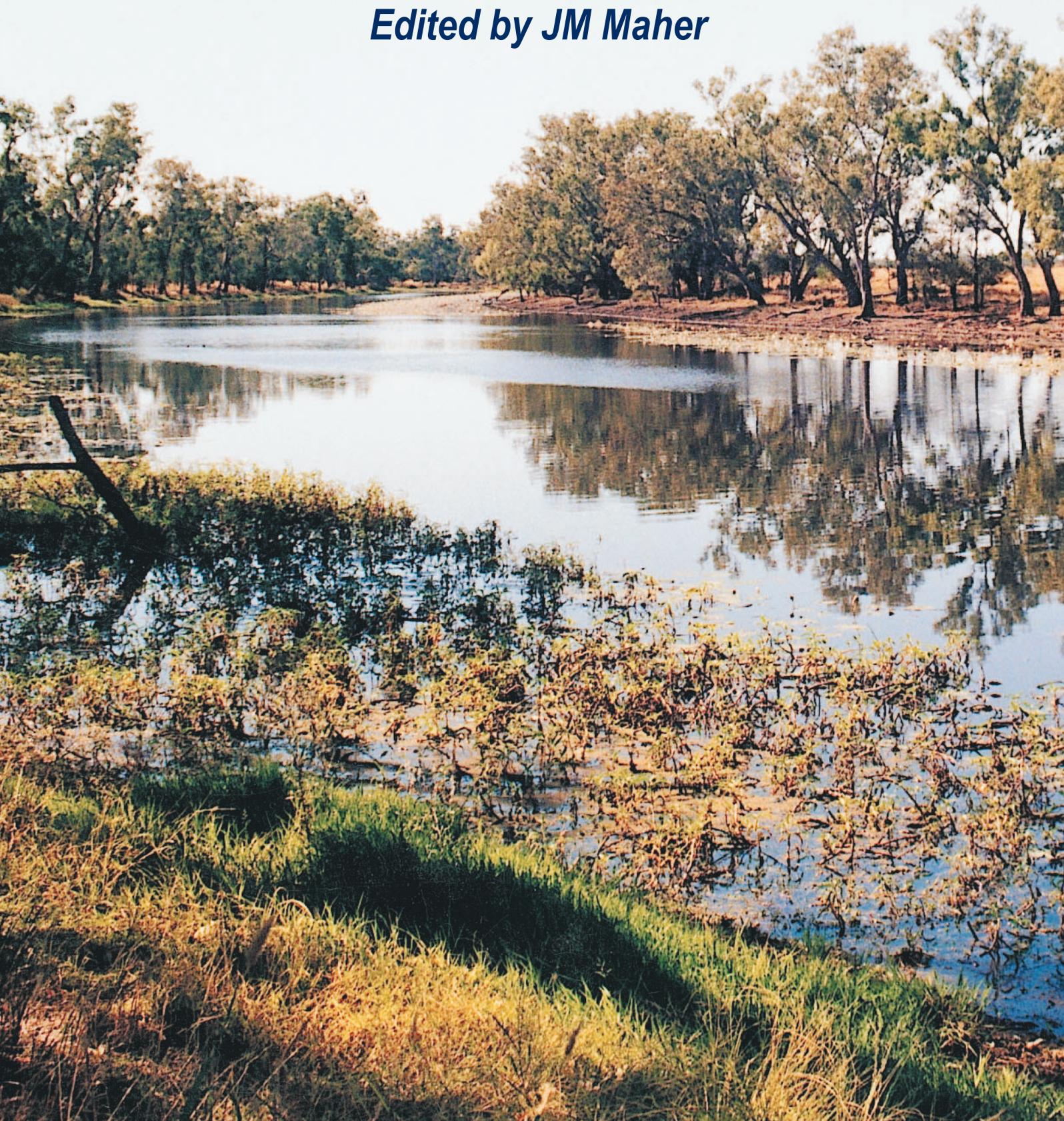


***Understanding and Managing Soils in the
Murilla, Tara and Chinchilla Shires***

Field Manual

Edited by JM Maher



Queensland Government Technical Report

This report is a scanned copy and some detail may be illegible or lost. Before acting on any information, readers are strongly advised to ensure that numerals, percentages and details are correct.

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Understanding and Managing Soils in the Murilla, Tara and Chinchilla Shires

Field Manual

Edited by J.M. Maher

Department of Primary Industries
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1. INTRODUCTION

The Land Management Manuals Project is a Department of Primary Industries 'self-help' initiative to aid decision making for sustainable land management and planning. This is achieved by increasing the awareness and aiding the understanding of land resources information within the community.

What is a Land Management Manual?

A Land Management Manual is a collation of currently available land resource data, combined with local knowledge and experience, primarily concerning soils and their management.

The preparation of the Manual involved a series of local producer workshops to obtain practical soil management information. This procedure ensured that the existing land resource information and its interpretation were up-to-date.

What area does the Manual cover?

The Manual discusses the attributes and limitations of the soils used for primary production for some 2.6 million hectares in the shires of Murilla, Tara and Chinchilla. The project area and its relationship to Manuals in surrounding regions are shown in Figure 1.1.

Why have a Land Management Manual?

Running a successful rural enterprise, over a long period of time, is dependent on the correct use of the available resources. Decision making should be determined by the ability of the resource to produce - not on historical practices which in some cases have led to resource degradation.

This Manual is designed to increase the awareness of the capabilities of the soils within the three shires, and in so doing, minimise potential land degradation. It brings together the currently available resource data and practical management information in a format which is easy to understand and use.

The Manual provides a handy tool for users to identify and evaluate their soils. The consideration of soils information is essential when developing long-term strategies for property management or for local planning.

What does the Manual contain?

The Land Management Manual package has three major parts contained within a ring-binder.

- **The *Field Manual*:** the core and most important component of the package. It provides a summary of the region's soil and land characteristics, and provides recommendations for appropriate management and use. This section of the Manual also provides information on identifying the soils. Various visual aids are provided for this purpose, including maps, tables, summary sheets and landscape and soil photographs. Farmers and graziers will find the summary sheets that contain land use and management information for their soils particularly useful. An increased knowledge of soils and their behaviour helps decision making on optimising production on different soils while minimising land degradation.
- **The *Resource Information*:** a reference document that provides a regional overview and places the soils information within this context. To support the information contained in the Field Manual, this document explains local land resource-related aspects in more detail. Land use problems encountered from local experience, and the solutions implemented are also dealt with.
- **The *Land Resource Areas (LRAs) maps*:** full colour maps showing the distribution of Land Resource Areas or landscapes (not soils) within the district.

Who should use the Manual?

The following list illustrates the range of potential users of the Manual. Although the list only gives one example per user, the range of possible uses is more extensive.

| | |
|---|---|
| Present landholders | - to re-assess the potential of their property |
| New landholders | - to assess the realistic potential of their property |
| Potential landholders | - to assess the realistic potential of a property |
| Property Management Planning (PMP) groups | - for resource-based property planning |
| Landcare groups | - for resource-based planning over large areas |
| Planners/consultants | - to assess property and land potential |
| Extension staff | - for sound advice on property potential |
| Educators | - for education on soils and their sound use |
| Land valuers | - for property potential and valuation |
| Rural banks | - for informed decision making |
| Local authorities | - for shire development plans |
| Dept. of Transport | - for better road construction and erosion control |
| Queensland Rail | - for erosion control |
| SWQEB | - for erosion control on line construction |
| Telecom | - for erosion control on line installation |

DAWSON - CALLIDE DISTRICTS

DPI DEPARTMENT OF
PRIMARY INDUSTRIES
QUEENSLAND

**MURILLA, TARA, and
CHINCHILLA SHIRES
LOCALITY MAP**

SCALE 1 : 1 250 000
kilometres 25 0 25 50 kilometres



LEGEND

| | |
|--|-------------|
| Murilla, Tara, and Chinchilla Shires Manual Boundary | ————— |
| Adjoining Manual District | ROMA |
| Shire Boundary | ————— |
| Shire Name | TARA |

