia, these surfaces are the end product of an extremely long cycle of geological erosion in the mid-Tertiary period, and are deeply weathered, featuring an intact laterite profile. Deep-weathering involves intense leaching and the breakdown of minerals, so soils which have developed on the laterite surface are of inherently low fertility.

Land units in this group include the peneplain surface (Unit 2.1), and its derivatives formed by partial stripping of the laterite profile. (Units 2.2 and 2.3).

LAND UNIT 2.1

Plains with medium-textured red earths supporting groved mulga woodland. The mulga grows in thickets (or groves) aligned on the contour of the landscape, which are spaced by relatively open areas supporting mainly wire grass.

GENERAL DESCRIPTION

Level plains; medium-textured red earths; a groved mid-high woodland of mulga with scattered broombush over wire, woollybutt and mulga mitchell grasses.

GEOLOGY

Tertiary lateritic deep-weathering profile, derived from crystalline basement rocks.
LANDFORM

Level or very gently-sloping plains, usually with gradients of less than 1%. Runoff drains by sheet flow, and defined drainage channels are absent except where traversed by major watercourses (eg. Charley Creek).

SOILS

Red earths (Gn 2.12). Typical profiles grade from a dark red (2.5YR3/6, 10.0R3/6) sandy clay loam, pH 6.0-6.5 at the surface to a red (2.5YR4/6) sandy clay, pH 6.5-7.0, by a depth of 0.6m. They have a massive structure with an earthy fabric throughout. Gravel and segregations are usually absent from the profile to a depth of at least 1.0m. The soil surface has a well-developed crust, and termite mounds are commonly present.

VEGETATION

Groved mulga woodland. The groves, aligned on the contour and up to 20m in width, consist of a mid-high open woodland of mulga with witchetty bush, native currant, broombush and native fuschia over sparse mulga mitchell grass. The intergrove areas, up to 50m wide, support a low open woodland of mulga with bloodwood and broombush over wire and woollybutt grasses, lifesaver burr and seasonally-abundant daisies.

LAND USE IMPLICATIONS

This landscape has a low potential for erosion, but storm runoff may initiate minor rilling where surface flows are concentrated by flat graded tracks or similar earthworks. If possible new roads should be planned on aerial photos to avoid low-lying areas where runoff flows will be greatest, and properly formed.

Pastures include few palatable species and are usually avoided by stock even when feed is scarce elsewhere. Mulga mitchell grass, the most acceptable feed present in any quantity, appears to disappear with prolonged grazing pressure. Similar country is known to induce the 'pegleg' phosphorus/protein deficiency syndrome in cows. Hot summer wildfires tend to promote a dense growth of unpalatable wire grass, which has no grazing value.

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LAND UNIT 2.2

Gently-sloping plains with an open cover of large mulga in association with annual grasses. Surfaces typically have a well-developed surface crust (foreground).

GENERAL DESCRIPTION

Level plains; medium-textured red earths; a mid-high open woodland of mulga over neverfall and annual grasses.

GEOLOGY

Probably partly-stripped Tertiary lateritic deep-weathering profile derived from crystalline basement rocks.

LANDFORM

Level or gently-sloping plains with gradients of less than 1% which act as broad drainage floors where runoff from upland areas flood out onto Unit 2.1. Runoff drains by sheet flow but is locally channelled by gutters.

SOILS

Red earths (Um 5.52). Typical profiles have a texture of sandy clay loam to a depth of 0.6m, grading in colour from a dark reddish brown (2.5YR3/4) at the surface to a red (2.5YR4/6) at this depth. Soil reaction trends from pH 6.0 at 0.01m to pH 7.0 at 0.3-0.5m. Profiles are massive in structure with an earthy fabric, and the soil material has moderately weak consistence (when dry) throughout. Surfaces are strongly crusted.
VEGETATION

A mid-high open woodland of mulga with scattered bloodwood and dead finish; over a ground cover of mulga, five-minute and neverfail grasses, cartwheel burr and lifesaver burr.

LAND USE IMPLICATIONS

The soils of this landscape have a moderate susceptibility to accelerated sheet wash, rilling and shallow gullying. Consequently the soil disturbance usually associated with stock watering points or yards should be avoided by locating such facilities on more stable land types. The flat grading of fencelines or tracks where sheet runoff will be concentrated and channelled downslope may initiate shallow gullying and should be avoided.

Pastures are productive and palatable to stock, so attract heavy grazing use where close to water. As a result, short-lived species such as five-minute grass have possibly replaced a greater abundance of productive annual species, particularly woollyoat grass.
LAND UNIT 2.3

Plains with weakly-crabholed red clays supporting mainly neverfail grass. Surfaces sometimes feature linear gilgai, readily visible as bands of neverfail tussocks (centre distance) and are slightly gravelly.

GENERAL DESCRIPTION

Level plains; weakly crabholed red clays; a mid-high sparse tussock grassland of neverfail, locally with cottonbush or needlewood.

GEOLoGY

Probably partly-stripped Tertiary lateritic deep-weathering profile derived from crystalline basement rocks.

LANDFORM

Level plains with slopes of less than 1.0% and very low relief. Surfaces drain by sheet flow. Linear gilgai depressions 20m in length and aligned along the contour are evident in some areas. (eg. west of Punya Dam), and crabholes are locally common.

SOILS

Red clays (Uf 6.12, Ug 6.6). Soils are sandy clay in texture to a depth of at least 0.6m, grading from a dark red (2.5YR3/6) and pH 7.5 at the surface to a red (2.5YR4/6) and pH 9.0 at this depth. They are moderately pedal with a rough-ped fabric. Surfaces are crusted and slightly gravelly with fragments of quartz and silcrete or laterite nodules.
VEGETATION

A mid-high sparse tussock grassland of neverfail, locally with sparse cottonbush or needlewood. Associated species include barley mitchell grass, feathertop wire grass, sensitive plant, cartwheel burr and copperburr. Winter rainfall response included goodenias, munyeroo and thread-petal, but with a summer growing season, woollyoat and mulga grasses could be present.

The neverfail grows within the gilgai depressions where these are present, but is of uniform distribution elsewhere.

LAND USE IMPLICATIONS

These soils have low erosion hazard and will remain stable under pastoral use. The flat grading of tracks, of course, should be avoided.

The neverfail pastures are moderately productive and relatively resilient under grazing use. Prolonged heavy grazing pressures may, however, reduce the abundance of palatable species other than neverfail and promote the growth of weedy plants such as goathead burr.
3. PEDIMENT SURFACES

Pediments are gently-sloping bedrock plains with smooth surfaces and only minor dissection by watercourses. Rainfall disperses as sheet flow. Typically, pediment surfaces occur in situations where geomorphic processes have completely stripped deeply-weathered parent materials. Since soils develop directly from freshly-weathered parent materials. Since soils develop directly from freshly-weathered parent rock, they have a superior mineral content and chemical fertility to those derived from deeply-weathered substrates.

LAND UNIT 3.1

A variable depth of alluvium mantle soils derived from underlying bedrock in this unit. The material above the stone line (at the pick handle) has been transported downslope, while the soil beneath grades into weathered rock.

GENERAL DESCRIPTION

Gently-sloping plains; sandy red earths; a mid-high sparse shrubland of geen-leaf and blue-leaf cassias with scattered bloodwoods over mulga grass.
GEOLOGY

Mafic granulites (provisionally Mt Hay Basic Granulite and Mt Chapple Granulite) and anorthosite (provisionally Mt Hay Anorthosite).

LANDFORM

Gently-sloping plains, usually as footslopes adjacent to hilly terrain. They have slopes of 1-5% with very low surface relief. Widely-spaced narrow drainage lines often flood out across the unit, depositing small alluvial fans on lower slopes. Runoff from the unit, however, is dispersed as sheet flow.

SOILS

Red earths (Gn 2.12, 2.13). A typical profile consists of a dark reddish brown (5.0YR3/3) sandy loam, pH 8.0, grading to a dark red (2.5YR3/6) light sandy clay loam, pH 8.0, by a depth of 0.1m. A stone line 0.2m thick occurs at 0.45m, overlying a red (2.5YR4/0) sandy clay loam, pH 8.5, which grades into strong brown (7.5YR5/6) light clay by a depth of 0.9m. Weathered parent material occurs at 1.6m. The profile is massive and earthy throughout. Some gravelly material is present on the surface and above the stoneline, and calcareous nodules are present at between 0.65 and 0.90m. A weak harpan occurs beneath the stone line. Surfaces have a well-developed crust.

