LAND UNITS OF THE CLMA
RABBIT ERADICATION PROJECT AREA -
Erdunda, Lyndavale and
Mt Ebenezer Stations

Rhonda J Whittard
Land Conservation Unit
Conservation Commission of the Northern Territory
ALICE SPRINGS

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SUMMARY

This report documents the land units of the CLMA Rabbit Eradication Project Area which is located about 200km south of Alice Springs and covers an area of 250 km². It is spread over parts of three stations, Mt Ebenezer, Erldunda and Lyndavale. Twenty-two land units are mapped and described in terms of landform, soils and vegetation. Five categories of landform are identified:

1. Old land surfaces with ironstone
2. Landscapes developed through geological erosion of the old land surfaces
3. Landscapes formed on calcareous substrates
4. Floodplains and floodouts associated with major drainages
5. Sandplain and dunefield

Each of these contain three to seven land units (types of country).

Six soil types are identified in the project area:

1. Siliceous Sands
2. Earthy Sands
3. Red Earths, Calcareous Red Earths
4. Red Calcareous Soils
5. Red or Brown clays
6. Solonchaks

Of these, the red earths and calcareous red earths are most common in the survey area, with red and brown clays the second most common type. The various sands and solonchaks are the least common.

A low open woodland, a mid high sparse shrubland and a low open grassland or forbland are the most widespread plant community types. Mulga and witchetty are the most common upper storey trees, and fuchsia bush, silver cassia, broombush, cottonbush, ruby saltbush, spiny saltbush and southern bluebush are the most common shrubs. The common grasses and forbs are woollyoat grass, limestone oat grass, oat grass, woollybutt, spinifex, mulga grass, white paper daisy, poached egg daisy, copperburrs, goathead burr, cartwheel burr, shrub sida, lifesaver burr, potato bush, tickweed, cannonball, buckbush and billybuttons.

The areas of highest infestation of rabbits are the calcareous shrubland areas, such as Units 3.1, 3.2, and 3.3. Unit 3.2 is the land type that has the most visual infestation. The rabbits tend to burrow in most of the land types, however, it was apparent that they are above-ground dwelling in some units, Unit 2.2 in particular. Warren sizes are larger in the sandplain and floodout areas, while in the sand dune areas there are more scattered individual burrows hidden under trees and shrubs. Implications for rabbit control and an indication as to the level of infestation are included.
ACKNOWLEDGMENTS

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SECTION ONE
INTRODUCTION

THE PURPOSE OF THE SURVEY

In 1990 the Central Land Management Association (CLMA) commenced a demonstration rabbit eradication program on an area of 250 square kilometres over three stations - Erldunda, Lyndavale and Mt Ebenezer. The project itself is to run to the year 2000 and involves poisoning, the ripping of warrens, follow up fumigation and a buffel-seeding and water ponding program.

There are two overall aims of the project. The first one is to determine the practicality of combining methods such as warren ripping, fumigation and 1080 poisoning. The second is to assess the economic advantage of a rabbit eradication and control program in terms of pastoral property management and assess other benefits that would arise from such a program.

The project also involves soil reclamation and pasture regeneration using techniques such as pitting, ponding and sowing perennial grasses, to help increase seasonal forage availability following the elimination of the rabbit population.

To evaluate the success of the project, the Department of Primary Industries and Fisheries (DPI&F) is undertaking a comparison of selected sites within the treated area, with similar control sites in the untreated area, to evaluate the effect of the combined rabbit eradication and pasture improvement program. The Land Conservation Unit of the CCNT was requested by DPI&F to conduct a land unit mapping survey of the Project Area to identify comparison areas, to aid site selection and evaluation, and to correlate rabbit numbers with soil and land type. Information collected in this survey will also help determine which of the different techniques used in eradication are best suited to the different land types. Apart from these uses the survey will be useful to the CLMA throughout the duration of the program for the assessment and evaluation of the various land types involved.

This report documents the survey which was conducted through the period November 1990 to March 1991. It describes the landforms, soils, and vegetation of the area and classifies them into similar groups termed land units. A land unit is a type of land with relatively uniform landform, soil and vegetation attributes. Within these units, land will have the same characteristics of erosion potential, attraction for rabbits etc. They have been mapped at a scale of 1:50 000.
BACKGROUND

The European Rabbit (Oryctolagus cuniculus) is reported to have entered the Territory from South Australia around 1894. It was first observed in the Lake Amadeus system and to the north of this area in 1902 (Strong, 1983). Its present distribution covers the southern two-thirds of the Northern Territory.

Rabbits have been a successful invader as they have the ability to breed throughout the year and can begin breeding at as young as three months of age. However, green pasture growth is needed to initiate breeding, therefore the dry seasons in Central Australia can somewhat restrict population growth.

Much research has documented the problems rabbits create as well as to the strategies available to control them.

Problems include competition with stock for forage, the prevention of seedling recruitment, the ringbarking of trees, extra grazing pressure, and damage due to burrowing around tanks and other structures, (Campbell, 1991).

Three factors appear important in the influence of rabbits on the environment:

1. Amount of rainfall
2. Soil factors
3. Rabbit density

This is well documented in the case of arid calcareous shrubby grasslands (Foran, 1986), one of the land types found in the project area. Foran (1986) found that although the amount of rainfall was the single most important factor affecting their impact, rabbit density became increasingly more important as heavy grazing prevented a response by the plant community to the influence of season.

Rabbits tend to invade calcareous soils as these are softer to dig in, yet remain strong enough to hold so burrows don't collapse. Soils with more clay content tend to be too difficult for rabbits to dig in successfully, while sandier soils are not structured enough and will easily collapse. This is the reason why large warrens occur in sandier country, and only smaller warrens with a few burrows occur under shrubs or trees. The root system of the vegetation helps hold the soil together so it doesn't collapse.

Rabbits can graze so selectively that plants with a negligible contribution to the biomass of the surrounding vegetation are actively sought out. They can therefore be held at least partially responsible for a lack of regrowth and a suppression of a number of species of plants in the arid zone, (Lange et.al., 1983).
Rabbits are therefore a problem, not only to the pastoralist, but to conservation parks, aboriginal lands and the environment as a whole.

Studies have been carried out on the impact of rabbit control measures in Central Australia. A two year study on a number of one kilometre square sites was carried out on a calcareous shrubby grassland south of Alice Springs. The results showed that 1080 (sodium monofluoroacetate) baiting was most effective as an initial knockdown treatment when numbers were high, with a program of ripping and fumigation as a follow up and a continuing control. This study recommended the treatment of a larger area so as to reduce migration of rabbits into the cleared area. (Foran et al., 1985).

One of the problems continually raised with the control of rabbits is the economic viability of such a program. Due to the cyclic behaviour of the rabbit populations and the unreliability of the rainfall, pastoralists are wary of the high costs related to rabbit control and are reluctant to commit large sums of money. Recommendations have been made as to the extent of rabbit control needed on areas of varying importance, but there is no concrete documentation as to the economic viability of this control in Central Australia.
PREVIOUS SURVEYS

Previous surveys of the study area have only been conducted using a land systems mapping approach. Land systems are compound mapping units which consist each of several unmapped land units and therefore describe an area or group of areas, which have comparably similar landform, soils, and vegetation. Previous surveys carried out in the area are as follows:

1 Perry et.al.(1962)

In the late 1950's the area was surveyed as part of a regional survey of land systems, by Perry et.al.(1962), at a scale of 1:1 000 000. Under this classification, there are three land systems covering the demonstration area. These are described as:

a) **Ebenezer** I.s. - Plains with slightly eroded margins, kunkar in the lower part, unchannelled valleys, up to 50ft relief; calcareous earths and stone-mantled texture-contrast soils; open or sparse shrubs with copperburrs or southern bluebush.

b) **Amadeus** I.s. - Saline pans with waterlogged clays; unvegetated or fringed with samphire. Fringing dunes of red sand with spinifex.

c) **Simpson** I.s. - Parallel, reticulate, and irregular sand dunes with stable flanks, minor areas of mobile sands; red dune sands and red clayey sands; spinifex.