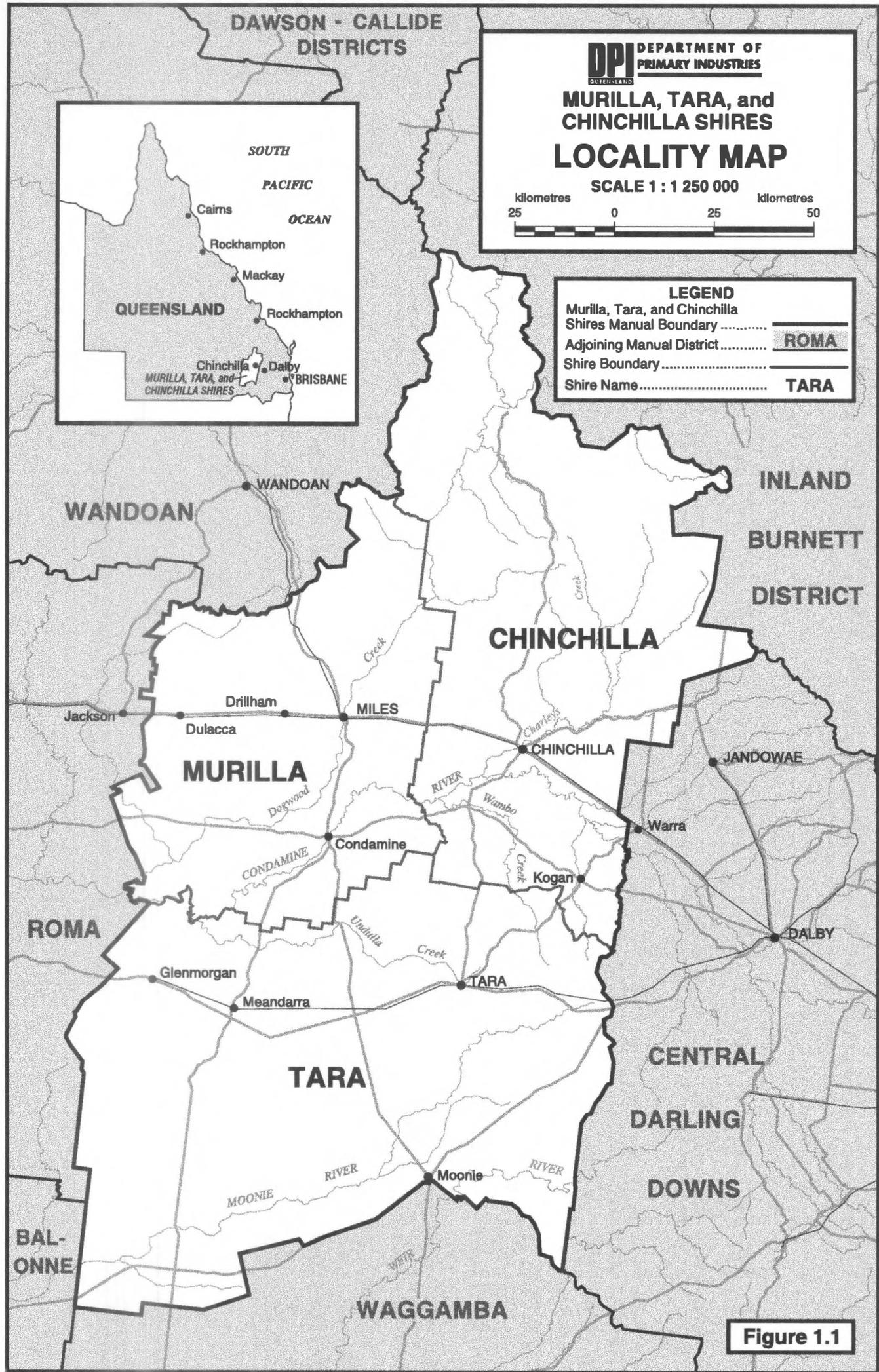


Figure 1.1

2. USING THE FIELD MANUAL

To use this Manual and the accompanying maps effectively, it is essential to understand the two major notions that are the basis of the soils' information. These are the '**Land Resource Area (LRA)**' and the '**Soils**'. Although they are both defined elsewhere, it is important to re-emphasise these concepts here.

The whole landscape is divided into mapping units (called LRAs) which are based primarily on geology, slope and relief. Soils are described based on their location within the landscape units. These landscape units help to reduce the complexity of the landscape to easily-handled proportions.

It must be stressed that for each LRA, it is the *dominant* landform, soil and vegetation characteristics which are described. Depending on the complexity of the landscape, considerable variation in these features can occur within any individual LRA. These variations arise because of the limitations imposed by the scale of mapping.

Errors in interpretation will occur through incorrect usage (e.g. enlarging the map scale) or if the user has unrealistic expectations of the map. Land and soils are a continuum, therefore map unit boundaries may not represent distinct changes, but rather a zone of gradual change. Regardless of the mapping scale used, there are always some areas which are too small to map accurately. Do not enlarge the map as this will not increase the accuracy of the information.

The landscape units (or LRAs) contain a number of different soils, which because of scale *are not mapped separately*. Once map units have been compiled they are not designed to identify the soils in a particular unit but to predict their probable occurrence. Field observations are necessary if positive confirmation is required.

Each soil group has a defined range of distinguishing properties i.e. they have similar profiles with similar horizon sequences, have developed from similar parent materials, and have many similar physical and chemical properties. However, they may occur on a range of different topography and have other land characteristics such as drainage, soil depth or stoniness which may influence management on these areas.

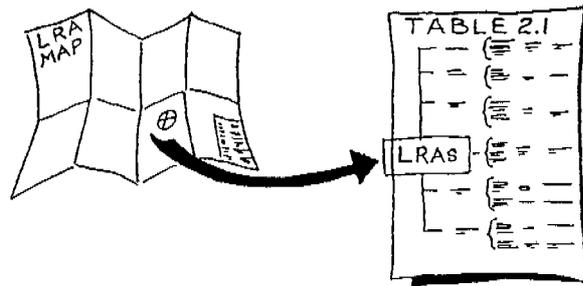
The LRA map enables a farmer to relate the information on regional features contained in the Manual, to on-farm features. The steps to make the link between the broad regional picture as presented on the LRA map, and the soils identified at the property level are set out below. In summary the steps in using this manual are:

- establishing a specific Land Resource Area (LRA);
- determining the relevant soil; and
- seeking the relevant land use and management information.

Determining the soil for any site

This manual provides land use and management recommendations that apply to soils which you can readily identify.

Step 1. First, find your location on the LRA map. Make a note of the LRA and surrounding LRAs on the map. Due to the scale of mapping it has not been possible to map out all LRAs occurring. One of these unmapped areas may coincide with your location on the ground. Match your general landscape with the description shown on the map legend and in Table 2.1.



Step 2. Once you have confirmed the Land Resource Area, identify the soils that are likely to occur within that LRA. Refer to Table 2.2, which shows the soils likely to be found within this, and surrounding LRAs. Note that because of the limitations of the scale of the map at 1:250 000, it is possible that other soils may occur on individual properties. This will have to be verified by field inspections of each area of the property.

| LRA | Soil | Soil | Soil | Soil |
|-----|------|------|------|------|
| 1 | 1 | 2 | 3 | 4 |
| 2 | 5 | 6 | 7 | 8 |
| 3 | 9 | 10 | 11 | 12 |
| 4 | 13 | 14 | 15 | 16 |
| 5 | 17 | 18 | 19 | 20 |
| 6 | 21 | 22 | 23 | 24 |
| 7 | 25 | 26 | 27 | 28 |
| 8 | 29 | 30 | 31 | 32 |
| 9 | 33 | 34 | 35 | 36 |
| 10 | 37 | 38 | 39 | 40 |

Step 3. The field inspection will require you to dig a hole or examine a cutting e.g. bank or roadside, to verify the soil on different parts of the landscape. For example, it is probable that there will be different soils on an alluvial plain, the terrace flat, on rolling slopes, hills, drainage lines, and so on. The soils can be further subdivided on the basis of topography, drainage, or other limitations such as rockiness, etc. into more detailed management units or 'land types'. Compare the description on the soil summary sheet and the representative soil photograph in the *Field Manual* with what you observe, and compare the landscape features. It must be stressed that the soil profile photo and accompanying description may represent *one example* in the range of soils found within the soil group. Also, there are usually a number of soils occurring within each LRA.