In the presence of small floodouts, where a greater depth of alluvium mantles the parent material, the stone line is not always present. Profiles grade from a dark reddish brown (5.0YR3/4) sandy loam, pH 6.5, at the surface to a reddish brown (5.0YR4/4) sandy clay by 0.6m.

VEGETATION

A mid-high sparse shrubland of green-leaf and blue-leaf cassias, broombush and dead finish over pastures of mulga grass. Scattered whitewood, bloodwood, and long-leaved corkwood are often present. Other common pasture species include woollyoat grass, lifesaver burr, mungaroo and potato bush, with desert bluegrass, woollybutt and ribbon grasses on small floodout areas.

LAND USE IMPLICATIONS

The soils of this unit have a low wind erosion hazard and a slight to moderate water erosion hazard. In particular, small alluvial deposits are subject to gully erosion if sheet runoff is concentrated into a channel by a surface disturbance such as a graded line, windrow or stock pad. Such a gully is active 3.5 km south-west of Kuranji Bore. Imperceptible sheet erosion may also result from the effect of storm runoff when groundcover is sparse. It is often only evident through the presence of gritty lag deposits on the soil surface and areas of weedy pasture growth.

Mulga grass pastures are palatable and productive when green, but acceptability declines with haying off. The woollyoat grass component accounts for much of their productivity, but is subjected to selective grazing pressure. Spelling during the summer growth period will assist in maintaining the vigour of this species by permitting seed setting.

The abundance of blue-leaf and green-leaf cassias has increased dramatically on this type of country over the past 15 years throughout central Australia. Pastoral productivity has been affected as a result on some areas. Burning practices may provide an avenue for the control of seedling shrubs if sufficient ground fuel to carry a fire can be accumulated.
LAND UNIT 3.2

Gently-undulating plains, often with scattered rock outcrop and gravelly surfaces, carrying an open woodland of mulga and whitewood over annual grasses. Low shrubs, mainly blue-leaf cassia and fuschia bush, are common on many areas.

GENERAL DESCRIPTION

Gently-sloping plains; medium-textured red earths; a mid-high open woodland of mulga with scattered broombush over mulga grass.

GEOLOGY

Mafic granulites (provisionally Mt Hay Basic Granulite and Mt Chapple Granulite) and anorthosite (provisionally Mt Hay Anorthosite).

LANDFORM

Gently-undulating plains with slopes of 1.0% or less and very low surface relief. Runoff disperses by sheet flow hence drainage features are absent. Rock outcrop is present on less than 1% of the unit.

SOILS

Red earths (Gn 2.13). Typical profiles grade from a dark red (2.5YR3/6) sandy clay loam, pH 7.0, at the surface to a dark red sandy clay, pH 7.5, at 0.1m, and a red (2.5YR4/6) ligh clay by a depth of 0.3m. Gravelly material is present at a depth of 0.4-0.6m. Profiles are massive and earthy throughout. Surfaces are crusted and often gravelly.
VEGETATION

A mid-high open woodland of mulga with scattered whitewood, bloodwood, long-leaved corkwood, broombush, blue-leaf cassia and rock fuchsia bush over pastures of mulga grass. Conkleberry and neverfail grass are sometimes present in narrow bands across the slope. Other groundcover species commonly recorded include five-minute and eight-day grasses, cartwheel burr and manyeroo.

LAND USE IMPLICATIONS

The soils of this unit have a slight water erosion hazard. Surface disturbances such as grader windrows which trap and channel sheet runoff flows across slopes may initiate the formation of rills. Imperceptible sheet erosion will occur if bare areas are subjected to storm runoff. This may only be evident through the development of gritty lag deposits on surfaces, wash features and areas of poor pasture growth, but can have a significant impact on productivity.

The mulga grass pastures are moderately productive. Mulga grass is of low palatability when dry, and much of the grazing value of these areas lies in less abundant species, particularly woollycoat grass. Spelling during the summer growth period can assist in maintaining the vigour of this grass.

Broombush, blue-leaf cassia and rock fuchsia bush have increased in abundance on this type of country throughout the district over the last 15 years, often to the point where pasture growth and accessibility have been affected. Burning practices may reduce shrub densities and destroy seedling growth in situations where sufficient ground fuel can accumulate.
4. **PIEDMONT FANS**

The piedmont zone is the area immediately at the foot of a mountain slope. Fans of detrital material of both alluvial (water-borne) and colluvial (mass wasting) origin accumulate in this zone as the change in slope from hillslope to plain promotes deposition.

Three phases of deposition, probably correlating with major fluctuations in climate, are evident on the plains at the foot at Mt Hay and Mt Chapple.

The most recent deposit, Unit 4.1, lies directly at the foot of the range and consists of coarse gravelly material. It overlies an older, more extensive deposit, mapped as Unit 4.2. This in turn partly mantles the residual surface of a much larger fan, Unit 4.3, recognizable as a slightly elevated, level gilgaied plain. This fan has been extensively dissected, exposing stripped surfaces (Unit 4.4) and releasing large quantities of alluvium (Units 4.5, 4.6 and 4.7).

**LAND UNIT 4.1**

Fans of coarse gravel and cobbles are present as an apron at the base of Unit 1.1, in re-entrant areas. Weeping spinifex (foreground) predominates.
GENERAL DESCRIPTION

Gently-sloping colluvial fans; gravelly soils; a tall open hummock grassland of weeping spinifex with scattered mulga and bloodwood.

GEOLOGY

Quaternary colluvial gravels.

LANDFORM

Fans of colluvial gravels, usually less than 300m in length, forming a discontinuous apron along the base of mountain slopes. Fan surfaces are extremely gravelly and have slopes of at least 4%. They are traversed by narrow watercourse channels which flood-out downslope. This unit is superimposed on Unit 4.2.

SOILS

Lithosols (Uc 1.23). Surfaces are of coarse gravel and little soil material is present. It consists of a dark reddish brown (2.5YR3/4) loamy sand, pH 7.0 with an earthy fabric.

VEGETATION

A tall open hummock grassland of weeping spinifex with scattered mulga and bloodwood. Other species present include blue mallee, umbrella bush, sandhill wattle, blue-leaf and green-leaf cassias and native fuschia.

LAND USE IMPLICATIONS

The gravelly nature of these surfaces minimizes the risk of erosion.

The unit has no pastoral value.
Gently-sloping terraces flanking the base of Unit 1.1 having surfaces strewn with cobbles and coarse gravel. They support mulga, rock fuschia bush and annual grasses.

GENERAL DESCRIPTION

Gently-sloping colluvial surfaces; stony, heavy-textured red earths; a mid-high open woodland of mulga with fuschia bush over mulga grass.

GEOLGY

Quaternary colluvial gravels and alluvium.

LANDFORM

Colluvial terraces, as gently-sloping plains inclined at 2% flanking mountainous terrain, usually downslope of Unit 4.1. Surfaces are gravelly with many large cobbles, and drain by sheet flow. Watercourses traversing the unit are broad, shallow and stony.
SOILS

Red earths (Uf 6.12). Typically a dark red (2.5YR3/6) light clay or fine sandy clay loam, pH 6.5-7.0, with a strongly pedal structure and rough ped fabric overlying a dark reddish brown (2.5YR3/4) medium clay, pH 8.5, with strongly developed smooth-faced peds at a depth of 0.4m. The texture boundary is marked by a distinct hardpan. Rounded tabular cobbles 70mm in diameter occupy 10% of the soil volume. Surfaces are crusted and strewn with coarse gravel and cobbles of granulite, fragments of quartz, and laterite nodules.

VEGETATION

A mid-high open woodland of mulga with scattered bloodwood over a shrub layer of rock fuschia bush, green-leaf and blue-leaf cassias, native fuschia and witchetty bush. The groundcover consists of mulga grass with minor neverfail, woollyoat grass, buckbush, cartwheel burr, veined peppercress and munyeroo. Wire grass and silky browntop are present in watercourse channels.

LAND USE IMPLICATIONS

These soils have a low erosion potential due to their fine texture and gravelly surface cover. However surface disturbances that intercept and channel sheet runoff flows will initiate minor rilling. The flat grading of tracks and fencelines should therefore be avoided.

Pastures have a moderate grazing potential.
Slightly elevated, gently-inclined plains with gilgaied red clays supporting barley mitchell grass. Surfaces usually have an abundance of large cobbles and gravel (foreground).

GENERAL DESCRIPTION

Level or gently-sloping colluvial surfaces; cobbly gilgaied red clays; a mid-high sparse tussock grassland of barley mitchell grass.

GEOLOGY

Quaternary colluvial gravels and alluvium.