While land systems mapping on this scale is suitable for regional planning and assessment it is not detailed enough for pastoral management, nor was it meant to be.

2 Department of Primary Industries and Fisheries (1989)

The Rangeland Production Unit of DPI&F has also mapped the three stations at a scale of 1:100,000 using a land systems mapping procedure. Due to the larger mapping scale of this survey, the land was mapped in greater detail and five land systems were identified over the 250sqkm area. These were:

a) **Ebenezer** I.s. - Calcareous plains with sandy loam to clay loam soils and bluebush or gently sloping sandy clay loam to clay loam soils.

b) **Amadeus** - Salt lakes and pans, including large areas of mostly bare waterlogged, saline clay soils, and fringing calcrete terraces with shallow soils.
c) **Simpson** - Sand dunes; soft desert country. Red sand dunes, and swales of variable soil texture from red clayey sands to calcareous earths.

d) **Karee** - Mulga plains with red loamy soils supporting perennial grasses.

e) **Angas-1** - Gently-sloping plains with sandy loam soils or calcareous earths (sometimes stony), supporting shrubby grasslands.

While this level of resolution is adequate for some purposes, for the relatively small size of the demonstration area it is inappropriate and the more detailed information available from land unit mapping was needed.

**GEOLOGY**

The geology of the Amadeus Basin was first mapped by Quinlan in 1962 at a scale of 1:1,000,000. More detailed work on the area was done by Stewart (1967) which involved mapping the Kulgera map sheet area (sheet SG/53-5) at a scale of 1:250,000. Further work on the Amadeus Basin was done by Wells et al. (1970).

**Proterozoic**

Basement rocks consist of the Arunta and the Musgrave-Mann complexes. The Arunta complex, made up of igneous and metamorphic rocks, was deformed during a mountain building process before the deposition of the sedimentary rocks of the basin.

The sedimentary history of the Amadeus basin began with the deposition of the Heavitree and Dean Quartzites. Subsequent movement of the earth's crust formed a basin within which evaporites were laid down in a shallow sea. This was followed by partially saline sediments and finally marine carbonate rocks and shale. These sediments make up the Bitter Springs Formation.

The Inindia Beds overlie the Bitter Springs Formation and are comprised of sandstone and siltstone. Most of the formation is probably marine, but as some tillitic siltstone has been recorded, it is assumed glacial conditions prevailed toward the end of this period of deposition. Movement in the form of an uplift of the earth's crust occurred again after the deposition of the Inindia Beds, and in a few places, most of the beds were eroded away.

The Winnell Beds were deposited on the eroded surface of the Inindia Beds. These beds consist of a basal siltstone followed by sandstone, siltstone and more sandstone. It is these sandstone beds which form the Basedow Ranges to the north west of the demonstration area.


**Cambro-Ordovician**

The Stairway Sandstone is one of the formations which makes up the Larapinta Group. It is found in the Basedow Ranges and rests on Proterozoic sediments. It consists of four main rock types - arenites, lutites, carbonates and phosphorites. The smoothness and rounding off of particles in this formation suggest a vigorous environment such as a beach or barrier island. There was a shift later to a poorly aerated lagoonal environment.

The Stokes Siltstone rests on the Stairway Sandstone, and is made up of grey and green siltstone and claystone with thin-bedded limestone and some sandstone interbeds. Conditions of deposition were generally tranquil and there is some suggestion of abnormally high salinities.

Overlying the Stokes Siltstone is the Carmichael Sandstone. This is made up of cross-bedded sandstone, and silty sandstone with siltstone and claystone interbeds. This indicates an estuary or delta type environment with periods of high salinity.

The Stokes, Stairway and Carmichael Sandstone are recorded as locally outcropping in the survey area.

After this period there is a break, and the area became a peneplain with large continental deserts established around it.

**Siluro-Devonian**

The Mereenie Sandstone, above the Carmichael Sandstone is made up of fine-grained sandstone with some thin basal conglomerate laid down in a shallow sea. No outcrops are recorded in the study area. Throughout the depositional period the form of the Amadeus Basin was an ill-defined and constantly moving shallow marine environment grading into and interfingered with lacustrine and aeolian environment.

**Devono-Carboniferous**

The Pertnjara group consists of siltstone, sandstone, quartz greywacke and conglomerate that overlies the Mereenie Sandstone. Two major periods of uplift is indicated by this group. Outcrops have not been identified in the study area.

After the deposition of the Pertnjara Group the Amadeus basin stabilised. This began a long period of erosion when material was transported out of the basin to the Simpson and Gibson Deserts.

**Tertiary**

During the Tertiary period from 65 million to 2-3 million years ago the area was a low, nearly featureless peneplain while the climate was warm and moist. This lead to the formation of laterite.
Extensive dissection of the Tertiary peneplain left areas of low relief leading to the landscapes of much of the northern study area. Remnant Tertiary surfaces form the tops of the flat-topped hills, while the surfaces revealed by stripping include deeply weathered and relatively fresh Paleozoic and Mesozoic claystone and mudstone.

Quaternary

During the Quaternary period, (2 m.y.a. - present) evaporites were deposited as part of the Lake Amadeus chain of salinas. These formed the salt lakes that fringe the southern boundary of the control site. Extensive alluvial deposits were modified by wind action to form the dune fields and sandplains that occur in the southern and south-eastern areas of the site.

LANDFORMS

The most prominent landform in the area is the Basedow Ranges to the north of the study site.

Many of the other landforms of the study area relate back to a peneplain (a featureless, nearly level erosional surface) that developed through a long period of erosion that occurred in the Tertiary period.

This old land surface has been partially stripped or dissected, leaving the residual mesas and flat-topped hills that dominate the northern half of the study site. This stripping and scarp retreat exposed freshly-weathered pediments (areas of bedrock plain) which have ironstone and gravelly surfaces and relatively low relief. This landscape appears in the central to the southern half of the study site, and elsewhere it has been partially and in some areas extensively buried by more recent alluvial and aeolian deposits.

The gently-undulating limestone country in the south eastern part of the study area has developed from sediments of a lakebed which have been exposed to erosion. The land type chosen for evaluation of the success of the rabbit control project, is part of this landscape.

Alluvial fans, floodplains and floodouts associated with presently active drainage occur in the central part of the study area.

The sandplains and dune fields which border the salt lakes in the southern part of the area, are a result of aeolian processes initiated with a change in climate to aridity during the late Pleistocene, the most intense phase of which occurred 16-18 000 years ago.

The salt lakes to the south consist of evaporites that were deposited in the Cainozoic and Quaternary periods, in association with the former Lake Amadeus-Karinga Creek drainage system.
SOILS

Soil attributes are a result of the type of parent material that they formed from, the landform they occur on, and the climatic environment that they were developed in. Many of the parent materials occurring within the study area are highly weathered and therefore soils are relatively infertile. The existing soils were largely developed in a moister climate prior to the present arid conditions, and have features such as strong red colouration which are not characteristic of aridic soils.

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

Soil Characteristics

Texture
Determined by the proportion of sand, silt and clay, which is indicated in the field by the behaviour of a moistened soil sample. Texture affects soil cohesion and therefore may influence ability of rabbits to dig in a particular soil type. It has a major impact on the moisture characteristics of a soil and hence its ability to support plant growth.