Table 2.1 *Brief description of LRAs*

| LRA | Brief description |
|---|---|
| <p>Clay Alluvial Plains</p> <p>1a</p> <p>1b</p> <p>1c</p> | <p>older, elevated alluvial plains of the Condamine River with many drainage lines; very open grassy woodland of poplar box</p> <p>river terraces, channels and associated plains of the Condamine River which are subject to periodic flooding; coolibah, river red gum open forest and woodland fringe the drainage lines, whilst poplar box grassy woodland occurs on the flat plains</p> <p>flat plains of basaltic alluvium modified in places with deposits from weathered shale and sandstone; few defined drainage lines; poplar box grassy woodland</p> |
| <p>Poplar Box Flat Plains</p> <p>2a</p> <p>2b</p> | <p>flat plains and stream terraces of shale and sandstone alluvium; poplar box shrubby woodland to open forest or poplar box and false sandalwood shrubby woodland; associated species include wilga, false sandalwood, sally wattle, limebush, bull oak and belah</p> <p>gently undulating to flat plains; woodland of poplar box and bull oak or of poplar box; associated species include narrow-leaved ironbark, false sandalwood, cypress pine and molly box</p> |
| <p>Cypress Pine Sands</p> <p>3a</p> <p>3b</p> | <p>flat to gently undulating sandy alluvial plains; on the sandier soils cypress pine, tumbledown gum and rough-barked apple predominate, with poplar box or bull oak woodland occurring on the heavier soils; Moreton Bay ash, rusty gum, sally wattle and wilga may also occur</p> <p>flat sand plains raised above the level of the surrounding clay plains; open forest of tumbledown gum and cypress pine on very deep sands and an open forest of bull oak, poplar box, cypress pine and tumbledown gum on texture contrast soils</p> |
| <p>Brigalow Plains</p> <p>4a</p> <p>4b</p> <p>4c</p> | <p>flat to gently undulating clay plains; very shallow to moderately deep gilgai may occur; brigalow, belah, wilga forest and associated black teatree; molly box woodland and poplar box shrubby woodland intermixed with brigalow forest at the edges of the plains</p> <p>flat clay plains; moderately deep to deep gilgai; brigalow, belah, wilga forest and associated false sandalwood, with black teatree forest, molly box woodland and poplar box shrubby woodland intermixed with brigalow forest on the poorer drained areas</p> <p>flat to gently undulating plains (may contain areas of 4b); belah forest with wilga, brigalow and false sandalwood</p> |

| | |
|---|--|
| <p>Brigalow Rises</p> <p>5a</p> <p>5b</p> <p>5c</p> | <p>gently undulating rises and plains on sandstone and shale; very shallow gilgai may occur; shrubby open forest of brigalow, belah and wilga with associated molly box and a shrubby open forest of belah, wilga and poplar box also occurs</p> <p>undulating rises; brigalow, belah, wilga shrubby forest with associated false sandalwood, and belah forest, poplar box shrubby woodland may occur on lower slopes</p> <p>undulating to steep, low sandstone hills and rises; softwood scrub and brigalow forest</p> |
| <p>Rolling Downs</p> <p>6a</p> <p>6b</p> | <p>undulating siltstone and mudstone rises; poplar box grassy open woodland</p> <p>undulating rises on fine-grained sediments; linear gilgai may occur; open grassland with scattered poplar box and silver-leaved ironbark on crests and upper slopes with coolibah and myall on lower slopes and valley flats</p> |
| <p>Ironbark/bull oak Forests</p> <p>7a</p> <p>7b</p> <p>7c</p> | <p>flat to gently undulating plains derived from weathered sandstone, may be associated with lower slopes of lateritised sandstone remnants; open forest of bull oak, bull oak and cypress pine or bull oak and narrow-leaved ironbark with associated rusty gum, tumbledown gum, wattles and molly box; poplar box and cypress pine occur along drainage lines</p> <p>undulating plains associated with the colluvial slopes of lateritised sandstone hills; layered open forest of ironbarks, rusty gum, cypress pine and wattles</p> <p>dissected, undulating sandstone rises with low hills; layered open forest of ironbarks, bull oak, cypress pine, wattles and rusty gum with some poplar box</p> |
| <p>Poplar Box Rises</p> <p>8a</p> <p>8b</p> | <p>gently undulating plains to rises associated with the edges of the brigalow plains or the dissected lateritised sandstone remnants; includes some local creek alluvia; poplar box, false sandalwood shrubby woodland, but mixed poplar box, silver-leaved ironbark, false sandalwood, limebush shrubby woodland also occurs; brigalow, belah forest is common on the upper slopes where these rises border the brigalow plains</p> <p>gently undulating plains to undulating rises on sandstone; layered forest and shrubby woodland of poplar box, false sandalwood and some myall; also occurring is a shrubby open forest of narrow-leaved ironbark, cypress pine, poplar box and false sandalwood</p> |
| <p>Light Forests</p> <p>9a</p> | <p>undulating plains and rises, often lateritised; shrubby woodland and layered open forest of ironbarks, bull oak, wattles, cypress pine and Queensland peppermint with poplar box occurring on the deeper soils; associated species include rusty gum and tumbledown gum</p> |

| | |
|---------------|---|
| 9b | plateaus and low sandstone hills to undulating plains, lateritic scarps are common; layered open forest of ironbarks and wattles, with spotted gum, lancewood, rusty gum, Queensland peppermint, yellow jacket, bull oak and cypress pine |
| 9c | steep sandstone hills and scarps; rock outcrops; ironbarks, spotted gum, rusty gum, cypress pine open forest |
| Granite Hills | |
| 10 | undulating to steep granite hills; rock outcrop; ironbarks and Queensland blue gum woodland |

Step 4. Continue to compare the information until a **reasonable** match is found. Matching descriptions does not imply that they must be 'identical', but rather that they should be similar in most aspects.

Step 5. Each area of your property can be mapped out as a management unit on a property plan. Where there is a change of topography, soil, drainage, erosion, geology, vegetation etc., which would necessitate a change in management practices, a new management unit or 'land type' should be identified and mapped out.

Step 6. Refer to the summary information on land use options and limitations, and management options for the selected soil.

As you gain knowledge of the land resources it will be possible to identify both the LRAs and soils using the summary information from the *Field Manual*.

Table 2.2 Relationship of soils to LRAs

| LRA | SOILS | |
|--|---|--|
| | Common Soils | Associated Soils |
| Clay Alluvial Plains 1a 1b 1c | Condamine, Cecilvale, Arubial Condamine, Cecilvale, Arubial Cecilvale | Combidiban, Davy, Chinchilla Bogandilla, Chinchilla Bogandilla |
| Poplar Box Flat Plains 2a 2b | Bogandilla, Arubial Braemar, Weranga | Combidiban, Davy, Chinchilla, Condamine Cutthroat, Davy |
| Cypress Pine Sands 3a 3b | Chinchilla, Davy, Combidiban, Bogandilla Davy, Combidiban | Nudley, Arubial Arubial |

| | | |
|---|---|---|
| Brigalow Plains 4a 4b 4c | Kupunn Tara Tandawanna | Tara, Arubial, Bogandilla, Rogers, Tandawanna Kupunn, Bogandilla, Rogers, Arden, Tandawanna Bogandilla, Weengallon, Arden |
| Brigalow Rises 5a 5b 5c | Ulimaroa Ulimaroa Cadarga, Moola | Bogandilla, Tandawanna Tandawanna, Bogandilla Bogandilla |
| Rolling Downs 6a 6b | Dulacca Inglestone, Inglestone shallow | Ulimaroa, Tandawanna Weengallon, Tandawanna |
| Ironbark/bull oak Forests 7a 7b 7c | Braemar, Cutthroat, Channing Cutthroat, Highmount, Minnabilla Braemar, Channing | Weranga, Highmount, Minnabilla, Davy, Combidiban, Arubial Weengallon Coalbah, Cutthroat |
| Poplar Box Rises 8a 8b | Coalbah, Bogandilla, Weengallon, Braemar Coalbah, Weranga | Cutthroat, Nudley, Kupunn, Arubial Braemar, Cutthroat |
| Light Forests 9a 9b 9c | Minnabilla, Braemar, Flinton Minnabilla, Binkey Minnabilla | Binkey, Highmount, Channing, Coalbah, Weengallon, Cutthroat, Davy, Bogandilla Flinton, Channing, Rogers, Cutthroat, Braemar, Coalbah Braemar, Binkey |
| Granite Hills 10 | Boonenne, Gordonbrook | Minnabilla, Highmount |

3. SOIL SUMMARY SHEETS

READ THIS IN CONJUNCTION WITH A SET OF SOIL SUMMARY SHEETS

The following sheets provide summary information about each soil and its associated land use suitability and management. Soil and site descriptions presented here are directly relevant to decisions on land use and management. A set of limitations to land use have been deduced from these descriptions and local experience. Recommendations are also given for crop and pasture suitability.

It must be emphasised that comments regarding best management practices are based on local knowledge and experience. The soil information is provided to enable the landholder or manager to consider this information and its implications when making any land management decisions.