LANDFORM

Fan surfaces, occurring as very gently inclined plains with slopes of 1% or less and very low surface relief. Surfaces feature crabhole gilgal with depressions 0.3m deep and 2m in diameter. Shallow drainage lines carry
upslope runoff across the unit. Low rises of stony material 0.5m in height are occasionally present.

The relationship between these plains and Unit 4.2 is unclear. Land Unit 4.2 may consist of a more recent deposit partly burying Unit 4.3. Alternatively, Unit 4.3 may be a residual surface which developed as Unit 4.2 was stripped by erosion processes. The existing areas of Unit 4.2 would then be relicts of an older, more extensive fan surface.

SOILS

Red clays (Ug 6.3). Profiles consist of a yellowish red (5.OYR4/6) or red (2.5YR4/6) medium clay, pH 8.5-9.0, strongly pedal with a rough-ped fabric, to a depth of at least 0.6m. Gravel is absent or comprises less than 5% of soil volume. Surfaces are crusted but self-mulching, and strewn with a 5-50% cover of gravel and cobbles of granulite or quartz. Nodules of laterite are locally abundant on the surface.

VEGETATION

A mid-high sparse tussock grassland of barley mitchell grass. Associated species include feathertop wire grass, buckbush and sunray (following winter rainfall), with neverfall, Queensland bluegrass, rhyncosia, goathead burr and native panic in depressions

LAND USE IMPLICATIONS

This land type has a low erosion hazard under pastoral use. The banks of minor drainage lines (see Unit 4.6) exhibit active slumping after rains, but other forms of soil loss are of negligible consequence.

Pastures are only of moderate palatability but produce a large bulk of feed.
LAND UNIT 4.4

Very gently-sloping plains with gravelly surfaces, lacking gilgai or seasonal cracking features, and supporting sparse neverfail, annual grasses and herbage (foreground). The dense growth of mitchell grass (distance) is specific to Unit 4.5 which has a different soil type.

GENERAL DESCRIPTION

Gently-sloping plains; gravelly red clays; a sparse tussock grassland of neverfail.

GEOLOGY

Quaternary colluvial gravels and alluvium.

LANDFORM

Very gently inclined plains with slopes of 1% or less and very low surface relief. Broad drainage lines with cracking clays (see Unit 4.6) pass through the unit, but are not marked by an appreciable change in relief. Surfaces are not gilgaied. The plains are an erosional surface which has developed through the dissection of Unit 4.3, which is an older landscape.

SOILS

Red clays (Uf6.12). Profiles are uniform in texture, usually a light clay, to a depth of 0.5m, but grade from a dark reddish brown (5.0YR3/4) and pH 7.5-8.5 at the surface to a yellowish red (5.0YR4/6) and pH 8.5-9.0. They are
strongly pedal, consisting of 10-15mm diameter subangular blocky rough-faced peds. Surfaces are crusted and carry a 10-25% cover of coarse gravel and cobbles of granulite or quartz. Fragments of silcrete and laterite nodules are locally common. Gravel is seldom present within the profile.

VEGETATION

A mid-high sparse tussock grassland of neverfail. Associated species include woollyoat, mulga, umbrella and feathertop wire grasses, buckbush, goathead burr, silky copperburr and sida. Barley mitchell grass grows on the cracking clays in depressions (see Unit 4.6).

LAND USE IMPLICATIONS

The soils of this unit have a low erosion hazard under pastoral use.

Pastures are moderately productive and resilient under average grazing management. Buffel grass will establish on red clays, but generally provides a better result when seeded into sandier soils such as those of Unit 6.1.
Level alluvial plains consisting of red clays with strong seasonal cracking features and resultant uneven surfaces (foreground). Gilgai are absent. Pastures are dominated by barley mitchell grass.

GENERAL DESCRIPTION

Low-lying alluvial plains; deeply cracking brown clays; a mid-high open tussock grassland of barley mitchell grass.

GEOLOGY

Quaternary alluvium

LANDFORM

Level alluvial plains with gradients of less than 1%, dissected by meandering stream channels 2m deep and up to 15m in width, which flood out via a network of small distributary depressions in low-lying areas. Relict meander channels are often visible in the vicinity of existing creeklines, and channel migration through streambank slumping is a continuing and active process. Surfaces are not gilgaied, but exhibit deep seasonal cracking.

SOILS

Red clays (Ug 6.3). Soil colour, texture and reaction are commonly uniform to a depth of 1.0m, as a dark reddish brown (5.0YR3/4) or reddish brown (5.0YR4/4) light medium clay or medium clay, pH 8.0-9.0, slightly or non-
calcareous. Profiles are strongly pedal, consisting of granular rough-faced peds to a depth of 0.1m, below which subangular blocky rough-faced peds predominate. Surfaces are crusted but self-mulching, and feature a strong seasonal cracking pattern with a polygonal pattern of fissures to 0.3m deep and a 0.1m in width. Gravel is absent from the profile.

VEGETATION

A tall sparse tussock grassland of barley mitchell grass. Other species present include red flinders grass, feathertop wire grass, neverfail, desert spurge, threadpetal, Bogan flea, verbine and munyeroo. River red gum forms a corridor along major creek channels, prickly wattle and mimosa bush colonizing prior channels.

LAND USE IMPLICATIONS

The soils have a low erosion hazard under pastoral use. Active stream migration is a normal process in this landscape, and results in the slumping of banks after creek flows. Gully encroachment where sheet flows from upslope terrain enter stream channels may be accelerated where the impact of stock is intense, such as at Valley Bore. However, the resultant headward movement of channels is unlikely to extend beyond the boundary of the land unit.

Pastures are of moderate quality but high productivity, and are resilient under grazing pressure. Prolonged grazing pressure may increase the prevalence of short-lived or unpalatable herbage species in the pasture as the more palatable species such as rhyncosia are grazed out.
Level plains with red clays, usually supporting fork-leaved corkwood in association with pastures of neverfail grass.

GENERAL DESCRIPTION

Level plains; red clays; a low open woodland of fork-leaved corkwood over neverfail grass.

GEOLOGY

Probably Quaternary alluvium.

LANDFORM

Level plains with slopes of less than 1% and very low surface relief, with no drainage features. They are usually slightly elevated above surrounding alluvial landscapes. Crabholes are present in localized areas, but are not common.

SOILS

Red clays (Uf 6.12). Soil colour and texture are commonly uniform down the profile, typically a dark red (2.5YR3/6) or yellowish red (5.0YR4/6) sandy clay or light clay to a depth of up to 0.9m. Local variations include sandy clay loam surface textures and sandy horizons at depth. Soil reaction is usually in the range pH 7.0-8.0 at the surface and pH 7.5-8.5 by a depth of 0.4m. Profiles have a moderately pedal structure in the upper 0.5m, consisting predominantly of subangular blocky rough-faced peds, 5-50mm in...
diameter. The abundance of fine and coarse gravel within the profile is variable, but surfaces usually carry a 5-10% cover of fine and coarse gravels, often quartz and calcified granite. Nodules of laterite or calcrete are occasionally present. A strong surface crust is always present.

VEGETATION

A low open woodland of fork-leaved corkwood with bloodwood, silver cassia, dead finish and mimosa bush over pastures of neverfail. Following winter rains, stinking threadpetal was dominant, but other species present include copperburr, sensitive plant, munyeroo and five-minute grass. Land with sandy clay loam surfaces supports whitewood with conkleberry and broombush, and some areas are treeless.

LAND USE IMPLICATIONS

These soils have a low erosion hazard under pastoral use. They exhibit some shrink-swell behaviour on wetting and drying, but may be more stable for structural foundations than adjacent mitchell grass soils.

Pastures supported a winter-rainfall response of short-lived herbage species when surveyed. They are likely to be moderately productive following summer rainfalls given the abundance of neverfail. Buffel grass will establish on these red clays, but will not respond and spread as well as on sandier soils.
LAND UNIT 4.7

Swamps with strongly cracking red clays supporting a shrub cover of northern bluebush. The groundcover consists mainly of Bogan flea at this site.

GENERAL DESCRIPTION

Low lying alluvial plains; deeply cracking red clays; a low sparse shrubland of northern bluebush.

GEOLOGY

Quaternary alluvium.

LANDFORM

Level alluvial plains with very low surface relief, forming terminal drainage basins. Surfaces exhibit pronounced seasonal cracking with fissures 1.0m deep, 0.1m in width and forming polygons 1.0m across.
SOILS

Red clays (Ug 6.3). The soil material consists of a dark red (2.5YR3/6) light clay, pH 8.5, to a depth of 0.1m, grading into a red (2.5YR4/6) light medium clay, pH 7.5 to a depth of at least 0.6m. Profiles are strongly pedal at the surface, with granular, rough-faced peds 20mm in diameter, becoming less distinct with depth. Surfaces are self-mulching and crusted, occasionally with a few small fragments of silcrete.