Colour
The colour of soil is assessed in the field and can give an indication of soil horizons and degree of development. Colours cited in this report relate to a moist fragment of soil.

pH
Indicates acidity or alkalinity. A pH of 7.0 is neutral, lower than this being acidic, and higher than this alkaline. Soils in the study area are generally alkaline, with only a few being neutral, and none acidic.

Fabric
This is the characteristic arrangement of individual particles in the soil material. Soil with an earthy fabric has a porous appearance and peds (a ped is a natural soil aggregate) are absent. When peds are present they may have a rough or a smooth-faced fabric. The soils of the survey area are generally of an earthy fabric, and pedal soils had rough-faced peds.

Structure
This is described in terms of the size, shape and abundance of peds. Massive structure has no distinct peds, while highly pedal soils, with well-developed structure have an abundance of distinct natural aggregates.

Soil Types

The following soil types were recorded on the station and are classified according to Stace et al (1968).
Red Earths and Calcareous Red Earths
These are medium-textured, red in colour, with a massive structure and earthy fabric. There is a gradual increase in clay content with depth down the profile. Calcium carbonate may be present at depth.

Red Calcareous Soils
The second most common soil type, these soils are also medium-textured and are highly alkaline. They have developed directly from the underlying calcareous rocks or calcrete.

Siliceous Sands
These are dune soils with sand-sized particles, single grain structure and a sandy fabric. They are red in colour.

Earthy Sands
These soils are found in sandplain areas. They have deep, sandy, uniform profiles with little increase in clay content with depth, massive structure, earthy fabric and are red in colour.

Brown and Red Clays
Deep, fine-textured soils that are strongly structured. They are found in seasonally flooded swamps and on gently-sloping plains.

Solonchaks
These are highly saline soils associated with the salt lakes.

Soils can also be classified according to the Principal Profile Form (Northcote 1979) which is derived from a key based on physical characteristics. The main divisions and sub-divisions are as follows.

Uniform - Profiles with uniform texture throughout
Uc - coarse textures
Um - medium textures
Uf - fine textures, non cracking
Ug - fine textures, cracking

Gradational - Profiles gradually increase in clay content with depth
Gc - calcareous throughout
Gn - non calcareous throughout
Duplex - Profiles have an abrupt texture boundary between the topsoil and the subsoil

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

Organic - These soils are not found in Central Australia

This classification is accompanied by a numerical code that specifies diagnostic characteristics of the individual profiles, as defined in Northcote (1979).

The Principle Profile Forms recorded in the study area include Uc1.23, Um1.33, Uf1.33, Uf1.43, Uf6.53, Uf6.71, Gc1.12, Gc1.22, Gn1.83, Gn2.13, Gn2.83, Gn4.13, Gn4.16, Dr4.53.

VEGETATION

The distribution of vegetation communities strongly reflects the landform and soil attributes. This therefore gives a visual indication of land units, although it must be remembered that vegetation varies slightly within individual units. In this report vegetation is described in terms of structural formation and floristics. Structural formations are described in terms of formation classes (defined by growth form and crown separation) qualified by height classes. Floristics are the dominant and/or characteristic species.

The most common structural formations and floristics are as follows:

Low Open Woodland

These communities consist mainly of mulga and/or witchetty bush with some dead finish and prickly wattle.

Mid-High Sparse Woodland

These consist commonly of spiny saltbush, fuchsia bush, silver cassia, broombush and juvenile mulga, witchetty, prickly wattle and dead finish.

Low Sparse Chenopod Shrubland

The dominant species here are cottonbush, southern bluebush, ruby saltbush and spiny saltbush. Some of the shrubs from the mid-high sparse shrubland are present, but sparse, in these areas.
Low Sparse Grass/Forbland

Species present common included oat, woollyoat and limestone oat grasses, kerosene grass, woollybutt, and mulga grass, with cannonball, tickweed, goathead burr, copperburr, buckbush, billybuttons, caltrop, shrub sida, lifesaver burr and potato bush.
SECTION THREE
LAND UNITS OF THE STUDY AREA

SURVEY METHODOLOGY

The study area was mapped into land units at a scale of 1:50,000, based on stereo-interpretation of aerial photographs as well as an extensive on-ground survey.

Available aerial photography included black and white prints flown in 1985 at a scale of 1:80 000 and colour prints at a scale of 1:50 000 flown in 1986. Both sets provided complete coverage.

Initial land unit boundaries were mapped on the 1:50 000 colour prints, using stereo-interpretation. From this suitable sites for field examination during the ground survey were identified. A total of about four weeks during the summer of 1990-1991 was spent in the study area conducting the ground survey. Seventy-three sites were recorded over the 250sqkm area (an intensity of about 1 site per 3.0 sq km area). Thirteen areas were identified outside the project area and examined as potential comparison areas. Vehicle access was reasonable over the whole area.

At each site various aspects of the landform, soil and vegetation were recorded according to the criteria of MacDonald et al. (1990) and representative areas photographed. Soil profiles were described from soil pits which were generally excavated to a depth of about 1.0 metres.

During and on completion of the field operations the tentative boundaries on the aerial photography were re-examined and amendments made. The boundaries were then transferred to a topographic map base which had been enlarged from 1:100 000 to 1:50 000, the final mapping scale.

The land unit chosen for assessment by DPIF (Land Unit 3.2) is made up of slightly undulating plains with gravelly red calcareous earths. It is predominately treeless, with annual grasses and herbage and large warrens are common and readily visible. Unit 3.2 occurs mainly in a northwest/south-east tract from the middle of the control area down to the south-eastern corner. Location of the assessment sites established within the treated area are indicated in Figure 1.

ASSESSMENT SITES

To assess the effect of the combined rabbit eradication and pasture improvement program, similar untreated areas close to the project area were identified on the basis of land attributes. These were designated as comparison sites and fenced to allow the grazing regime to be controlled to match the treated area. Sites were in proximity to the project area to eliminate differences in rainfall as much as possible. The comparison areas are to be relocated periodically throughout the programmed assessment period.
Sites used in assessment of the untreated areas are located to the north west of the project area on Mt Ebenezer station and to the south west on Lyndavale station. Figure 2 shows the location of the comparison sites in relation to the project. The location of individual sites in the northern area is show in Figure 2, while the location of the southern sites can be seen in Figure 4.

The differences between the areas are to be recorded by measurement of the following attributes -

1. Standing herbage biomass by species
2. Tree/shrub density
3. Tree/shrub aerial cover
4. Herbage species frequency

**LAND UNITS**

The land units described in this report consist of areas of land with relatively uniform landform, soil and vegetation attributes. The combination of these attributes determines the intrinsic characteristics of the unit such as erosion potential, pasture productivity and the number of warrens and rabbits. Due to the limitations of the level of resolution possible at the mapping scale some variation will occur within the units.

Twenty-one land units are described in this report, and these can be classified into five groups based on their geomorphic characteristics. These are:

1. Old land surfaces with ironstone
2. Landscapes developed through geological erosion of the old land surfaces
3. Landscapes formed on calcareous substrates
4. Floodplains and floodouts associated with major drainages
5. Sandplains and dunefields

Within each of these groups there are three to five different units.

Ranges and the geologically older landscapes occur generally in the north of the project area, while the majority of the sandplain, dunefield and salt lake areas occur in the south and east.
UNIT DESCRIPTIONS

1 OLD LAND SURFACES WITH IRONSTONE

UNIT 1.1

General Description
Plains with red clays supporting groved mulga over a low sparse forbland.

Geology
Tertiary deeply-weathered rocks and laterite.