Soils information

The sheets provide photographs of the soil landscape and an example soil profile. These are accompanied by summary information on the example soil's characteristics and chemical and physical properties.

Landscape description: summarises the soil's position within these landscapes and their likely locations. The vegetation usually associated with each soil is also given. It should also be noted that vegetation descriptions are not diagnostic for each soil. However, they can generally be used as a guide or indicator of the occurrence of a particular soil or to the presence of some important properties that are related to certain soils e.g. soils with deep sandy surfaces.

Soil characteristics: it must be stressed that this comprises a photograph and description of an *example* soil profile for the named soil. The range of distinguishing soil features, including chemical and physical attributes of the named soil which are relevant to land use, are briefly summarised. These general soil features will also aid in the identification of a given soil.

The soil description is simplified from the profile descriptions contained in Appendix 3 of the *Resource Information*, but is detailed enough to identify the soil. Soil colour, structure and types of segregations are defined in the Glossary.

Statements are made on the availability of nutrients in the top 10 cm of the soil at the *sampling site only*. The general ratings used for the interpretation of soil chemical analyses are given in Table 3.1.

Surface soil and subsoil pH values are given for each soil. Further explanation of pH is given in the Glossary.

Salinity and sodicity within the profile are based on the chemical analyses of the soil samples taken for each example soil. Salinity is based on the electrical conductivity (EC) value and relates to inherent salinity (that is, the presence of salts in the profile). Sodicity relates to the exchangeable sodium percentage (ESP) value. These terms are defined in the Glossary.

An estimate is given of the plant available water capacity (PAWC) within the rooting zone, or the ability of the soil to retain moisture for use by the crop or pasture. Section 5.4 of the *Resource Information* gives a more detailed discussion of the soil chemical and physical properties.

Table 3.1 Ratings used for interpretation of soil analyses

| Soil Test | Units | Ratings | | | | |
|---------------------|---------|----------|------------|-----------|-----------|-----------|
| | | Very low | Low | Medium | High | Very high |
| Cl | (%) | <0.01 | 0.01-0.03 | 0.03-0.06 | 0.06-0.20 | >0.20 |
| P _{ACID} | (mg/kg) | <10 | 10-20 | 20-40 | 40-100 | >100 |
| P _{BICARB} | (mg/kg) | <10 | 10-20 | 20-40 | 40-100 | >100 |
| Extr. K | (m.eq%) | <0.1 | 0.1-0.2 | 0.2-0.5 | 0.5-1.0 | >1.0 |
| Cu | (mg/kg) | <0.1 | 0.1-0.3 | 0.3-5 | 5-15 | >15 |
| Zn pH >7 | (mg/kg) | <0.3 | 0.3-0.8 | 0.8-5 | 5-15 | >15 |
| pH <7 | (mg/kg) | <0.2 | 0.2-0.5 | 0.5-5 | 5-15 | >15 |
| Mn | (mg/kg) | <1 | 1-2 | 2-50 | 50-500 | >500 |
| Total N | (%) | <0.05 | 0.05-0.15 | 0.15-0.25 | 0.25-0.5 | >0.5 |
| Org. C | (%) | <0.5 | 0.5-1.5 | 1.5-2.5 | 2.5-5.0 | >5.0 |
| Total P | (%) | <0.005 | 0.005-0.02 | 0.02-0.05 | 0.05-0.10 | >0.10 |
| Total K | (%) | <0.1 | 0.1-0.5 | 0.5-1.0 | 1.0-3.0 | >3.0 |
| Total S | (%) | <0.005 | 0.005-0.02 | 0.02-0.05 | 0.05-0.10 | >0.10 |
| PAWC | (mm) | <50 | 50-100 | 100-150 | 150-200 | >200 |
| Dispersion ratio | | | <0.6 | 0.6-0.8 | >0.8 | |

pH - extremely acid <4.5; very strongly acid 4.5-5.0; strongly acid 5.1-5.5; medium acid 5.6-6.0; slightly acid 6.1-6.5; neutral 6.6-7.3; mildly alkaline 7.4-7.8; moderately alkaline 7.9-8.4; strongly alkaline 8.5-9.0; very strongly alkaline >9.0

Land use information

The land use information has been compiled from local knowledge and experience.

Land use options: the most suitable uses for the particular soil are presented. It must be understood though that the ultimate decision on land use rests with the land manager who must take into consideration current climatic and economic conditions.

Land use limitations: includes aspects important to soil management.

Management options: lists important recommendations for responsible land management which allow optimal land use with minimum land degradation. Commonly recommended crops and pastures are listed.

These recommendations are based on the known inherent properties of the soils and the limitations they present to any land use.

ARDEN

Brief description: Deep, self-mulching red cracking clays, with gilgai, on brigalow-belah plains

Land Resource Areas: Minor in Brigalow Plains

LANDSCAPE DESCRIPTION

Landform and distribution

- flat to gently undulating plains from Glenmorgan to Moonie
- slopes between 1 and 3%
- frequently associated with the footslopes of lateritic scarps where they form a narrow transitional zone between the lateritic soils and the grey brigalow clays

Vegetation

- tall, open forest of brigalow with belah and occasional poplar box and yapunya
- understorey: wilga and false sandalwood



Windermere Rd south of Glenmorgan, Oct. 1994

SOIL CHARACTERISTICS



Pit 'Narrawong', Windermere Rd, 12 km S Glenmorgan

| Depth | Description |
|------------|---|
| 0-2 cm | brown, medium clay; loose, self-mulching surface. Abrupt to - |
| 2-60 cm | reddish brown, medium heavy clay; well structured; a little gravel; a few soft carbonate segregations; Clear to - |
| 60-100 cm | brown, heavy clay; faint mottles; moderately structured; a few carbonate segregations. Gradual to - |
| 100-150 cm | reddish brown, medium heavy clay; weakly structured. |

General soil features

- moderately to strongly self-mulching cracking clays, with a finely structured surface (forms a weak surface crust after rain)
- normal gilgai or crabhole gilgai may or may not be present - where developed, some variation in profile characteristics and surface condition may be seen, e.g. gilgai mounds are red and depressions are grey; the depth to carbonate layers and acid subsoils is usually greater in depressions than on mounds management of these soils is aided by a fine, friable seedbed and well structured upper subsoil
- lower subsoils are strongly sodic with extreme salinity levels but low dispersion
- soil pH is neutral to alkaline at the surface, becoming strongly alkaline at 30cm then strongly acid below 100cm
- plant available water capacity (PAWC) in the root zone of gilgai mounds is low (50-100 mm); gilgai depressions have higher PAWC levels
- N - medium, P- low (cropping), high (pastures), K - very high, Cu - medium, Zn - medium

ARDEN

LAND USE LIMITATIONS

- main limitation is the combination of gilgai microrelief and the adverse subsoil conditions
- levelling of crabhole gilgai may expose subsoils that are saline, sodic or acidic with a subsequent reduction in crop growth

LAND USE OPTIONS

- suitable long-term cropping soils
- also suitable for fodder crops, and grazing sown grasses and legumes and native pastures

MANAGEMENT OPTIONS

Pasture

Native

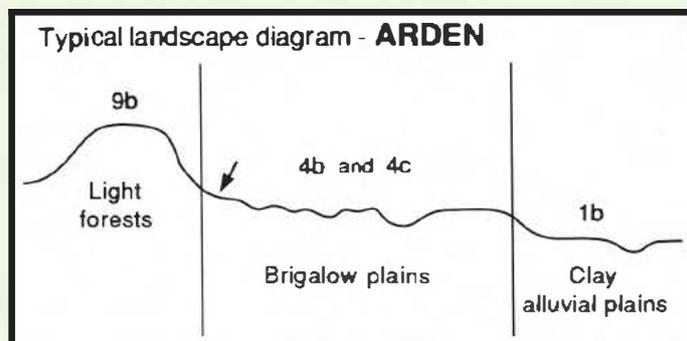
- key desirable species: Queensland bluegrass, fairy grass, curly windmill grass, brigalow grass, creeping windmill grass, creeping saltbush
- highly productive, cleared native pasture
- grows prolific bluegrass after clearing
- withstands reasonable grazing pressure with no significant erosion problems
- stocking rates: 1 beast/4 to 8 ha

Sown

- suitable grass and legume species include: Bambatsi, purple pigeon grass, buffel grass, Katambora Rhodes grass, lucerne and medics
- stocking rates: 1 beast/3 to 6 ha