VEGETATION

A low sparse chenopod shrubland of northern bluebush. Associated species include sickle lovegrass, verbine, Bogan flea, cartwheel burr and bergia.

LAND USE IMPLICATIONS

These soils have a very low erosion hazard. They will remain untrafficable for a considerable period after wetting, and because of their marked shrink-swell, are unsuitable for the foundation of structures.

Northern bluebush is a palatable and nutritious shrub which is complemented in these pastures by verbine, a high quality herbage species. Both can be eliminated by prolonged heavy grazing pressures (ie total defoliation of the bluebush).
5. LIMESTONE PLAINS

Limestone-like materials have formed in two situations on Amburla.

The calcretes of Unit 5.1 have developed where calcium carbonate has been precipitated from a groundwater table to cement sand and gravel into a solid mass. Calcrete formation usually occurs when groundwater tables are falling with the onset of arid climatic conditions, and is associated with sites where they are at a shallow depth, such as at the foot of gravelly colluvial fans.

The silcretes and calcareous siltstones of Unit 5.2 are older materials which developed on the floor of a Tertiary lake. The dissection and removal of the silcrete capping by erosion since the late Tertiary has exposed the calcareous substrate on which the cracking clays of Unit 5.3 have developed.

LAND UNIT 5.1

GENERAL DESCRIPTION

Low rises; red calcareous soils; a mid high open woodland of bloodwood over limestone oat grass.

GEOLOGY

Quaternary calcretes.

LANDFORM

Low rises with slopes of up to 2% and relief to 3m. Drainage features are absent except where watercourses from upslope cross the unit. The unit generally occurs in association with sandy floodouts (Unit 6.1) and gravelly terraces (Unit 4.2) adjacent to the ranges.

SOILS

Red calcareous soils (Gc 1.12). To a depth of about 0.3m, these are yellowish red (5.YR4/6) with a texture of light sandy clay loam and containing up to 30% by volume coarse and fine gravel. They then grade into a dark reddish brown (5.YR3/4) sandy clay loam with up to 40% gravel, and coarse material predominates beneath 0.4m. Most of the gravel consists of rounded fragments of granulite with a calcium carbonate surface coating. Soil reaction is alkaline, usually pH 9.0 and calcareous. Profiles are massive and earthy throughout. Surfaces are crusted and have a cover of up to 60% fine and coarse gravel.

VEGETATION

A mid-high open woodland of bloodwood with long-leaved corkwood, needlewood and broombush, over pastures consisting of limestone oat and oat grasses, kerosene grass, sida and copperburr.

LAND MANAGEMENT IMPLICATIONS

These soils are subject to both sheet erosion by storm runoff and windstripping when vegetation cover is sparse. Soil loss results in an increasingly gravelly surface with revegetates poorly. Calcareous soils are a favoured habitat of rabbits, which promote pasture degeneration and
erosion. Ripping and fumigation is an effective control practice where infestations are localized.

These pastures produce a moderate quantity of palatable feed when in good condition. However valuable annual species, particularly oat grass, can be grazed out and replaced by sidas and other herbage species under continual heavy grazing pressures. Limestone oat grass, which is unpalatable, also increases in abundance in this unit as pasture condition deteriorates.

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Level, slightly elevated plains with red earth soils supporting open mulga (weeping form) and annual grasses. Chalcedony gravel is abundant on the soil surface (foreground).

GENERAL DESCRIPTION

Low platforms of chalcedony outcrop; heavy-textured red earths; a low open woodland of mulga over neverfail and mulga grasses.

GEOLOGY

Tertiary chalcedony overlying calcareous sandstone, siltstone and mudstone (possibly Waite Formation).

LANDFORM

Platforms with level surfaces and relief to 1.0m above surrounding terrain. Rock outcrop occupies about 5% of the surface area. No defined drainage features.
SOILS

Red earths (Gn 4.13). Profiles consist of a dark reddish brown (2.5YR3/4) sandy clay loam, pH 6.5, to a depth of 0.1m, grading to a dark red (2.5YR3/6) light clay, pH 7.5. This merges into sandy clay, pH 9.0, by a depth of 0.3m. The soil material is weakly to moderately pedal, consisting predominantly of rough-faced polyhedral peds to 20mm diameter, with a trend to moderately strong consistence by a depth of 0.5m. Profiles contain up to 5% chert gravel, and surfaces are very gravelly (up to 60%), providing protection from sheet erosion. Crusting is also a feature of soil surfaces.

VEGETATION

A low open woodland of mulga (weeping growth-form locally dominant) with silver cassia, broombush and rock fuschia bush over neverfail, mulga and five-minute grasses and cartwheel burr. Stinking threadpetal was common after winter rains.

LAND USE IMPLICATIONS

The soils on this type of country have only a slight erosion hazard and the mantle of surface gravel acts to protect them from erosion. Removal of the gravel by flat grading during track or fence construction is undesirable as the channelling of runoff may initiate scouring.

Pastures are moderately productive and resilient under moderate grazing pressure. Excessive grazing pressure will lead to a predominance of short-lived species such as five-minute grass.
LAND UNIT 5.3

Plains with gilgaied, calcareous red clays supporting barley mitchell grass.

GENERAL DESCRIPTION

Level plains; gilgaied, slightly calcareous red clays; a tall sparse tussock grassland of barley mitchell grass.

GEOLOGY

Possibly Tertiary calcareous siltstone (Waite Formation).

LANDFORM

Level or slightly undulating plains with slopes of 1% or less and very low surface relief. Areas receiving run-on from upslope terrain possess a network of minor drainage lines which are visible on aerial photography but indistinguishable on the ground. However, most areas exhibit no drainage features. All surfaces have well-developed crabhole gilgai relief. This
landscape is probably an erosional product of the dissection of the silcrete surface mapped as Unit 5.2.

SOILS

Red clays (Ug 5.38) Profiles consist of a dark reddish brown (2.5YR3/4) or red (2.5YR3/6) light clay, pH 8.5-9.0 and slightly to highly calcareous to about 0.3m, grading to a dark red (2.5YR3/6) medium to heavy clay, pH 8.5-9.0 and highly calcareous. Highly calcareous, reddish brown (2.5YR4/4) heavy clays, pH 9.0, were recorded to a depth of about 1.0m. They have a high degree of pedality throughout with granular or polyhedral rough-faced peds to a depth of 0.1m, below which angular blocky smooth-faced peds predominate.

Few coarse fragments are present within the profile, but surfaces commonly have a 5-25% cover of quartz and silcrete gravel, together with nodules of calcrete and laterite. There is a well-developed surface crust.

VEGETATION

A tall sparse tussock grassland of barley mitchell grass. Other species present include neverfail, weeping mitchell grass, feathertop wire grass, rhynchosia, desert spurge, verbine, woollyoat grass and buckbush.

LAND USE IMPLICATIONS

These soils are inherently stable and therefore have a very low erosion hazard. The clays shrink and swell with wetting and drying, and consequently provide an unsuitable foundation for major structures.

Pastures are moderately palatable to stock and highly productive, producing a large bulk of feed. Annual grasses and herbage species provide the greatest nutritional value, but the mitchell grass maintains palatable dry material throughout the year.
6. FLOODPLAINS AND FLOODOUTS

These units consist of active alluvial systems formed by existing watercourses under the influence of the present climatic regime. Unit 6.1 consists of coarse-textured alluvium deposited when creeks arising in hilly terrain drop their sediment where they spill out onto the plains. Unit 6.2 consists of re-distributed fine-textured alluvium derived from colluvial deposits (Units 4.1-4.6).

LAND UNIT 6.1

The layering of sandy sediments and gravels characteristic of this unit is visible in the bank of this creek south-east of Valley Bore. Kerosene grass (foreground) and woollybutt dominate pastures.

GENERAL DESCRIPTION

Alluvial fans flanking ranges; sandy brown alluvial soils; a mid-high open woodland of bloodwood, whitewood, supplejack and ironwood over woollybutt and kerosene grasses.

GEOLOGY

Holocene alluvial deposits.

LANDFORM

Alluvial fans, typically present where creeklines exit hilly terrain and flood out on adjacent plains, fed by a central watercourse channel branching into minor distributaries. Surfaces have slopes of 1% or less and low relief, often slightly hummocky.
SOILS

Alluvial soils (Uc 5.21). These soils commonly consist of layered sediments and occasionally gravels. Most profiles are sandy loam in texture to a depth of about 1.0m, grading in colour from a dark reddish brown (5.0YR3/4) at the surface to a yellowish red (5.0YR4/6) at this depth. Soil reaction is alkaline, with surface values of pH 7.5-8.0 trending to pH 8.0-9.0 at 0.5-1.0m depth, but calcium carbonate is not present. Gravelly horizons, commonly of granite pebbles with a calcified skin, are sometimes present at depths of 0.6-1.5m, but surfaces usually have a less than 5% cover of coarse material. Profiles have massive structure with an earthy fabric. Surfaces are crusted.