Landform
Gently sloping plains with low relief, generally having less then 1% slope. Runoff is dispersed by sheet flow the grove-intergrove vegetation pattern. Defined drainage lines are absent.

Soils
Great Soil Profile - Red Clays
Principle Profile Form - Uf6.53

Profile Description:
Soil texture is a light clay to 10cm, light medium clay to 20cm, and a medium clay to 50cm. This soil is moderately pedal, with angular-blocky, rough-faced peds, from 0-30cm then massive with an earthy fabric to 50cm. The profile is alkaline throughout with a pH of 9.5. Soil colour is yellowish-red (5.0YR46) to 20cm and a dark red (2.5YR36) from 20-50cm. Calcareous nodules are present from 30-50cm, sized 6-7mm and 80%. Ironstone nodules are abundant on the surface in the open areas between the mulga groves.

Vegetation
A groved, low open woodland containing mulga and dead finish, over a mid-high sparse shrubland with spiny saltbush and fuchsia bush. The under storey is a low sparse forbland with some umbrella grass but mainly shrub sida, lifesaver burr, potato bush, white paper daisy, copperburr, mulla mulla, and some peppercress. The open areas between the mulga groves support very sparse forbs and grasses.

Land Management Implications
Low incidence of warrens, however, little regeneration of mulga is occurring. The soils are fairly stable, with little erosion hazard.
Unit 1.1 Plains with red clays supporting grooved mulga over a low sparse forbland. A distinguishing feature is the abundant ironstone gravel.

Unit 1.3 Low rises with red earths supporting open mulga and witchetty bush over sparse annual forbs. Distinguishing features include surface ironstone gravel and large warrens.
UNIT 1.2

General Description
Flat-topped hills with gravelly, calcareous red earths supporting witchetty bush and mulga over annual grasses and forbs.

Geology
Tertiary deeply-weathered rocks and laterite.

Landform
Flat-topped rises and low mesas, with slopes of less than 1%, and relief (up to 1 m). Drainage features are absent.

Soils
Great Soil Group - Calcareous Red Earths
Principle Profile Form - Gc1.12

Profile Description:
Surface textures range from light sandy clay loam to sandy clay loam to a depth of 20cm, grading to a sandy clay at 20-50cm. Structure from 0-50cm depth is massive with an earthy fabric. The profile is alkaline throughout with a pH of 9.5. Soil colour is a reddish-brown (5.0YR44) from 0-20cm tending to yellowish-brown (5.0YR46) from 20-50cm. The carbonate content of the fine earth from 0-50cm is high. There are no ironstone or calcareous nodules in this profile.

Vegetation
The upper storey consists of low open woodland with mulga and witchetty bush over a mid-high sparse shrubland of prickly wattle, with southern bluebush, spiny saltbush, dead finish, broombush, ruby saltbush, and fuchsia bush. The groundcover is a low sparse forbland consisting of goathead and copperburrs, lifesaver burr, white paper daisy, tickweed, cannonball, shrub sida, variable daisy, and Neobassia astrocarpa. There is sparse oat grass present.

Land Management Implications
Large warrens are occasionally present. There is some indication of mulga and witchetty bush regeneration. The soils have a moderate water erosion hazard which will be evident as sheet erosion.
UNIT 1.3

General Description
Low rises with red earths supporting open mulga and witchetty bush over sparse annual forbs. Surfaces are gravelly with ironstone.

Geology
Tertiary deeply-weathered rocks and laterite.

Landform
Low rises and gentle slopes of less then 1%, with little relief (less then 1m). Drainage features absent.

Soils
Great Soil Group - Red Clays.
Principle Profile Form - Uf1.33 and Uf1.43

Profile Description:
Texture is a sandy clay to a depth of 50m although some sites have a light clay from 30-50cm. From 0-50cm profiles have a massive structure with an earthy fabric, and are alkaline with a pH of 9.5. Soil colour is a red-brown (5.0YR44) to 20cm depth, then a yellowish-red (5.0YR46) to 40 or 50cm. At some sites from 40-50cm the colour is dark brown (7.5YR44). Calcium carbonate is absent from the fine earth to 10cm depth, but is then present in increasing abundance to 50 cm depth. Ironstone nodules comprise 5% of soil material to 10cm and 2% from 10-30cm. Calcareous nodules comprise 80% of material from 0-50cm. Angular tabular quartz fragments are present on the surface with an abundance of 20% from 0-10cm at 5%.

Vegetation
A low open woodland of witchetty bush and mulga, with some dead finish and fork-leaved corkwood. Occasionally only isolated trees are present. The middle stratum is a mid-high sparse shrubland consisting of fuchsia bush, southern bluebush with spiny and ruby saltbush, over a low sparse forland of potato bush, billybuttons, cannonball, copperburr, white paper daisy, lifesaver burr, mulla mulla, buckbush, tickweed, peppercress, and Rhyncharrhena linearis.

Land Management Implications
Large warrens are occasionally present. Some regeneration of dead finish is occurring. These soils are fairly stable, with little erosion hazard.
UNIT 1.4

General Description
Plains with red earths, supporting witchetty bush and mulga over annual grasses and herbage.

Geology
Tertiary deeply-weathered rocks and laterite.

Landform
Gently sloping plains of less than 1% slope with low relief (less than 1m), drained by broad flat-floored depressions.

Soils
Great Soil Group - Red Earths
Principle Profile Form - Gn2.13

Profile Description:
Texture grades from a light sandy clay loam or sandy clay loam surface to a sandy clay loam from 20-30cm and sandy clay from 30-60cm. Profiles have a massive structure and earthy fabric from 0-60cm. They are alkaline soils with pH 9.5 throughout. Soil colour is a yellowish-red (5.0YR46) throughout. Fine earth shows no acid reaction from 0-10cm, and very reactive from 10-60cm. Surfaces are gravelly with occasional ironstone and calcareous nodules. Calcareous nodules are present from 20-60cm comprising 40% of soil material.

Vegetation
A low open woodland of mulga and witchetty bush is dominant, with some dead finish over a mid-high sparse shrubland consisting of fuchsia bush and broombush, as well as some southern bluebush and cottonbush. The groundcover consists of a low sparse grassland of oat and limestone oat grass, mulga grass, woollybutt and button grass with potato bush, copperburr, caltrop, shrub sida, mulla mulla, cannonball, tickweed, white paper daisy, munyeroo, goathead burr and caustic weed.

Land Management Implications
Rabbits are present, but large warrens are few. Tree and shrub regeneration is generally absent. The soils have a slight erosion hazard due to the gravelly surfaces and low relief. Sheet erosion will occur if the groundcover is lost, and rilling will result if runoff flows are channelled by surface disturbances such as grader windrows.
UNIT 1.5

General Description
Dissected plains with red earth soils, supporting open witchetty bush shrubland, over sparse annual herbage.

Geology
Tertiary deeply-weathered rocks and laterite.

Landform
Dissected plains with gentle slopes to 1% and low relief (to 1 m). Runoff is carried by broad drainage floors.

Soils
Great Soil Group - Red Earths
Principle Profile Form - Uf6.7

Profile Description:
Soil texture is a sandy clay loam or sandy clay to 10cm depth and a sandy clay from 10-50cm. At one site this graded to a sandy loam at 50cm. The structure from 0-50cm is massive with an earthy fabric and the soil is alkaline with pH 9.5 from 0-50cm. Soil colour is yellowish-red (5.0YR46 and 5.0YR56) to 20cm and reddish-brown (5.0YR54) to 50cm. The abundance of gypsum nodules present in the profile ranged between 30% from 0-20cm to 70% from 20-50cm depth and the fine earth is moderately calcareous from 0-50cm.