Cropping

- suitable grain crops include: wheat, barley, grain sorghum, chickpeas and grain millet
- suitable fodder crops include: oats, forage sorghum, silk sorghum, lab lab and cowpeas
- retain stubble on crop fallows using zero or minimum tillage
- with cereal cropping, subsoil salts will be leached downward, increasing the effective rooting depth and hence the plant available water capacity



ARUBIAL

Brief description: Hardsetting thin (< 15 cm), bleached sandy surface, over brown or black clay subsoil on alluvial plains

Land Resource Areas: Clay Alluvial Plains, Poplar Box Flat Plains, (minor in Cypress Pine Sands, Brigalow Plains, Ironbark/bull oak Forests and Poplar Box Rises)

LANDSCAPE DESCRIPTION

Landform and distribution

- slight rises in the Condamine River flood plain; or
- gently undulating to flat alluvial plains, particularly in the Drillham and Dulacca areas

Vegetation

- shrubby or grassy woodland of poplar box, or poplar box and bull oak, or an open forest of bull oak; may have some brigalow
- understorey: false sandalwood, wilga, sally wattle and limebush
- cypress pine and belah are associated species of sandy rises on brigalow plains



Near pit site Leichhardt H'way south of Miles, Dec. 1994

SOIL CHARACTERISTICS



Pit, Leichhardt H'way, north of Condamine

| Depth | Description |
|-------------|---|
| 0 - 10 cm | brown, sandy loam; hardsetting, massive. Abrupt to - |
| 10 - 11 cm | light brownish grey, sandy loam; partially bleached. Sharp to - |
| 11 - 50 cm | dark greyish brown, medium clay; strong domed structure. Clear to - |
| 50 - 120 cm | brown, light medium clay, coarse sandy; weak structure; some hard and soft carbonate; a little gravel. Clear to - |
| 120 - 160 | brown, light medium clay; orange mottle; weak structure. |

General soil features

- texture contrast soils with a sharp change between the surface soil and subsoil
- surface texture is sandy loam to sandy clay loam, or occasionally loamy sand, commonly 10-15 cm thick
- a bleach usually occurs at the surface soil/subsoil boundary, indicating poorly drained and highly dispersible, sodic subsoils
- surface colours are dark brown to brownish black, over brownish grey, brownish black or black clay subsoils which may be mottled
- surface soils set hard when dry
- surface soils have a slightly acid to neutral pH, while the subsoils are strongly alkaline
- subsoil salinity is medium, but high to very high in the deep subsoil
- plant available water capacity in the root zone is very low (< 50 mm)
- N - low, P - low (cropping), high (pastures), K - medium to high, Cu - medium, Zn - low

ARUBIAL

LAND USE LIMITATIONS

- shallow effective rooting depth due to sodic to strongly sodic and relatively impermeable subsoils; water and air movement and root growth are restricted in these subsoils
- shallow surface soils have a low to very low plant available water capacity which limits crop production
- soil workability and crop establishment are also limited by the hardsetting surface soils

LAND USE OPTIONS

- suitable for grazing native and sown pastures

MANAGEMENT OPTIONS

Pasture

Native

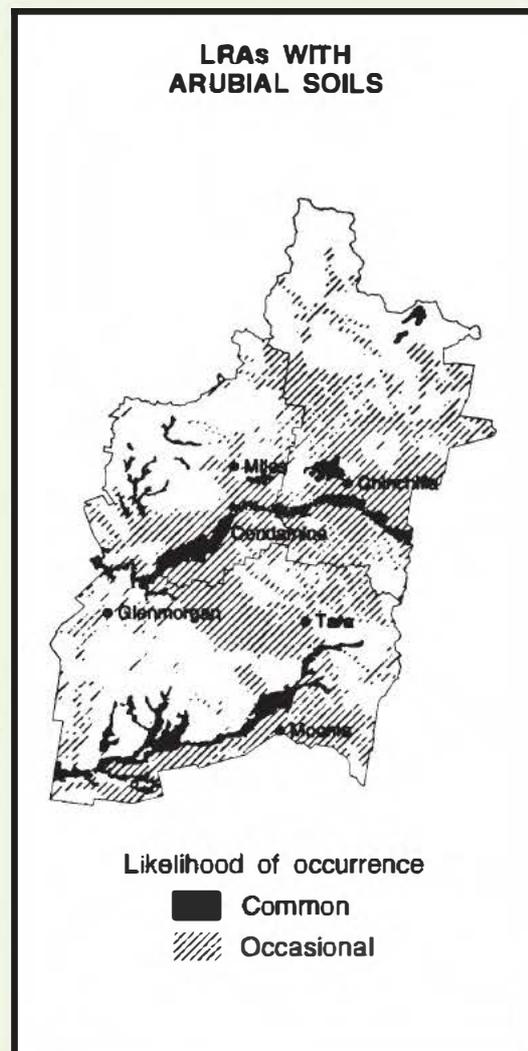
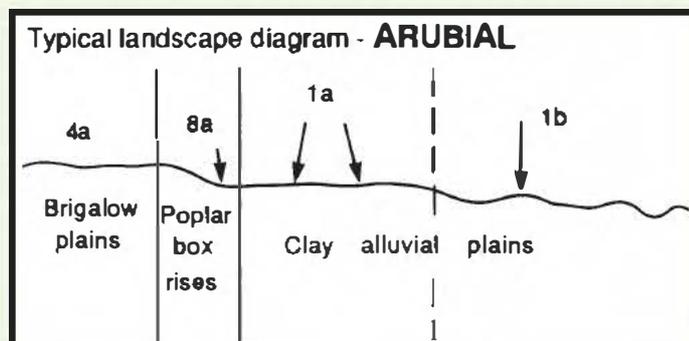
- key desirable species: Queensland bluegrass, forest bluegrass and pitted bluegrass
- stocking rates: 1 beast / 4 to 10 ha

Sown

- suitable grass and legume species include: Bambatsi, purple pigeon grass, buffel grass and medics
- buffel will run-down without medics
- medics have difficulty surviving dry winters
- cultivation may be required to regenerate pastures
- Stocking rates: 1 beast/3 to 8 ha

Cropping

- not recommended



BINKEY

Brief description: Shallow texture contrast soils, bleached sandy surface, over mottled gravelly clay subsoil

Land Resource Areas: Light Forests

LANDSCAPE DESCRIPTION

Landform and distribution

- generally associated with lateritised sandstone remnants
- dominant on upper slopes (2-5%) of ridges and hilltops of plateaus and
- low hills to undulating plains
- less commonly, they occur on mid slopes (2%) of lateritised sandstone rises

Vegetation

- grassy woodland to layered open forest of narrow-leaved ironbark and bull oak with some cypress pine and rusty gum
- understorey: some Queensland peppermint



Warrego H'way, 7 km west of Miles, July 1994

SOIL CHARACTERISTICS



Gully exposure, Warrego H'way 7 km W of Miles

| Depth | Description |
|-----------|--|
| 0-22 cm | brown, sandy loam; some gravel; hardsetting, massive. Clear to - |
| 22-40 cm | light grey, sandy loam; conspicuously bleached; much ironstone and quartz gravel. Sharp to - |
| 40-90 cm | light yellowish brown, medium heavy clay; weak structure; much gravel. Gradual to - |
| 90-140 cm | pale brown, medium heavy clay; some gravel. |

General soil features

- texture contrast soils with a sharp change between the surface soil and subsoil
- abundant stone and gravel throughout the profile, particularly the subsoil, and rock outcrop occurs
- surface texture varies from loamy sand to loam, but is usually sandy loam, commonly 15 to 30 cm thick
- a bleach occurs at the surface soil/subsoil boundary, indicating periodic waterlogging and sodic subsoils
- surface colours are brown to reddish brown, over grey or yellow clay subsoils which are mottled (subsoil colours may be brown to reddish brown)
- depth to parent material varies, but is usually less than 80 cm
- the soils are acid to very strongly acid throughout
- plant available water capacity in the root zone is very low
- N, P, K - very low to low

BINKEY

LAND USE LIMITATIONS

- main limitation is the gravel and stone throughout the profile
- fertility and plant available water levels are therefore low to very low
- subsoils are sodic to strongly sodic, highly dispersible and prone to erosion if exposed
- regrowth

LAND USE OPTIONS

- suitable for grazing native pastures
- limited suitability for grazing sown pastures
- timber production may also be an option