VEGETATION

A mid-high open woodland of bloodwood, whitewood, supplejack and ironwood, with scattered beefwood, prickly wattle and broombush, over woollybutt and kerosene grasses. Other pasture species recorded include three-awn wanderrie, oat grass, mulga grass, rough wire grass, sida, buckbush, Chinese lantern, caltrop and tarvine. Silky brown top, curly windmill grass, desert bluegrass and wire grass are often present along watercourses, together with inland teatree.

LAND USE IMPLICATIONS

These areas have a moderate wind erosion hazard and will tend to drift when bare and disturbed. Gully erosion can also occur if runoff is intercepted and channelled by stock pads or flat graded lines. Ideally watering points and other improvements should be located away from this land type to minimize soil disturbance.

Pastures are of low to moderate productivity. Kerosene and woollybutt grasses are only grazed when more palatable feed is unavailable. Consequently, heavy grazing pressures will selectively eliminate minor species such as oat grass. Dense shrub growth sometimes establishes on this type of country during a run of favourable seasons. Buffel grass should establish readily on these soils.

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LAND UNIT 6.2

Floodouts with the medium-textured red earths supporting dense mulga. Pastures under the dense canopy cover are often sparse, consisting mainly of tussocks of neverfail grass.

GENERAL DESCRIPTION

Floodplains and floodouts along creek channels; heavy-textured brown alluvial soils; a mid-high open woodland of bloodwood, ironwood, river red gum and mulga over silky browntop.

GEOLOGY

Holocene alluvium.

LANDFORM

Floodplains and floodouts along creek channels (Charley and Amburla Creeks), with slopes of less than 1% in the direction of flow and hummocky surface relief of up to 1m. The floodplains range in width from 200m to 1.2 km, and usually have one or more braided channels 1.5m deep with a sandy bed load. Relict flood channels are evident as shallow depressions.

SOILS

Brown alluvial soils (Uf 6.12). Profiles typically consist of a weakly pedal reddish brown (5.0YR4/4) light clay, pH 7.0-8.5, to a depth of 0.1m, merging into a weakly pedal yellowish red (5.0YR4/6) sandy clay, pH 7.5-8.0 to a depth of 0.7m. Below this depth, soil structure tends to be massive and earthy. In the upper part of the profile, pedality is expressed as small subangular
blocky or granular rough-faced peds. Gravelly layers are sometimes present. Surfaces are crusted and often covered with litter.

VEGETATION

A mid-high open woodland of bloodwood and ironwood with scattered mulga in association with a shrub layer of broombush, prickly wattle, silver cassia, dead finish and emu-bush, over pastures of silky browntop with neverfail, golden beard grass, desert bluegrass, oat kangaroo grass, curly windmill grass, yellow top and verbine. River red gum lines the creek channels.

LAND USE IMPLICATIONS

The soils of these areas have a low erosion hazard under pastoral use. However graded lines or tracks along the unit may divert flood flows and scour out. To maximize trafficability and minimize erosion potential, tracks should be located on adjacent, more stable land types. The unit is subject to occasional flooding.

Pastures are of low palatability but high productivity. Most of the perennial grasses are attractive to stock while green (when plenty of other feed is available), but decline in digestibility and value with haying off. Consequently minor herbage species and annual grasses are most sought after by stock in dry conditions.
Floodouts with medium-textured red earths supporting dense mulga. Pastures under the dense canopy cover are often sparse, consisting mainly of tussocks of neverfail grass.

GENERAL DESCRIPTION

Drainage floors; heavy-textured red earths; a mid-high woodland of mulga over neverfail grass.

GEOLOGY

Quaternary alluvium

LANDFORM

Level or very gently sloping drainage floors with slopes of less than 1% and featureless surfaces that drain by sheet flow. The unit includes several small swamps north of Twin Bore.
SOILS

Red earths (Gn 2.12). Profiles usually consist of a dark reddish brown (2.5YR3/4) or dark red (2.5YR3/6) sandy clay loam, pH 6.0, to a depth of 0.1m, below which it grades to a red (2.5YR4/6) sandy clay, pH 7.0, to at least 0.6m. They are massive and earthy throughout, although variants exhibit weak pedality, particularly where crabholed. Surfaces are crusted, carry a 70-80% cover of litter and surface deposits of fine gravelly material are locally abundant. Termitaria are occasionally present. The soils of the small swamps near Twin Bore have strong seasonal cracking characteristics resulting in the formation of small crabholes.

VEGETATION

A mid-high woodland of mulga over a ground cover of neverfail grass with lifesaver burr, manyeroo, curly windmill grass and climbing saltbush. Witchetty bush, ironwood, native currant and broombush are often present but uncommon.

LAND USE IMPLICATIONS

In most situations these soils have a low erosion hazard. However flat graded roads and similar earthworks which trap and channel sheet runoff flows will tend to scour out, depositing sandy sediment on downslope stretches of track. Additionally, the disruption of sheet flooding by the channelling of runoff flows will drought pastures downslope of the wash-out. These effects are evident several kilometres north-west of Amburla homestead. Tracks and graded lines are best located on adjacent, more stable soils than on this land unit if such problems are to be avoided. Sheet flooding of the unit is likely following prolonged heavy rainfall. Pastures consist predominantly of neverfail which is both productive and resilient under moderate grazing pressure.
7. RELICT ALLUVIAL PLAINS

Relict floodout deposits, probably of Pleistocene age, occupy much of Amburla, veneering peneplain, pediment and other older surfaces. They were once active floodout systems fed by 16 Mile Creek, Charley Creek and watercourses arising in the Mt Hay range during a period when climatic conditions were much moister than at present. Although channel features remain visible in some areas (see Unit 7.5), it is unlikely that they would carry contemporary flows in other than exceptional floods.

**LAND UNIT 7.1**

![Image of Level plains with red clays carrying neverfail grass. The soils have strong seasonal cracking characteristics, which results in a very uneven surface and the formation of small crabholes.]

**GENERAL DESCRIPTION**

Drainage floors, crabholed red clays; a mid-high sparse tussock grassland of neverfail grass.

**GEOLOGY**

Quaternary alluvium

**LANDFORM**

Level or very gently-sloping drainage floors or closed depressions, with slopes of less than 1.0%. They are usually featureless, but shallow drainage lines pass near Kuranjí Bore together with relict watercourse features. Units 7.1 and 7.3 partially overlie this landscape, creating closed depressions.
SOILS

Red clays (Ug 6.3). The surface material is typically a light clay, pH 8.0, trending to a medium clay, pH 8.5, by a depth of 0.3m. Soil colour remains relatively uniform with depth, either as dark reddish brown (5.0YR3/4) or a yellowish red (5.0YR4/6). Profiles are moderately pedal throughout, consisting of subangular blocky rough-faced peds. A marked increase in consistence from moderately weak to very firm (dry) was noted at 0.6m. Surfaces are crusted and exhibit a strong seasonal cracking pattern producing crabholes to 0.5m deep, 0.3m diameter and 2.0m apart. They are sometimes slightly gravelly.

VEGETATION

A mid-high sparse tussock grassland of neverfail. Minor species present include cartwheel burr, sida and copperburr.

LAND USE IMPLICATIONS

In most situations this unit is a stable landscape with a low erosion hazard. The heavy soil texture and rough surface condition minimise the potential for sheet wash. However the development of a large gully system at the head of a drainage channel 5 km north-west of Amburla homestead suggests that care should be exercised with the siting of earthworks for tracks or other purposes to ensure that sheet runoff flows are not intercepted and channelled.

Sheet flooding of the unit is possible following prolonged heavy rainfall. The clays swell markedly on wetting, providing an unstable foundation for the construction of improvements.
LAND UNIT 7.2

Sandplain with red earthy sands supporting mulga or witchetty bush and commonly broombush (foreground) over sparse pastures of woollybutt grass.

GENERAL DESCRIPTION

Low rises, merging into sandplain; red earthy sands; a low open woodland of mulga and witchetty bush over woollybutt grass.

GEOLOGY

Pleistocene alluvium

LANDFORM

Relict alluvial plains and floodout deposits, as sinuous braided low rises to 300m in width with relief to 2m, merging into featureless sandplain. Slope is less than 1% and drainage features are absent.