Vegetation
A low open woodland of witchetty bush with some dead finish and prickly wattle, over scattered cottonbush and southern bluebush. The groundcover consists of a low sparse forbland consisting of potato bush, lifesaver burr, white paper daisy, mulla mulla, copperburrs, caltrop and cannonball with some umbrella grass.

Implications
Large warrens are uncommon, but rabbits are present. Tree and shrub regeneration is absent. Soils generally have a slight erosion potential with the exception of those in the drainage lines which are susceptible to gullying.
Unit 1.6
Plains with red clays supporting open witchetty bush shrubland over sparse annual grasses and forbs. A distinguishing feature is the abundant broombush.
UNIT 1.6

General Description
Plains with red clays supporting open witchetty bush shrubland over sparse annual grasses and forbs.

Geology
Tertiary deeply-weathered rock and laterite.

Landform
Gently rolling plains with low relief up to 1m. Slopes up to 1%. Defined drainage features are absent and runoff disperses by sheet flow.

Soils
Great Soil Group - Red Clays
Principle Profile Form - Uf6.71

Profile Description:
Textures grade from a light clay to light medium clay from 0-10cm, medium clay from 10-30cm, then a heavy clay from 30-50cm. Some sites had sandy clay textures throughout the profile. The heavier soils are moderately pedal to 30cm and strongly pedal from 30-50cm. The peds have a angular-blocky shape with a rough-faced fabric from 0-50cm. Lighter soils have a massive structure and earthy fabric from 0-50cm. All soils are alkaline with a pH of 9.5 throughout. Soil colour is yellowish-red (5.0YR46) to 30cm and yellowish-red (5.0YR56 or 5.0YR44) to 50cm. There is a slight acid reaction of fine earth at 0-20 or 30cm with a moderate acid reaction, from 20 or 30-50cm. Ironstone occurred in some profiles with an abundance of 20% between 0-10cm, 10% between 10-20cm and 1% between 20-50cm. Occasionally 1-2% calcareous nodules are present by 50cm. Ironstone nodules occur locally on the surface.

Vegetation
A low open woodland with witchetty bush dominant and sparse dead finish over in mid-high sparse shrubland of broombush and prickly wattle. The lower stratum consists of a low sparse forbland of goathead burr, white paper daisy, tickweed, cannonball, caltrop, caustic weed, and copperburr with some woollybutt, oat and limestone oat grass. The latter grasses would probably be dominant given favourable seasonal conditions and the absence of rabbits.

Land Management Implications
Rabbits are present, but large warrens are generally uncommon. The regeneration of witchetty bush and dead finish is occurring. In view of the heavy surface soil texture, the erosion potential of the unit is slight, but if run-off is channelled by tracks or other earthworks, rilling may occur.
UNIT 1.7

General Description
Breakaway areas with gravelly red earths supporting sparse annual grasses.

Geology
Dissected Tertiary deeply-weathered rock and laterite.

Landform
Low gravelly rises, with retreating scarps. Moderate to steep slopes, and relief of up to 10m.

Soils
Great Soil Group - Red Earths
Principle Profile Form - Gn2.83

Profile Description:
Textures grade from a sandy clay loam at the surface to a sandy clay at 10-20cm and a light medium clay from 30-50cm. At 50-70cm the soil becomes fairly light, a sandy loam. Soil structure is moderately pedal from 0-20cm, and weakly pedal from 20-30cm, with sub-angular blocky peds and rough-faced fabric. From 30-70cm the soil becomes massive with an earthy fabric. The pH is 9.5 from 0-70cm. Soil colour to 50cm is a red-brown (5.0YR44 and 5.0YR54) and is a light red-brown (5.0YR63) to 70cm. There is no reaction to acid in the fine earth from 0-20cm but it is very reactive from 20-70cm. The surface has a lag deposit of chalcedony gravel.

Vegetation
A low open woodland consisting of mulga, over a mid-storey low sparse shrubland of southern bluebush and scattered harlequin fuchsia bush. The lower stratum, a low open grassland contains oat grass, eight-day grass, and umbrella grass with cannonball, potato bush, tickweed, silver tails, and copperburr.

Land Management Implications
Some rabbit warrens are present. No sign of tree or shrub regeneration was recorded. The erosion hazard is moderate.
Unit 1.7
Breakaway areas with gravelly red earths supporting sparse annual grasses. A distinguishing feature of these gravelly breakaway areas is the presence of southern bluebush.
Unit 2.1
Gently sloping red earth plains with mulga and witchetty bush over annual grasses & herbage. A distinguishing feature of this unit is the bare, scaldy surfaces with sparse grass cover.
LANDSCAPES DEVELOPED THROUGH GEOLOGICAL EROSION OF THE OLD LAND SURFACES

UNIT 2.1

General Description
Gently sloping red earth plains with mulga and witchetty bush over annual grasses and herbage.

Geology
Partially stripped Tertiary deeply-weathered rocks.

Landform
Gently sloping plains with slopes of less than 1%, and low relief. Drainage features are absent.

Soils
Great Soil Group - Red Calcareous Soils
Principle Profile Form - Gc1.22

Profile Description:
Textures grade from a sandy clay loam to 30cm, into a sandy clay to 50cm. Soil structure from 0-50cm is massive and with an earthy fabric. Soils are alkaline with a pH 9.5 from 0-50cm. Colours are a dark red (2.5YR36) to 30cm and red (2.5YR46) 30-50cm. Calcium carbonate is present in the fine earth throughout. Calcareous nodules are present from 20-50cm with an abundance of 10-15%. Surfaces characteristically have a strong surface crust.

Vegetation
The upper storey is a low open woodland consisting of mulga, witchetty, prickly wattle and dead finish. The groundcover consists of a low open grassland of kerosene grass, oat grass, limestone oat grass, mulga grass, neverfail and locally hard spinifex with forbs such as billybuttons, cannonball, potato bush, shrub sida, lifesaver burr, munyeroo, poached egg daisy, caltrop, caustic weed, paddy melon, tickweed, goathead burr, and copperburr. Isolated shrubs of southern bluebush heavily browsed by rabbits are locally present.

Land Management Implications
Rabbits are present although warrens are uncommon. There is no apparent regeneration of the major shrub species probably due to the impact of rabbits. Soils have a slight to moderate water erosion risk but the channelling of runoff by linear surface disturbances such as grader windrows will initiate rill erosion. Sheet erosion by water will exacerbate the strong surface crusting characteristic of this unit and result in bare scalded areas that do not respond after rains. Surface soils will break down to bulldust under constant trafficking by vehicles.
UNIT 2.2

General Description
Gently sloping red clay plains with southern bluebush over annual grasses and herbage.

Geology
Partial stripped Tertiary deeply-weathered rocks and laterite.

Landform
Plains with gentle slopes of less than 1% and low relief. Drainage features are absent.

Soils
Great Soil Group - Red Clays
Principle Profile Form - Uf6.53

Profile Description:
Surface texture is a sandy clay loam to sandy clay to a depth of 10cm, then a sandy clay to 30cm and a light medium clay from 30-50cm. Structure from 0-50cm is generally massive and with an earthy fabric, but at some sites soil structure 10-30cm is weakly pedal with a sub-angular blocky (sometimes platy) peds and rough-faced fabric and 30-50cm is again massive and earthy. The pH from 0-20cm is 8.5 and from 20-50cm is 9.5. Soil colour ranges from a dark red (5.0YR34) to a red-brown (5.0YR44) surface. From 30-50cm the colour is red-brown (5.0YR44) or dark red-brown (5.0YR34). The fine earth has a high carbonate content from the surface to 50cm. Calcareous nodules from 10-20cm are 30% of soil material, from 20-30cm are 40% and from 30-50cm are 50%. Some sites have ironstone nodules from 0-50cm with an abundance of 40%. Algal crusting and surface cracking are present, with gravel in localised areas.