MANAGEMENT OPTIONS

Pasture

Native

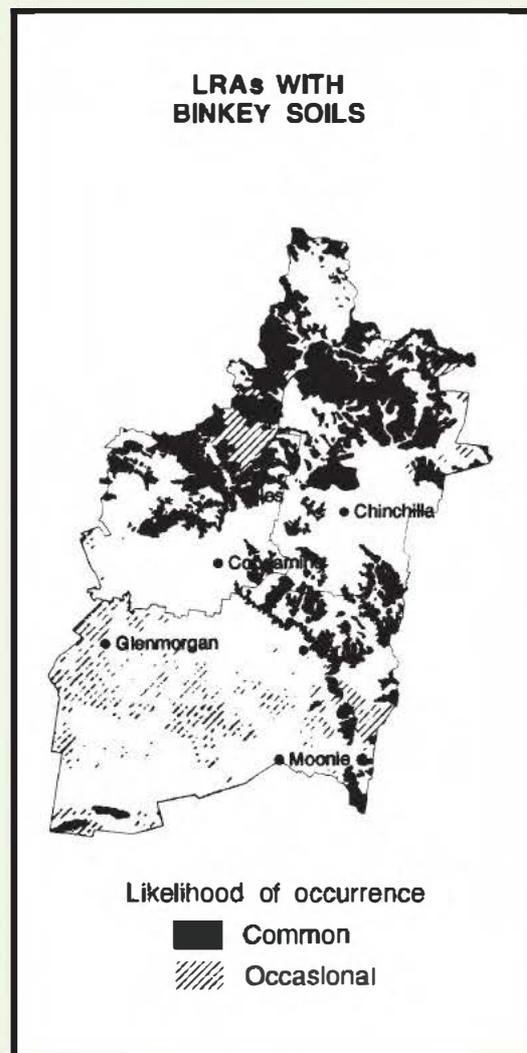
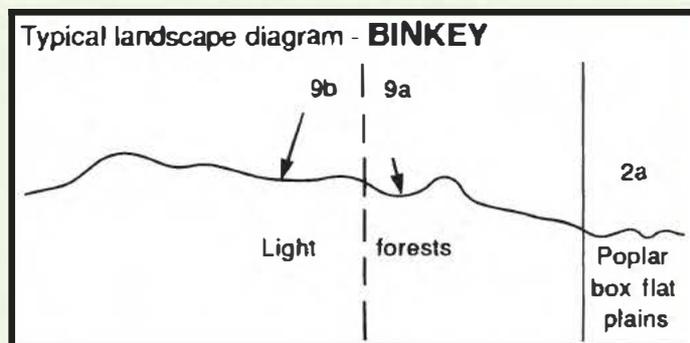
- key desirable species: Queensland bluegrass, forest bluegrass and pitted bluegrass
- optimum use is grazing native pastures
- stocking rates: 1 beast/10 to 20 ha

Sown

- suitable grass species include: Pioneer Rhodes grass
- Rhodes grass may only last 2 to 3 yrs, but is probably the most suitable sown pasture
- clear regrowth after 2 to 3 years in Rhodes grass
- economics of sown pasture is questionable

Cropping

- not recommended



BOGANDILLA

Brief description: Hardsetting thin (< 15 cm), bleached clay loam surface, over black or grey clay subsoil on alluvial plains

Land Resource Areas: Poplar Box Flat Plains, Cypress Pine Sands and Poplar Box Rises, (minor in Clay Alluvial Plains, Brigalow Plains, Brigalow Rises and Light Forests)

LANDSCAPE DESCRIPTION

Landform and distribution

- widely distributed on valley floors and flat plains associated with local drainage lines
- may also occur on slopes (1 - 1.5%) around the edges of the brigalow clay plains

Vegetation

- shrubby woodland to open forest of poplar box with associated bull oak, belah and sometimes cypress pine
- understorey: false sandalwood, wilga, sally wattle and limebush
- also shrubby woodland of poplar box and brigalow or open forest of molly box when associated with brigalow lands



West of Cecil Plains, Sept. 1993

SOIL CHARACTERISTICS



Pit, south of Condamine golf course

| Depth | Description |
|-----------|---|
| 0-8 cm | dark greyish brown, clay loam; hardsetting, massive. Sharp to - |
| 8-10 cm | greyish brown, clay loam; massive; partially bleached. Sharp to - |
| 10-35 cm | very dark greyish brown, medium clay; well structured. Clear to - |
| 35-60 cm | dark greyish brown, medium clay; well structured; some soft carbonate. Gradual to - |
| 60-160 cm | brown, medium heavy clay; well structured; much soft carbonate. |

General soil features

- texture contrast soils with a sharp change between the surface soil and subsoil
- surface texture is clay loam, or occasionally loam or sandy clay loam, commonly 10 to 15 cm thick
- a bleach usually occurs at the surface soil/subsoil boundary, indicating poorly drained and sodic subsoils
- surface colours are dark brown, dark greyish brown, very dark grey, brown and brownish grey, over black, dark greyish brown and greyish brown clay subsoils which may be mottled
- surface soil pH is slightly acid, subsoils are alkaline
- surface soils set hard when dry and in some areas, shallow gilgai may have developed
- salinity levels are medium in the subsoil, becoming very high to extreme in the deep subsoil
- plant available water capacity in the root zone is low (50-100 mm)
- N - low to medium, P - low to high, K - medium to high, Cu - medium, Zn - low

BOGANDILLA

LAND USE LIMITATIONS

- strongly sodic and highly to very highly saline
- water and air movement and root growth are restricted in these subsoils
- plant available water capacity is low
- subsoils are highly dispersible and erode if exposed
- workability is difficult; if cultivated, the surfaces tend to seal and set hard after rain
- may be subject to seasonal flooding on valley floors

LAND USE OPTIONS

- mainly suited to grazing native and sown pastures
- suitable for short-term cropping only

MANAGEMENT OPTIONS

Pasture

Native

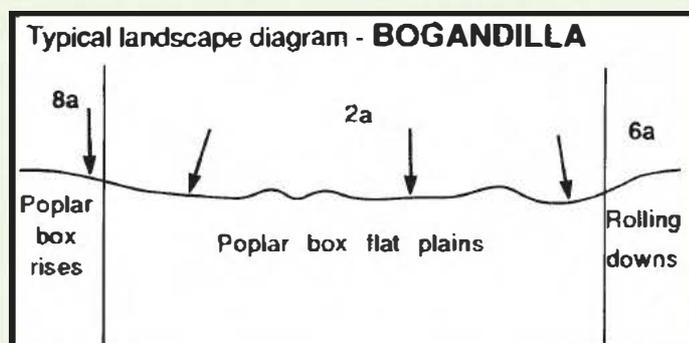
- key desirable species: Queensland bluegrass, forest bluegrass and pitted bluegrass
- ripping to the top of the subsoil, increases water infiltration and enhances pasture growth
- stocking rates: 1 beast/4 to 10 ha

Sown

- suitable grass and legume species include: Bambatsi, purple pigeon grass, Katambora Rhodes grass and medics
- stocking rates: 1 beast/3 to 8 ha

Cropping

- these are regarded as marginal cropping soils requiring good management for success
- suitable fodder and grain crops include: oats, forage sorghum, barley and wheat
- minimum tillage is recommended as opposed to zero till because of hardsetting surface soils



BOONENNE

Brief description: Yellow or brown sandy texture contrast soils on granite hills

Land Resource Areas: Granite Hills

LANDSCAPE DESCRIPTION

Landform and distribution

- mainly mid to lower slope positions of undulating low hills to steep hills in the far north of Chinchilla Shire
- slopes range from 3% to > 20%

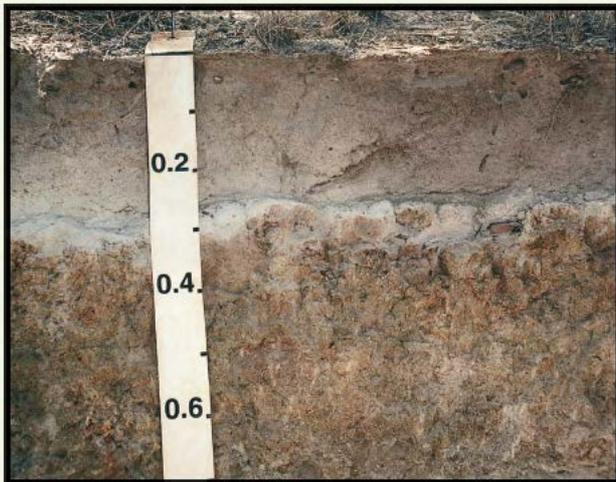
Vegetation

- open forest to woodland of silver-leaved ironbark, narrow-leaved ironbark and Queensland blue gum with some kurrajong
- understorey: wattles and minor beefwood