SOILS

Earthy sands (Uc 5.21, Gn 2.12 minor). Soils are usually of uniform texture, a sandy loam, to a depth of at least 1.0m, but in some cases heavier textures are encountered within 0.6m of the surface. Soil colour is a dark red (2.5YR3/6) or red (2.5YR4/6) throughout. Soil reaction trend is from pH 6.0-6.5 at the surface to pH 7.0-8.0 at about 0.6m depth, and the profile is massive and earthy. Gravel is absent. Surfaces are weakly crusted and partially veneered by gritty deposits.
VEGETATION

A mid-high open woodland of mulga, merging with a tall open shrubland of witchetty bush, with broombush over pastures of woollybutt. Other species present include wire, woollybutt wanderrie, kerosene, oat and mulga grasses, lifesaver burr and potato bush.

LAND USE IMPLICATIONS

These soils have a low erosion hazard under pastoral use. However the coarse surface texture would render these soils subject to wind erosion if the vegetation cover is removed. Earthworks will initiate only minor wash with storm runoff.

Pastures are of low palatability and productivity but are resilient under grazing use. Woollybutt is sparingly palatable while green, becoming less digestible as it dries off. Minor herbage species and annual grasses provide much of the feed value of these pastures. Buffel grass should establish readily if seeded into these soils with a pitter.
LAND UNIT 7.3

The soils of this unit have slightly sandier surface textures than Unit 7.2, and support open whitewood with woollybutt pastures. Shrubs such as weeping emu-bush (foreground) are commonly present.

GENERAL DESCRIPTION

Low rises; red earthy sands; a mid-high open woodland of whitewood over woollybutt grass.

GEOLOGY

Pleistocene alluvium

LANDFORM

Sandplain associated with Unit 7.1, as parts of low sinuous rises that comprise relict floodout deposits. These areas are possibly the result of wind action modifying Unit 7.1 during aridity in the late Pleistocene. Surfaces are featureless.

SOILS

Earthy sands (Uc 5.21). Surface soils are clayey sand in texture to a depth of 0.3m, below which they grade into a sandy loam to a depth of at least 0.9m. Soil colour is a red (2.5YR4/6, 2.5YR4/8), and soil reaction pH 7.0 throughout the profile. They are massive soils with an earthy fabric. Layers with up to 10% medium gravel were recorded between 0.6 and 0.9m. Surfaces have a weak crust which is extensively veneered by a deposit of coarse sand.
VEGETATION

A mid-high open woodland of whitewood with some fork-leaved corkwood and scattered broombush, dead finish and spiny saltbush over pastures of woollybutt and woollybutt wanderrrie grasses.

LAND USE IMPLICATIONS

The coarse-texture of the surface soil on this unit suggests that it could have a moderate wind erosion risk. However, soil movement does not seem to present a major problem on highly disturbed areas such as at Kuranji and Mt Hay Bores. Elsewhere, low drift mounds were recorded around dead timber. Discretion should therefore be exercised in locating improvements on this type of country.

Pastures are of moderate productivity but the main species, woollybutt, has poor palatability when dry. The soils of this unit are well-suited to the establishment of buffel grass.
Depressions with relatively sandy soils, supporting dense mulga and pastures of eight-day grass. These differ from Unit 6.3, which has heavier soils and more productive pastures based on neverfail grass.

GENERAL DESCRIPTION

Low-lying areas within sandplain; sandy red earths; a mid-high woodland of mulga over eight-day grass.

GEOLOGY

Pleistocene alluvium.

LANDFORM

Low-lying plains and depressions with slopes of less than 1% and featureless surfaces. They mainly occur where sandy alluvium has buried older drainage floors, and although they may carry run-on flows during very heavy rainfalls, subsurface drainage may have a greater role in supporting their dense growth of mulga.
SOILS
Sandy red earths (Gn 2.12). Typical profiles have a dark red (2.5YR3/6) sandy loam surface, pH 6.5, grading to a red (2.5YR4/6) colour by a depth of 0.3m. Texture becomes slightly heavier with depth, a light sandy clay loam by 0.6m and a sandy clay loam by 0.9m, but colour and pH remain uniform. They have a massive structure and earthy fabric throughout. Surfaces are weakly crusted.

VEGETATION
A mid-high woodland of mulga with scattered witchetty bush, ironwood, native currant, silver cassia and native fuschia, over eight-day grass pastures.

Tusocks of cotton panic grass grow beneath the mulga canopy, and stinking threadpetal was recorded as abundant after winter rainfall.

LAND USE IMPLICATIONS
The soils of this unit have a low erosion hazard under pastoral use. However stock pads, tracks and graded lines which intercept and channel runoff flows are likely to suffer minor wash after heavy rainfalls. Minor wind erosion may occur if large areas of vegetation cover are lost, such as after a fire.

Eight-day grass pastures provide highly palatable green feed even after relatively light rainfalls, but fail to persist once dry conditions set in. Perennial grasses such as cotton panic provide a more substantial body of feed, but are of low abundance. The overall productivity of this type of country is therefore relatively low.

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LAND UNIT 7.5

This unit consists of terminal floodout lobes on 18-Mile and Charley Creeks. They are now inactive, but channel and levee features remain visible on aerial photographs. Stock seem to be attracted to these areas, judging by the abundance of dung and tracks (foreground).

GENERAL DESCRIPTION

Relict floodout lobes; red earthy sands; a tall sparse shrubland of witchetty bush with mulga and whitewood over woollybutt grass.

GEOLOGY

Pleistocene and possibly Holocene alluvium.

LANDFORM

Relict floodout deposits consisting of distributary channels and terminal lobes. These occur as low banks up to 300m in width but with relief of less than 2m, usually with a central bed-load channel of light-coloured sand up to 20m in width.
SOILS

Earthy sands (Uc 5.21). Profiles have a texture of loamy sand and pH 6.5-7.5 to a depth of at least 1.0m. Colour trends from a dark reddish brown (2.5YR3/4) at the surface to a dark red (2.5YR3/6) by 0.3m, with little further change with depth. The soil is massive and with an earthy fabric. Up to 5% fine quartz gravel occurs throughout the profile and on the soil surface, which is usually loose rather than crusted.

VEGETATION

A tall sparse shrubland of witchetty bush with scattered mulga, broombush and emu-bush over pastures dominated by woollybutt grass. Other species present include woollybutt wanderrie, kerosene grass, potato bush, munyeroo, buckbush, tropical speedwell and occasionally hard spinifex. Scattered whitewoods fringe the bed-load channels.

LAND USE IMPLICATIONS

This type of country has a low erosion hazard under pastoral use. Although soils are very sandy, the grain size is coarse and relatively resistant to wind movement even when surfaces are bare and disturbed.

The woollybutt pastures are of low palatability and productivity. However, areas inspected had signs of active grazing by stock and kangaroos, suggesting that these soils may have suitable characteristics to maintain a green pick long after rainfalls. The soils are suitable for the establishment of buffel grass.
Bare claypan areas are a natural feature of parts of the 16-Mile Creek floodout, and are not a result of accelerated erosion. Surface crusting patterns suggest that some areas pond runoff (foreground).

GENERAL DESCRIPTION

Level plains; heavy-textured red earths; bare or with sparse herbage.

GEOLOGY

Pleistocene alluvium.

LANDFORM

Level plains, often as closed depressions enclosed by Unit 7.1. The surface was possibly derived from an old alluvial soil which was partly-stripped, then mantled by subsequent sandy deposits (Unit 7.1). It is featureless, and either drains by sheet flow or ponds water, depending on slope.

SOILS

Red earths (Gn 2.12) Typical profiles are dark red (10.0YR3/6) or dark reddish brown (2.5YR3/4), sandy clay loam in texture and pH 6.0-6.5 to a depth of up to 0.3m, then grading into a sandy clay, pH 6.5-7.0, of the same colour. They are usually massive and earthy, but some profiles are slightly pedal at depth, and contain a small quantity (less than 5%) of fine gravel throughout. Surfaces have a strong crust which is partly veneered by coarse sandy deposits, often distributed in broad contoured bands.
VEGETATION

Absent, or as a low sparse cover of herbage including cartwheel burr, five-minute grass, buckbush, lifesaver burr, potato bush, Bogan flea and stinking threadpetal. Areas with a sandy veneer carry scattered tussocks of woollybutt, wire and mulga grasses. Mulga and ironwood are usually present as isolated trees.

LAND USE IMPLICATIONS

These soils have a low erosion hazard under pastoral use. They do not represent an eroded or 'scalded' surface.