Vegetation
A low sparse chenopod shrubland of southern bluebush with bladder saltbush, broombush and silver cassia. The lower storey is a low sparse forbland commonly with copperburr, potato bush, white paper daisy, tickweed, buckbush, cannonball, caltrop, Birdsville indigo, bindweed, mulla mulla, and caustic weed, with grasses including woollybutt, oat grass, limestone oat grass and umbrella grass. Isolated trees of witchetty, dead finish and prickly wattle are often present.

Land Management Implications
Rabbits are mainly surface dwelling on this land type and warrens are scarce. Poisoning is consequently the preferred control measure.

Soils have a moderate water erosion hazard. The channelling of runoff by grader windrows and other linear surface disturbances will initiate rill erosion. The medium-textured surface soils will pulverise to bulldust under constant trafficking by vehicles.
Unit 2.2
Gently sloping red clay plains with southern bluebush over annual grasses and herbage. A distinguishing feature is abundant southern bluebush.
UNIT 2.3

General Description
Gently sloping plains with calcareous red clays, supporting cottonbush over annual grasses and herbage.

Geology
Stripped Tertiary deeply-weathered rocks.

Landform
Gently sloping plains with slopes of less than 1%, and relief of less than 1m. Drainage features are absent.

Soils
Great Soil Group - Red Clays
Principle Profile Form - Uf1.33

Profile Descriptions:
Soil texture is a light medium clay from 0-50cm depth. Soils have weakly pedal structure throughout, with sub-angular blocky, rough-faced peds. The pH is 8.5 to 10cm and 9.5 from 10-50cm. Soil colour is red-brown (5.YR44) to 20cm and a dark red-brown (5.YR33) to 40cm. Fine soil reaction to acid varies, generally from no reaction to slightly reactive at the surface, with a highly visible reaction from 20 or 30-50cm.

Vegetation
A low sparse shrubland of cottonbush with some spotted fuchsia bush, over a low sparse forbland of white paper daisy, cannonball, mulla mulla, shrub sida, minnie daisy, and sickle lovegrass.

Land Management Implications
Rabbits are surface dwelling and there is a low occurrence of warrens. Consequently poisoning is the preferred method of rabbit control. Soils have only a slight water erosion hazard because of their heavy textures, the low slope and sheet drainage pattern.
UNIT 3.1

General Description
Low rises and plains with red calcareous soils supporting sparse witchetty bush over annual grasses.

Geology
Quaternary calcretes.

Landform
Low rises with slopes up to 2%, and relief up to 1m. Drainage features are absent.

Soils
Great Soil Group - Red Calcareous Soils
Principle Profile Form - Um5.61

Profile Description:
Soil texture is a sandy clay loam from the surface to 50cm and structure is massive and earthy throughou. The soils are alkaline, with pH 9.5 throughout and soil colour is red-brown (5.0YR44) to 20cm and yellow-red (5.0YR46) to 50cm. There is a high carbonate content in the fine earth throughout the profile. Calcareous and ironstone nodules occur from 10-50cm at 20%. Gravelly surfaces may be present.

Vegetation
A tall sparse shrubland of witchetty bush, over a mid-high sparse shrubland of silver cassia with some dead finish present. The groundcover is a low sparse grassland consisting of woollybutt, oat, limestone oat and woollyoat grasses, with potato bush, white paper daisy, tickweed, cannonball, goathead burr, copperburr, and shrub sida.

Land Management Implications
Rabbits are abundant in small warrens and there is negligible regeneration of the principal tree and shrub species. The erosion potential is slight. However, if graded tracks or other earthworks channel storm runoff, rilling will occur. Surface soils are calcareous, and will turn to bulldust if pulverised by heavy trafficking of vehicles.
Unit 3.1  Low rises and plains with red calcareous soils supporting sparse witchetty bush over annual grasses. Distinguishing features include the dead witchetty bush and cassias.

Unit 3.2  Treeless undulating plains with red calcareous soils with gravelly surfaces supporting sparse shrubs over annual grasses herbage.
UNIT 3.2

General Description
Treeless, undulating plains with gravelly surfaces supporting sparse shrubs over annual grasses and herbage.

Geology
Quaternary calcretes.

Landforms
Slightly undulating plains, with low slopes of up to 1%, and relief to 3m. Drainage features are absent or exist as poorly defined flat floored depressions.

Soils
Great Soil Group - Red Calcareous Soils
Principle Profile Form - Gc1.22

Profile Description:
The surface texture to 10cm is generally a sandy clay loam, with some sites lighter (light sandy clay loam) and some sites heavier (sandy clay). From 10-30cm texture grades to a sandy clay, with a light clay from 30-50cm and light medium clay from 50-60cm. The structure is massive and the fabric is earthy throughout. The pH ranges from 8.5 at 0-20cm, 9.5 at 20-50cm and 10.0 from 50-60cm. Soil colour is red-brown (5.0YR44 and 5.0YR46) to 30cm, and a red-brown (5.0YR54) or dark red (2.5YR36) to 50cm. The calcium carbonate content of the fine earth is slight from 0-10 or 20cm, moderate from 20 to 30cm and high from 30-60cm. Ironstone nodules are present on the surface and in the profile from 0-30cm at 30% and calcareous nodules are present from 30-40cm at 50%. Surfaces are sometimes gravelly.

Vegetation
Isolated witchetty bush and less frequently mulga are occasionally present in association with a mid-high sparse shrubland consisting of harlequin, fuchsia bush, broombush and southern bluebush over a low sparse forbland of white paper daisy, caustic weed, cannonball, lifesaver burr, caltrop, billybuttons, cartwheel burr, glycine, and verbine with oat grass, mulga grass and button grass. Annual grasses are likely to be dominate following favourable summer rains if grazing pressure from rabbits is low.

Land Management Implications
Large warrens common and readily visible and there is no sign of shrub regeneration. The lighter surface soils are susceptible to wind stripping when bare and they are also subject to sheet erosion by runoff. Soils can turn powdery if disturbed when dry. Soil loss results in gravelly surfaces, which in turn results in slow revegetation of areas.
UNIT 3.3

General Description
Undulating plains with gravelly surfaces supporting witchetty bush and mulga over annual grasses and forbs.

Geology
Quaternary calcrites.

Landform
Undulating plains, with slopes up to 2% and relief up to 3m. Drainage is poorly defined.

Soils
Great Soil Group - Red Calcareous Soils
Principle Profile Form - Dr4.53

Profile Description:
Soil texture is generally a light sandy clay loam or a sandy clay loam from 0-10cm grading to a sandy clay at 10 cm and a light clay at 20cm. The texture below 30 cm is a light medium clay. Soil structure is massive and earthy throughout, and reaction ranges from pH 8.5 at 0-30cm to pH 9.5 from 30-50cm. Soil colour is red-brown (5.0YR44) to 30cm and yellow-red (5.0YR46) to 50cm. The carbonate content of the fine earth is slight from 0-20cm, moderate from 20-30cm and high from 30-50cm. Ironstone and calcareous nodules occur in the profile from 30-50cm each at 10% of the soil material. Surfaces are commonly gravelly.

Vegetation
A low open woodland of witchetty bush and mulga, over a low sparse shrubland of ruby and spiny saltbush. Pastures consist of low sparse grassland of oat, woollyoat and limestone oat grass, with white paper daisy, cannonball, cartwheel burr, shrub sida and caltrop.