Auburn River School Rd, north of Auburn, Oct. 1994

SOIL CHARACTERISTICS



Roadside exposure, Auburn River School Road, Auburn

| Depth | Description |
|----------|---|
| 0-10 cm | Brown, coarse sandy loam; hardsetting, massive. Gradual to- |
| 10-25 cm | light brownish grey, conspicuously bleached, coarse loamy sand; massive. Abrupt to- |
| 25-45 cm | mottled, light yellowish brown, medium clay, coarse sandy; weak columnar structure. Gradual to- |
| 45-70 cm | mottled, yellowish brown, medium clay, coarse sandy; massive. Abrupt change to: |
| 70+ cm | weathering granite; brown, coarse sandy loam. |

General soil features

- texture contrast soils with a sharp change between the surface soil and subsoil
- hardsetting, structureless surface soil
- surface soils are grey to brown, loamy sands to sandy clay loams over mottled, yellowish brown, grey or yellow clay subsoils
- workability is easy, surface pulverizes with cultivation and sets hard on drying; narrow moisture range for cultivation
- plant available water capacity in the root zone is very low (< 50 mm)
- surface soil pH is slightly acid to neutral; upper subsoil is neutral, becoming strongly alkaline with depth
- strongly sodic below 50 cm
- N - low to medium, P - very low to low (cropping), medium (pastures), K - medium to high, Cu - low, Zn - medium

BOONENNE

LAND USE LIMITATIONS

- very low plant available water holding capacity will restrict dryland crop growth
- high erosion hazard - particularly prone to tunnel erosion
- hardsetting surface affects infiltration and ease of cultivation
- low fertility
- small seeded crops and pastures difficult to establish due to rapid drying of sandy surface
- high risk of gully and sheet erosion if cultivated
- when cultivated, surface sealing develops after rain which affects crop establishment
- poor internal drainage

LAND USE OPTIONS

- suitable for grazing native and sown pastures

MANAGEMENT OPTIONS

Pasture

Native

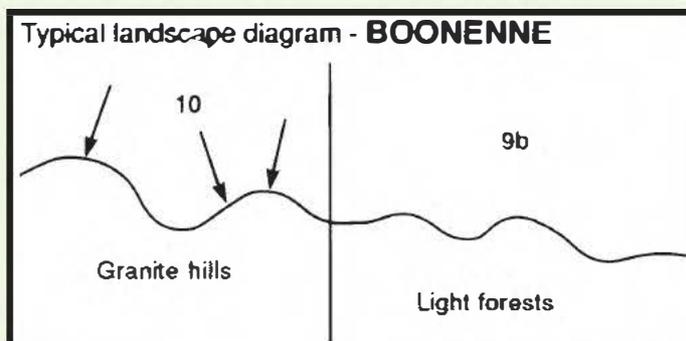
- key desirable species: narrow-leaved speargrass and bluegrass
- maintain good surface cover at all times
- stocking rates: 1 beast/6 to 12 ha

Sown

- suitable grass and legume species include: Rhodes grass, fine stem stylo, and wynn cassia
- only suitable for low sloping country
- maintain good surface cover at all times
- stocking rates: 1 beast/4 to 10 ha

Cropping

- not recommended
- optimum land use is sown pastures (if slopes low); if cultivated, return to pasture



BRAEMAR

Brief description: Moderately thick (20 to 40 cm), bleached sandy surface, over mottled, yellowish brown to greyish brown clay subsoil derived from sandstone

Land Resource Areas: Ironbark/bull oak forests, Light Forests, Poplar Box Rises and Poplar Box Flat Plains

LANDSCAPE DESCRIPTION

Landform and distribution

- dominant on sandstone plains and rises with some scarps in the Kogan to Condamine area, north of Columboola and Glenmorgan areas
- mid to upper slopes (1-3%)

Vegetation

- layered open forest of narrow-leaved ironbark and bull oak with some poplar box and cypress pine; or, a layered woodland of poplar box and cypress pine
- understorey: false sandalwood, wilga, limebush and wattles; occasionally beefwood



Dalby-Kogan Rd, just west of Braemar Creek, July 1994

SOIL CHARACTERISTICS ;S



Gully exposure, Dalby-Kogan Rd, W of Braemar Ck

| Depth | Description |
|-----------|---|
| 0-5 cm | very dark greyish brown, sandy loam; massive. Clear to - |
| 5-15 cm | greyish brown, sandy loam; massive. Clear to - |
| 15-30 cm | light grey, conspicuously bleached, sandy loam; massive. Sharp to - |
| 30-60 cm | brown, light clay sandy; strong columnar structure. Clear to - |
| 60-120 cm | mottled, greyish brown, light clay sandy; massive. |

General soil features

- texture contrast soils with a sharp change between the surface soil and subsoil
- surface texture is sand to sandy loam, commonly 20 to 40 cm thick
- a conspicuously bleached subsurface layer, which varies in thickness, occurs above the subsoil; this bleach indicates that the subsurface becomes very wet periodically and some water moves laterally to local drainageways; moisture supply is limited later in the season
- because the subsurface is too wet periodically, roots are likely to suffer damage due to wetness and a depleted oxygen supply; generally, the thicker the subsurface, the less well drained and aerated are the soils
- surface colours are greyish brown, dark brown, brown or occasionally reddish brown, over greyish brown, yellowish brown or brown clay subsoils which are mottled
- surface soils set hard and may seal when exposed to rain
- pH is strongly to medium acid in the surface and slightly to strongly acid in the subsoil
- subsoils are strongly sodic with high to extreme salinity levels
- plant available water capacity in the root zone is very low (< 50 mm)
- N - low, P - very low, K - medium to very low, Cu - low, Zn - medium

BRAEMAR

LAND USE LIMITATIONS

- main limitations are their shallow effective rooting depth, low ability to hold moisture, seasonal waterlogging, very low fertility and susceptibility to erosion
- when the strongly sodic subsoils are exposed they erode easily resulting in severe gully and tunnel erosion; siting of dams needs careful consideration
- these soils support a natural vegetation susceptible to regrowth

LAND USE OPTIONS

- suitable for low intensity grazing of native pastures
- only marginally suitable for the establishment of sown pastures

MANAGEMENT OPTIONS

Pasture

Native

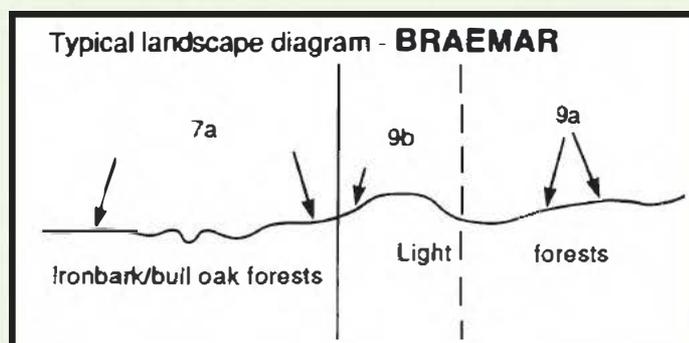
- species include: black speargrass and wiregrass
- difficult to manage
- any disturbance of the natural vegetation will result in woody regrowth and erosion problem; the control of this is costly and must be considered in any development plans
- stocking rates: 1 beast/6 to 12 ha

Sown

- suitable species include: Pioneer Rhodes grass digit grass, wynn cassia and serradella
- extensive clearing can lead to problems with regrowth, erosion and longevity of pastures
- P needs to be added for pasture establishment
- stocking rates: 1 beast/6 to 12 ha

Cropping

- not recommended



CADARGA

Brief description: Hardsetting, red non-cracking clays, on brigalow uplands

Land Resource Areas: Brigalow Rises

LANDSCAPE DESCRIPTION

Landform and distribution

- mid to upper slopes of undulating to rolling rises and low sandstone hills
- slopes between 4 and 10%
- located in the Kragga - Cadarga area north of Chinchilla

Vegetation

- softwood scrub (with a range of species including crow's ash and bottle tree). Some spotted gum and ironbarks



'Overstone', Cadarga Road, Cadarga, Sept. 1994

SOIL CHARACTERISTICS



Pit on 'Overstone', Cadarga Rd, Cadarga

| Depth | Description |
|------------|---|
| 0-15 cm | reddish brown, light medium clay; massive. Clear to - |
| 15-55 cm | red, medium clay; massive; some small ironstone nodules |
| 55-105 cm | red, medium heavy clay; moderately structured; some ironstone nodules |
| 105-120 cm | mottled, yellowish red, medium clay; massive. Clear to - |
| 120-140 cm | as above with weathered sandstone |
| 140+ cm | weathered sandstone |