The pastures are of low productivity and limited pastoral value. Any green pick after rains is likely to be highly attractive to stock. Attempts to establish buffel grass on these soils will probably meet with limited success.
8. **SANDPLAIN**

The land units of this group consist of aeolian (wind-blown) sand deposits which have developed through the wind modification of extensive alluvial plains (see Units 7.1-7.4) during arid phases of the late Pleistocene climate. They probably reached their present extent during the last peak of aridity, 16,000 years ago (Bowler, 1976).

The original alluvial surface has been modified in at least three phases. Unit 8.1 exhibits the least change in landform and soil characteristics, and maintains the mulga and witchetty bush community of Units 7.1-7.4. Units 8.2 and 8.3 have been subsequently altered to a greater extent, with wind sorted soils of coarser-texture and the development of low dunes. However some alluvial features including well-defined braided banks and channel features remain obvious. Unit 8.4 consists of localized areas where Unit 8.3 has been further modified by wind action, and is consequently a result of the most recent phase of aridity, probably terminating 16,000 years ago.

**LAND UNIT 8.1**

![Slight undulating sandplain with red earthy sands supporting witchetty bush and hard spinifex. This type of country merges with Unit 7.2.](image)

**GENERAL DESCRIPTION**

Level sandplain; red earthy sands; a tall sparse shrubland of witchetty bush over hard spinifex.

**GEOLOGY**

Pleistocene aeolian deposits on alluvium.
LANDFORM

Sandplain with level or very slightly-undulating featureless surfaces, merging into Unit 7.1. Relief is less than 1.0m.

SOILS

Earthy sands (Uc 5.52, Gn 2.12). Profiles are commonly dark red (2.5YR3/6) throughout, grading in texture from a clayey sand at the surface to a sandy loam by a depth of 0.3m. Soil reaction is slightly acid, with pH 5.5 at the surface increasing to pH 6.5-7.0 by a depth of 1.0m. Profiles are massive and earthy throughout. Surfaces have a well-developed crust partly veneered by coarse sandy deposits. Termite mounds up to 1.0m in height are common.

VEGETATION

A tall sparse shrubland of witchetty bush with mulga, sandhill wattle, native currant, ironwood, silver cassia and native fuschia over hard spinifex with kerosene grass, woollybutt wanderrie, parakeelya and woollybutt grass. In some areas, such as near No. 1 Bore, a mid-high open woodland of mulga over spinifex predominates.

LAND USE IMPLICATIONS

The soils of this unit will remain stable while the cover of spinifex remains intact. When bare, such as after a fire, they will be subject to wind erosion, particularly if surfaces are disturbed, breaking down the protective crust. The surface crust generates runoff during heavy rainfall, and if sheet flows are channelled by tracks or graded lines, minor rilling may result. For this reason, minimum surface disturbance is preferable to the repeated flat grading of tracks and fencelines.

The spinifex pastures are of very low value to stock. Parakeelya and other herbage species will provide opportunistic grazing with favourable seasonal conditions, but the limited abundance of coarse grasses such as woollybut will only support very low stock numbers at other times. Burning practices can provide a temporary increase in the abundance of grasses and herbage. Buffel grass will establish with difficulty on these soils, and growth and spread will be limited by soil infertility.
LAND UNIT 8.2

Level sandplain with red earthy sands supporting fork-leaved corkwood (middle distance) with hard spinifex.

GENERAL DESCRIPTION

Level sandplains; red earthy sands; a mid-high hummock grassland of hard spinifex with sparse fork-leaved corkwood.

GEOLOGY

Pleistocene aeolian deposits on alluvium.

LANDFORM

Level sandplain with featureless surfaces of very low relief. Drainage features absent.

SOILS

Earthy sands (Uc 5.21). Profiles are dark red (2.5YR3/6) throughout, with a surface texture of clayey sand grading into a sandy loam by a depth of 0.3m, with no further increase in clay content until a depth of at least 1.2m. Soil reaction is slightly acid, grading from pH 6.0 at the surface to pH 6.5 by 0.3m, then remaining uniform with depth. The soils are massive and earthy with a very weak consistence throughout the profile. Surfaces are crusted and veneered with loose coarse sand, and occasionally have deep cracks 3mm in width and up to 3.0m in length. Termite mounds are present but not abundant.
VEGETATION

A mid-high open hummock grassland of hard spinifex with scattered fork-leaved corkwood. Other common species include dogwood, Maitland's wattle, Acacia adscens and milga. Kerosene grass is scattered amongst the hummocks of spinifex.

LAND USE IMPLICATIONS

This land type has a low erosion hazard while the spinifex cover remains intact. If denuded by fire and the surface disturbed, minor drift will result. The surface crust will generate runoff during heavy rainfalls, which may cause minor wash along graded lines which concentrate surface flows.

These pastures have very low pastoral productivity. Sparse tussocks of kerosene grass and seasonal herbage growth comprise most of the feed resource. Buffel grass will establish with difficulty on these soils, and spread will be minimal.
LAND UNIT 8.3

This unit consists of low rises with red earthy sands, which have a higher sand content than those of Units 8.1 and 8.2, supporting desert grevillea and hard spinifex.

GENERAL DESCRIPTION

Low rises; red earthy sands; a tall sparse shrubland of desert grevillea over hard spinifex.

GEOLOGY

Pleistocene aeolian deposits on alluvium.

LANDFORM

Low rises, often sinuous and up to 200m in width, merging into sandplain, usually with relief of less than 2.0m. In isolated instances, north-west trending longitudinal dunes with narrow crests and up to 5.0m of relief have developed, and relict floodout channel features are sometimes evident.
SOILS

Earthy sands (Uc 5.52). These soils are red (2.5YR3/6) in colour and clayey sand in texture to a depth of at least 1.0m. Soil reaction ranges from pH 6-0-6.5 at the surface to pH 6.5-7.5 at a depth of 1.0m. Profiles are massive and earthy throughout with a very weak, almost loose consistence. Surfaces are crusted but extensively veneered with gritty deposits. The dune soils are siliceous sands.

VEGETATION

A tall sparse shrubland of desert grevillea over hard spinifex. Scattered fork-leaved corkwood, bloodwood, Maitland's wattle and sandhill wattle are usually components of the shrub stratum, while kerosene grass and parakeelya grow amongst the spinifex tussocks. Relict floodout features support a tall sparse shrubland of umbrella bush with isolated bloodwoods over hard spinifex. Pink fringe myrtle is present on dune areas.

LAND USE IMPLICATIONS

The land type is stable while vegetated, but is susceptible to wind erosion if the spinifex cover is lost.

The pastures are of very low pastoral value. Burning may temporarily increase the abundance of coarse grasses and herbage, but productivity is severely limited by poor soil fertility. Buffel grass is unlikely to establish and persist on these soils.
LAND UNIT 8.4

Sandplain with red earthy sands supporting blue mallee and hard spinifex. The soils are very sandy, similar to Unit 8.3, and of very low fertility.

GENERAL DESCRIPTION

Gently-undulating sandplain; red earthy sands; a tall sparse shrubland of blue mallee.

GEOLOGY

Pleistocene aeolian deposits

LANDFORM

Gently undulating sandplain with featureless surfaces and relief of less than 1.5m, usually associated with Unit 8.3.

SOILS

Earthy sands (Uc 5.52). These soils are red (2.5YR3/6) in colour throughout the profile and grade in texture from a clayey sand at the surface to a sandy loam by a depth of 0.3-0.6m. No further increase in clay content occurs to at least a depth of 1.0m. Soil reaction is slightly acid, with pH 6.0 at the surface increasing to pH 6.5 by a depth of 0.3m, then remaining constant down the profile. The soil material is massive and earthy with a weak consistence. Surfaces have a well-developed crust, which is mantled with up to 5mm depth of coarse sand and grit over 50% of the area. The grit includes fragments of quartz and laterite nodules.
VEGETATION

A tall sparse shrubland of blue mallee over hard spinifex. Common shrub species include broombush, prickly wattle, sandhill wattle, plumbush, silver cassia, umbrella bush, emu-bush and native fuschia. The only pasture species recorded was kerosene grass. An isolated area of black gidgea occurs north of No. 1 Bore.

LAND USE IMPLICATIONS

This unit is stable while the cover of spinifex remains intact. However exposed soils are susceptible to wind erosion.

Few species of pastoral value grow in this type of country. However the abundance of kerosene grass and herbage could be increased temporarily with appropriate burning practices. The soils are of very low fertility, and buffel grass is unlikely to establish or persist satisfactorily.
Drainage depressions in sandplain areas, with red earth soils of a higher clay content than adjacent earthy sands, supporting dense pastures of silky browntop (foreground). Shallow groundwater may influence the productivity of these areas.