Land Management Implications
This unit has a low abundance of large warrens. No regeneration of the major shrub species is evident. Soils have slight potential for water erosion and tracks and other earthworks should be planned with discretion, as channelled runoff may cause rill erosion.
Unit 3.3
Undulating plains with gravelly surfaces supporting witchetty bush and mulga over annual grasses and forbs.
UNIT 4.1

General Description
Drainage floors dissected by creek channels, with red earths supporting mulga woodland with annual and perennial grasses.

Geology
Quaternary alluvium.

Landform
Slightly sloping drainage floors with well defined channels, having slopes of less than 1% with relief up to 1m.

Soils
Great Soil Group - Calcareous Red Earths
Principle Profile Form - Gn2.13

Profile Description:
Surface soils are sandy loam in texture, grading to a light sandy clay loam by a depth of 10cm, and a sandy clay loam by 30cm. Profiles have a red colour (2.5YR48), a massive and earthy structure, and a reaction of pH 9.5 throughout. Calcium carbonate is present in the fine earth below a depth of 30cm.

Vegetation
A low open woodland with mulga, dead finish and prickly wattle over a mid-high sparse shrubland of silver cassia, broombush, southern bluebush, Maitland's wattle, spiny saltbush, and desert fuchsia. The lower storey consists of a low sparse grassland of oat grass, umbrella grass, button grass, and windmill grass with goathead burr, tickweed, white paper daisy, paddymelon, shrub sida, indigo, cannonball and mulla mulla. Buffel grass is established on this land type.

Land Management Implications
Rabbits are present, but large warrens are uncommon. Little regeneration of shrubs occurring. The light textured soils are susceptible to both wind and water erosion especially if bare of vegetation. Graded roads and other earthworks may channel runoff and cause rilling or gullying.
UNIT 4.2

General Description
Drainage floors with red earths supporting prickly wattle over annual and perennial grasses.

Geology
Quaternary alluvium.

Landform
Drainage floors dissected by creek channels. These have slopes of 1% or less and low surface relief to 1m.

Soils
Great Soil Group - Calcareous Red Earths
Principle Profile Form - Gn4.13

Profile Description:
Surface textures range from light sandy clay loam to sandy clay loam, but are usually the latter by a depth of 10cm. Clay content increases to a sandy clay by 30cm and a light clay by 50cm. Soil colour is a dark red (2.5YR36) to 50cm and a yellow-red (5.0YR46) to 80cm. Soil reaction is pH 8.5 to a depth of 30cm and pH 9.5 to a depth of 80cm. Some calcium carbonate is present below a depth of 30cm. Coarse fragments occur in the profile from 0-30cm at 20% are angular in shape and average 3mm in size.

Vegetation
A low open shrubland of prickly wattle with spiny saltbush, broombush, and juvenile ironwood, dead finish and mulga over a low sparse grassland with buffel grass, native millet, umbrella grass, and woollybutt grass. Forbs include tickweed, goatherd burr, copperburr, white paper daisy, paddymelon, caltrop, caustic weed and spiked malvastrum.

Land Management Implications
Rabbits are present but large warrens are uncommon and major shrub species are regenerating. Surface soils have a slight water erosion hazard and care should be exercised when planning earthworks on this unit if rilling is to be avoided. There is a very low wind erosion risk.
Unit 4.1  Drainage floors dissected by creek channels, with red earths supporting mulga woodland with annual and perennial grasses.

Unit 4.2  Drainage floors with red earths supporting prickly wattle over annual and perennial grasses. A distinguishing feature is the abundance of prickly wattle.
Unit 4.3
Seasonally flooded swamps with brown clays supporting coolibah woodland over annual and perennial grasses. A distinguishing feature is the coolibah woodland...
UNIT 4.3

General Description
Seasonally flooded swamps with brown clays supporting coolibah woodland over annual and perennial grasses.

Geology
Quaternary alluvium.

Landform
Low lying, seasonally flooded swamps, with level floors and relief less then 1m.

Soils
Great Soil Group - Brown Clays
Principle Profile Form - Gn4.13

Profile Description:
Heavy textured soils with light medium clay surface soils to 10cm, grading to a medium clay by 20-30cm, and a heavy clay from 30-50cm. Structure is weakly pedal with platy peds to 10cm and moderately pedal with angular or sub-angular blocky peds from 10-50cm. There is a rough-faced fabric throughout the profile. The pH is 8.0 to 10cm and 8.5 from 10-50cm. Colour is red-brown (5.0YR44) to 20cm and dark red-brown (5.0YR34) to 50cm. Surfaces are strongly crusted and seasonally cracking.

Vegetation
A mid-high open woodland of coolibah in the upper storey, with a mid-high sparse shrubland of juvenile ironwood, ruby and spiny saltbush over a low open grassland of neverfail and button grasses with shrub sida and cannonball.

Land Management Implications
Large warrens are uncommon but rabbits are present in individual burrows. Little tree or shrub regeneration is occurring. The erosion potential is negligible, due to the heavy texture of surface soils, but there is a high risk of flooding.
UNIT 4.4

General Description
Floodplains with red clays supporting coolibah and old man saltbush on fringes.

Geology
Quaternary alluvium

Landform
Floodplain with slopes of less than 1% and relief up to 2m, dissected by broad creek channels.

Soils
Great Soil Group - Red Clays
Principal Profile Form - Uf1.33

Profile Description:
Soil colour is yellow-red (5.0YR46) to 30cm and red (2.5YR48) to 80cm. Profiles are sandy clay in texture to a depth of 30cm, then a light clay to at least 80cm. They are massive and earthy throughout, and strongly alkaline, having a pH 8.5 to 30cm and pH 10.0 below this depth. Calcium carbonate occurs in the fine earth throughout. Surfaces are puffy and the soils are probably moderately saline.

Vegetation
A tall open shrubland of old man saltbush with scattered coolibah on the fringes of the creek channels in association with a tall open forbland of samphire and copperburr.

Land Management Implications
There is sign of an abundance of rabbits throughout this unit. Warrens are not readily apparent but individual burrows are present and some rabbits may be surface dwelling. There is no visible regeneration of the saltbush. The unit has only a slight erosion hazard.
UNIT 4.5

General Description
Salt lakes surrounded by unstable dunes.

Geology
Quaternary evaporites.

Landform
Salt lakes with level, featureless surfaces with little relief.

Soils
Great Soil Group - Solonchaks
Principle Profile Form - Gn4.16

Profile Description:
These are heavy soils, light clay in texture to a depth of 10cm, then gradually trending to a heavy clay with depth. Under the surface salt crust the soil colour is red (2.5YR46), turning black (5.0YR2.5/1) by a depth of 5cm. Soil reaction is strongly alkaline, with pH 9.5 - 10.0 throughout.

Vegetation
The salt lakes themselves are bare, although they are fringed with samphire.

Land Management Implications
The presence of rabbits was noted on the salt lakes. However, the larger lakes may act as an obstacle to rabbit movement. There is a low erosion potential.
5 SANDPLAINS AND DUNEFIELDS

UNIT 5.1

General Description
Dunefield with broad swales between sand rises. Red sands supporting mulga and witchetty over hard spinifex.

Geology
Quaternary aeolian deposits.

Landform
Dunefield with broad swales, having slopes less than 1% with relief up to 2m, and linear dunes with relief greater than 2m.

Soils
Great Soil Group - Earthy Sands
Principle Profile Form - Uc1.23

Profile Description:
Texture is a light sandy clay loam from 0-80cm. In the swales, soil with a pH of 8.0 to 50cm and 8.5 from 50-80cm. Soil colour is red (2.5YR46) throughout profile which is massive with sandy fabric. There is no carbonate present in the fine earth.

Vegetation
Low open woodland of mulga with witchetty and dead finish over a mid-high open shrubland of broombush with juvenile mulga, dead finish and witchetty bush. The lower stratum consists of tall open hummock grassland of hard spinifex with woollybutt, kerosene grass, oat grass, and mulga grass. Forbs present include tickweed, white paper daisy, poached egg daisy, and golden everlasting.

Land Management Implications
Rabbits are present, but only in small warrens under shrubs, and the regeneration of shrubs is occurring. There is slight water erosion potential and if the vegetation cover is removed the soil is susceptible to wind erosion.
Unit 5.1
Dunefield with broad swales between sand rises. Red earthy sands support mulga and witchetty over hard spinifex.
Unit 5.2
Sandplain with areas of low dunes, supporting open mulga woodland over annual grasses.
UNIT 5.2

General Description
Sandplain with areas of low dunes, supporting open mulga woodland over annual grasses.

Geology
Quaternary aeolian deposits.

Landform
Level or slightly undulating sandplain having relief of up to 2m with slopes less then 1%. Drainage features are absent, and some areas have low dunes.

Soils
Great Soil Group - Earthy Sands
Principal Profile Form - Gn2.13

Profile Description:
Texture grades from a light sandy clay loam to 30cm depth sandy clay loam from 30-50cm. Structure is massive with an earthy fabric throughout the profile. Profiles are alkaline with pH 7.5 to 30cm and 9.5 from 30-50cm. Soil colour is red-brown (2.5YR44) to 10cm, dark red (2.5YR36) to 50cm and red (2.5YR36) to 70cm. The fine earth does not contain calcium carbonate. Ironstone nodules are present in the profile from 0-50cm at 5-10%.

Vegetation
A low open woodland of mulga, ironwood, witchetty, and dead finish, over a mid-high open shrubland consisting of spiny saltbush, broombush, silver cassia, ruby saltbush, turpentine bush, and harlequin fuchsia bush. The lower stratum consists of a low open tussock grassland of erect kerosene grass, woollybutt, mulga grass, oat grass, windmill grass and woollyoat grass, with tickweed, white paper daisy, goathead burr, mulla mulla, caustic weed, poached egg daisy, paddymelon, potato bush, indigo, cartwheel burr, golden everlasting, copperburr, cannonball, and Helipterum charsleyae.

Land Management Implications
Large warrens are common, but the regeneration of major shrub species is still occurring. Soils have a slight erosion risk and will be susceptible to both wind and water erosion if groundcover is removed. Earthworks that divert surface runoff, such as grader windrows, will initiate rill erosion.
UNIT 5.3

General Description
Sandplain with minor areas of low dunes supporting sparse hopbush and fushia bush over annual grasses.

Geology
Quaternary aeolian deposits.

Landform
Level or slightly undulating sandplain, with slopes up to 1% and relief up to 2m and locally with occasional low dunes. Drainage features are absent.

Soils
Great Soil Group - Earthy Sands
Principle Profile Form - Gn2.13

Profile Description:
Texture grades from a light sandy clay loam to 10cm depth to a sandy clay loam by 30cm and a sandy clay by 60cm. Profiles are massive and earthy throughout. Soil reaction is alkaline, with pH 8.5 to 30cm and pH 9.5 from 30-60cm. Soil colour is red-brown (5.0YR44) or dark red (2.5YR36) to 10cm, red-brown (2.5YR44) or dark red-brown (2.5YR34) to 30cm and dark red (2.5YR36) to 60cm. Occasionally calcareous nodules present at 10% from 50-60cm but calcium carbonate was not detected in the fine earth fraction.

Vegetation
A mid-high open woodland of ironwood, mulga, witchetty, dead finish and prickly wattle. The mid-high stratum consists of a mid-high sparse shrubland of weeping emu bush, turpentine bush, sticky hopbush and spiny saltbush. The lower stratum is a low open grassland of kerosene grass, woollybutt, cotton panic, tall curly windmill grass, mulga grass, oat grass, limestone oat grass, cattle bush, poached egg daisy, tickweed, buckbush, paddymelon, native tobacco, white paper daisy, mulla mulla, copperburr, caltrop, munyeroo, tar vine, goathead burr, cannonball, lifesaver burr.

Land Management Implications
Large rabbit warrens are present in this unit and there is little regeneration of the major tree and shrub species. There is a slight water erosion risk which will be accentuated by disturbances to surface drainage patterns such as caused by grader windrows. There is a minor wind erosion risk.
UNIT 5.4

General Description
Mobile dunes fringing salt lakes with red siliceous sands supporting kerosene grass and herbage.

Geology
Quaternary aeolian deposits

Landform
Mobile dunes consisting of blowouts and advancing slip faces, with relief up to 5m.

Soils
Great Soil Group - Siliceous Sands
Principle Profile Form - Uc1.23

Profile Description:
These are deep profiles, loamy sand in texture throughout, with single grain structure and a sandy fabric. They are alkaline, with pH 7.0 from 0-10cm, pH 8.0 between 10-20cm, and pH 9.0 from 20-50cm. Profiles are red (2.5YR4/6) throughout, and calcium carbonates is absent.

Vegetation
Isolated witchetty bush is present. The groundcover consists of a low open grassland consisting of kerosene grass, poached egg daisy, and buckbush.

Land Management Implications
Rabbits are present in warrens and individual burrows occur under shrubs. These soils have a severe wind erosion risk and drift will occur on areas where the groundcover is removed.
Unit 5.4
Mobile dunes fringing salt lakes with red siliceous sands supporting kerosene grass and herbage. Distinguishing features include blowouts and large sand drifts.
REFERENCES


# LIST OF PLANTS MENTIONED IN TEXT

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<thead>
<tr>
<th>SCIENTIFIC NAME</th>
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Forbs
Boerhavia coccinea
Brachycome ciliaris
Calocephalus platycephalus
Cleome viscosa
Convolvulus erubescens
Cucumis myriocarpus
Dissocarpus paradoxus
Euphorbia drummondii
Glycine sp
Halosarcia halocnemoides
Helichrysum bracteatum
Helioterum chersleyae
Helioterum floribundum
Indigofera linnaei
Indigofera sp
Lepidium sp
Malvastrum americanum
Minuria leptophylla
Myriocephalus stuartii
Neobassia astrocarpa
Nicotiana sp
Portulaca oleracea
Psoralea sp
Ptilotus exaltatus
Ptilotus obovatus
Rycharhena linearis
Salsola kali
Sclerolaena bicorns
Sclerolaena cornishiana
Sida platycalyx
Sida rohlena
Solanum ellipticum
Tribulus terrestris
Trichodesma zeylanicum

Tar Vine
Variable Daisy
Yellow Billy Buttons
Tickweed
Australian Bindweed
Paddymelon
Cannonball
Caustic Weed
Glycine
Samphire
Golden Everlasting
White Paper Daisy
Birdsville Indigo
Indigo
Peppercress
Spiked Malvastrum
Minnie Daisy
Poached Egg Daisy
Tobacco
Munyeroo
Vorbine
Tall Mulla Mulla
Silver Tails
Buckbush
Goathead Burr
Cartwheel Burr
Lifesaver Burr
Shrub Sida
Potato Bush
Caltrop
Cattle Bush
Figure 1: Location of assessment sites established within the treated area.
Figure 2: Location of comparison sites in relation to the project area.
NORTHERN COMPARISON SITE

LAND TYPES

- Calcareous Plains
- Undulating Footslopes
- Floodplain and Floodout
- Sandplain

Figure 3: Location of individual sites in the northern comparison area. The land types in the area are shown.
Figure 4: Location of individual sites in the southern comparison area. The land types in the area are shown.