GENERAL DESCRIPTION

Drainage depression within sandplain; red earths; a tall sparse shrubland of sandhill wattle with scattered bloodwood over silky browntop.

GEOLOGY

Pleistocene alluvial and aeolian deposits.

LANDFORM

Flat-floored drainage depressions up to 600m in width with slopes of less than 1% and very low surface relief. Channel features are absent and drainage is dispersed as sheet flow.
SOILS

Red earths (Gen 2.12). The surface soil is a dark reddish brown (2.5YR3/4) sandy loam, pH 6.5-7.0 to a depth of 0.1m, grading into a light sandy clay loam, pH 6.5. At about 0.3m, there is a diffuse boundary to a dark red (2.5YR3/6) sandy clay loam, which occurs to a depth of at least 0.6m. Local variants have slightly heavier textures, grading from a sandy clay loam at the surface to a sandy clay at a depth of about 0.4m. Profiles are massive and earthy throughout. Surfaces have a well-developed crust, mantled with a veneer of gritty material and litter. Termite mounds to 1.2m in height are common.

VEGETATION

A tall sparse shrubland of sandhill wattle with fork-leaved corkwood, emu-bush, Maitland's wattle, mulga, silver cassia and broombush over mainly silky browntop. Other groundcover species include hard spinifex, wire grass, yellow top, kangaroo grass, Bogan flea and minyeroo.

LAND USE IMPLICATIONS

These depressions have a low erosion hazard under pastoral use. However, care should be exercised in the siting of graded lines or tracks on these soils. If sheet flood flows are intercepted and channelled by windrows, scouring will result and downslope pastures no long receiving run-on will be droughted. Tracks should be sited on adjacent land types rather than running along a drainage floor.

Pastures are of low to moderate quality but produce a large bulk of feed. Silky browntop is relatively palatable while actively growing, but is unacceptable when rank or dry.
LAND UNIT 8.6

Sandplain with red earthy sands supporting inland tea-tree (background) and umbrella bush over hard spinifex. The tea-tree suggests the presence of shallow groundwater.

GENERAL DESCRIPTION

Drainage floor; red earthy sands; a tall sparse shrubland of inland tea tree and umbrella bush over hard spinifex.

GEOLOGY

Pleistocene aeolian deposits.

LANDFORM

Low-lying sandplain with level, slightly hummocky surfaces associated with a regular pattern of small closed depressions. Surface relief is less than 1.0m. The landscape is probably influenced by a shallow groundwater table associated with subsurface drainage into the Lake Lewis saline on Napperby.

SOILS

Earthy sands (Uc 5.21). Soils are clayey sand in texture and red (2.5YR4.6) in colour to a depth of 0.55m, with an abrupt boundary to a dark red (2.5YR3/6) sandy loam, marked by a hardpan that breaks down rapidly on wetting. Profiles are massive and earthy throughout, and surfaces have a well-developed crust. Soil reaction data not recorded. The presence of the hardpan is probably associated with a seasonal fluctuating groundwater table.
VEGETATION

A tall sparse shrubland of inland tea-tree and umbrella bush with silver cassia, native currant, plumbush, spotted fuschia and pink plains bush over hard spinifex. Minor groundcover species include kerosene grass, parakeelya, purple sand-sage and wiry podolepis. The tea-tree, which comprises 40% of the shrub cover, generally occurs in clumps.

LAND USE IMPLICATIONS

This land unit has a low erosion hazard under pastoral use. However extensive removal of the vegetation cover will expose coarse-textured surfaces to wind erosion. Soils are likely to be moderately saline at depth.

The pastures have low grazing value. Parakeelya provides some feed following favourable rainfalls, but at other times the sparse kerosene grass is of limited value.
REFERENCES


In most cases, the common names adopted in this listing are those proposed by Strong (1987). Where alternatives are used, Strong's preferred name is indicated in brackets.

**Trees**

<table>
<thead>
<tr>
<th>Common Name(s)</th>
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<tr>
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**Grasses**

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- Mulga
- Ironwood
- Black Gidgea
- Whitewood
- Native Currant
- Blue Mallee
- Bloodwood
- Ghost Gum
- Beefwood
- Fork-leaved Corkwood
- Needlewood
- Quandong
- Sandhill Wattle
- Mimosa Bush
- Witchetty Bush
- Umbrella Bush
- Curry Wattle
- Dead Finish
- Acacia Bush
- Pink Fringe Myrtle
- Conkleberry
- Silver Cassia
- Grey Cassia
- Blue (Blunt)-leaf Cassia
- Broombush (Desert Cassia)
- Green (Oval)-leaf Cassia
- Northern Bluebush
- Rock Fuchsia Bush
- Desert Fuchsia
- Native Fuchsia
- Weeping Emu-bush
- Holly Grevillea
- Low Hibiscus
- Cottonbush
- Pink Plains Bush
- Plumbush
- Wire Grass (Two Gland Threeawn)
- Mulga Grass
- (Erect) Kerosene Grass
Aristida inaequiglumis
Aristida strigosa
Astrakia elymoides
Astrebla pectinata
Bothriochloa exarathiana
Chloris pectinata
Chrysopeggon fallax
Dianthus affine
Dianthus sericosum
Digitaria coenica
Enneapogon avenaceus
Enneapogon polyphyllus
Enteropogon acticularis
Eragrostis dielsii
Eragrostis eriopoda
Eragrostis falcata
Eragrostis setiifolia
Eriachne helmsii
Eriachne muaroata
Eulalia fulva
Fibristylis dichotoma
Isotoma vaginiflora
Monachather paradox
Pantaw decompositum
Thyridolepis mitchelliana
Tragus australis
Triodia basedowii
Triodia cieandii
Tripogon loliformis

Wire Grass (Unequal Threeawn)
Rough Wire Grass (Threeawn)
Weeping (Hoop) Mitchell Grass
Barley Mitchell Grass
Desert Bluegrass
Comb Chloris
Golden Beard Grass
Dwarf Bluegrass
Queensland Bluegrass
Umbrella Grass
Oat Grass (Bottlewashers)
Woollyoat Grass (Leafy Nineawn)
Curly Windmill Grass
Mallee Lovegrass
Woollybutt Grass
Sickle Lovegrass
(Narrow-leaf) Neverfail
Woollybutt Wanderrie
Mountain Wanderrie
Silky Browntop
Eight Day Grass
Red Flinders Grass
Bandicoot Grass
Native Millet
Mulga Mitchell Grass
Small-burr Grass
Hard (Lobed) Spinifex
Weeping Spinifex
Five-minute Grass

Forbs

Abutilon otocarpum
Atriplex spp.
Bergia henshallii
Boerhavia spp.
Calotis hispidula
Cleome viscosa-
Clerodendrum floribundum
Convolvulus erubescens
Einaida nutans
Euphorbia drummondii
Euphorbia tonnensis
Evolvulus alsinoides
Goodenia spp.
Helioperum chisenyi
Hibiscus brachycal SUS
Indigofera linifolia
Ipomea spp.
Lepidium ozytrichum
Lepidium phebopetalum
Malvastrum americanum
Marsilea drummondii
Neptunia spp.
Portulaca oleracea
Pearsalea patens
Ptilotus atriplicifolius

Chinese Lantern

Travine
Bogan Flea
Tickweed
Smooth Spiderbush
Australian Bindweed
Climbing Saltbush
Caustic Weed
Desert Spurge
Tropical Speedwell

Native Indigo

Green Peppercress
Veined Peppercress
Spiked Malvastrum
Common Nardoo
Sensitive Plant
Munyeroo
Native Verbine
Crimson Foxtail
Ptilotus macrocephalus
Ptilotus obovatus
Rhagodia spinosa
Rhynchosia minima
Salsola kali
Salerolaena bicornis
Salerolaena calcarata
Salerolaena cornishiana
Salerolaena costata
Salerolaena eriacantha
Salerolaena lanicuspis
Sida platycalyx
Sida rohlsae
Sida spinosa
Sida spp.
Solanum ellipticum
Stenopetalum nutans
Teucrium racemosum
Tribulus terrestris
Triahodesma zeylanicum
Wahlenbergia communis
Wahlenbergia spp.

Large Green Pussytail
Silver Tails
Spiny Saltbush
Buchbush (Prickly Saltwort)
Buchbush
Red Copperburr
Cartwheel Burr
Bladder
Silkly Copperburr
Woolly Copperburr
Lifesaver Burr
Shrub Sida
Spiny Sida
Potato Bush
Stinking Thread-petal
Grey Germander
Galtrop
Cattle Bush
Tufted Bluebells