General soil features

- deep, non-cracking clays with structureless, hardsetting surfaces
- the surface texture is usually a friable, light clay to light medium clay, colours are reddish brown to brown
- subsoils are red, permeable clays with textures ranging from medium clay to medium heavy clay
- the soils are well drained and have a high plant available water capacity (150-200 mm)
- surface soil pH is strongly acid, becoming extremely acid with depth
- the soils are non-saline and non-sodic
- N - low, P - high (cropping), very high (pastures), K - high, Cu - medium, Zn - medium

CADARGA

LAND USE LIMITATIONS

- main limitation is susceptibility to erosion
- surface sets hard or forms a strong surface crust when dry; this affects infiltration and ease of cultivation
- marsupial overgrazing (particularly in cleared areas verging on forest)
- woody weeds
- low pH may cause nutrient imbalances

LAND USE OPTIONS

- suitable for grazing native and sown pasture
- also suitable for fodder crops

MANAGEMENT OPTIONS

Pasture

Native

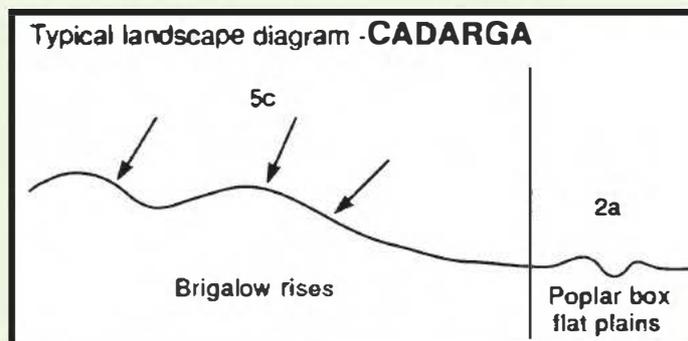
- key desirable species: black speargrass, forest bluegrass, Queensland bluegrass
- stocking rates: 1 beast/4 to 10 ha

Sown

- most suitable species include: Katambora Rhodes grass, green panic, siratro, Bambatsi, purple pigeon grass, Premier digit grass, creeping bluegrass and Biloela buffel grass
- stocking rates: 1 beast/3 to 8 ha

Cropping

- Suitable fodder crops include: oats and forage sorghum



CECILVALE

Brief description: Surface sealing, grey or black cracking clays, with a coarse blocky subsoil, on alluvial plains

Land Resource Areas: Clay Alluvial Plains

LANDSCAPE DESCRIPTION

Landform and distribution

- the Condamine River, and the older, higher lying alluvial plains, particularly upstream from the Condamine township

Vegetation

- poplar box grassy woodland



Chinchilla-Kogan Rd, south of Condamine River, Nov. 1994

SOIL CHARACTERISTICS



Pit, Chinchilla-Kogan Rd south of Condamine River

| Depth | Description |
|-----------|---|
| 0-2 cm | dark greyish brown, light clay; weakly structured. Sharp to - |
| 2-10 cm | dark greyish brown, light medium clay; well structured. Clear to - |
| 10-25 cm | dark greyish brown, medium clay; well structured. Clear to - |
| 25-65 cm | greyish brown, medium heavy clay; well structured; some hard and soft carbonate. Clear to - |
| 65-120 cm | dark greyish brown, medium heavy clay; moderately structured; a little hard and soft carbonate. |

General soil features

- deep, cracking clays with crusting surfaces
- surface soil is usually sandy clay to light clay, structureless to weakly structured and about 2 cm thick; amount of sand in immediate surface soil will vary from paddock to paddock, however, the important feature is their sealing characteristics
- surface colours are grey, light brownish grey or dark grey, over grey to dark brownish grey subsoils
- subsoils are very coarse blocky in structure and may become massive with depth
- surface soils are mildly alkaline, becoming very strongly alkaline in the subsoil
- plant available water capacity in the root zone is low (50 -100 mm)
- below 30 cm subsoils are sodic to strongly sodic
- salinity levels are low in the upper subsoil but become high to very high in the deep subsoil
- N - medium to low, P - low (cropping), medium (pastures), K - medium to high, Cu - medium, Zn - very low

CECILVALE

LAND USE LIMITATIONS

- when cultivated, these soils puddle badly following rain and form a hard surface crust or seal, hence they are difficult to maintain in a fine seedbed condition
- the surface crust results in impaired infiltration and poor germination and seedling emergence of small seeded crops and pastures
- workability is poor; restricted to a narrow moisture range

LAND USE OPTIONS

- suitable for a wide range of grain and fodder crops
- suitable for native and sown pasture production

MANAGEMENT OPTIONS

Pasture

Native

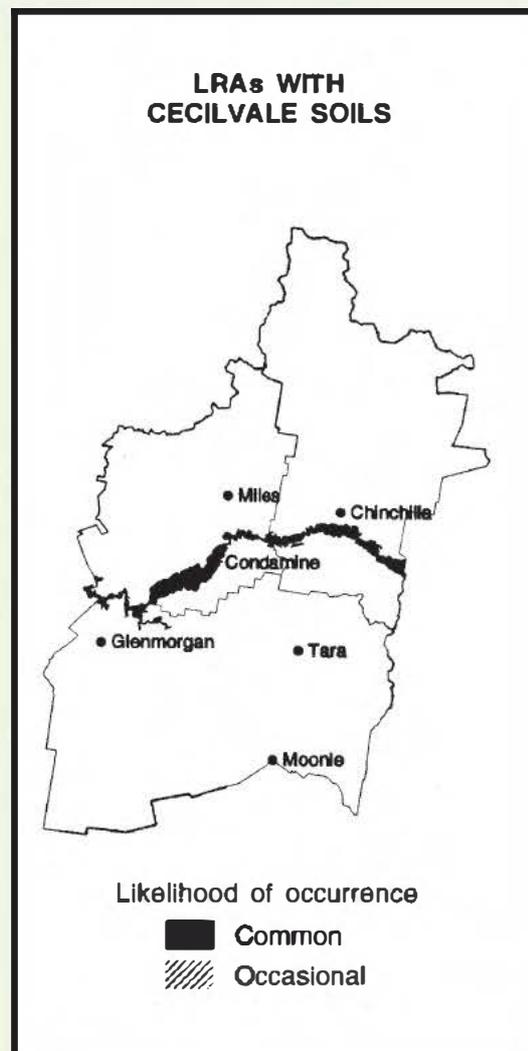
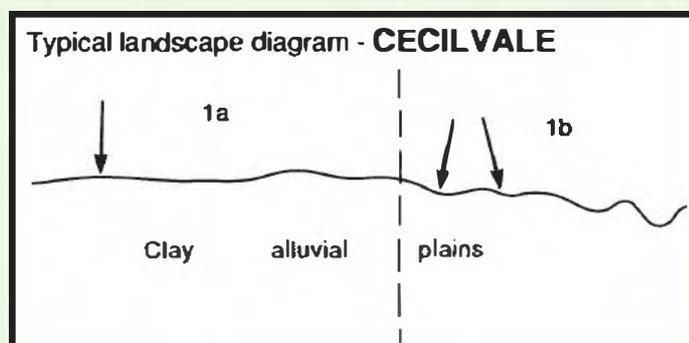
- key desirable species: Queensland bluegrass, forest bluegrass and pitted bluegrass
- many mixed enterprise farms graze stock on a mixture of native pastures, forage crops and crop stubbles
- stocking rates: 1 beast/4 to 10 ha

Sown

- suitable species include: Katambora Rhodes grass, purple pigeon grass, Bambatsi, creeping bluegrass and medics
- stocking rates: 1 beast/3 to 8 ha

Cropping

- Suitable species include: wheat, barley, chickpeas, oats and forage sorghum
- Management of the surface soil is the key to the management of these soils
- Use minimum tillage and stubble mulching to maintain maximum levels of stubbles anchored to the surface; use crops that provide a good stubble cover
- Strip crop to spread water flows to non-erosive velocities
- Work dry, not wet however, can be abrasive on implements
- Crop pasture rotations are used to maintain soil fertility and improve soil structure



CHANNING

Brief description: Hardsetting thin (< 15 cm), bleached sandy loam to loam surface, overred brown clay subsoil overlying sandstone

Land Resource Areas: Ironbark/bull oak Forests (minor in Light Forests)

LANDSCAPE DESCRIPTION

Landform and distribution

- flat to gently undulating outwash plains derived from lateritised sandstone in the east; minor component on slopes (0-3%) of sandstone rises to low hills
- dissected rises in the Channing Creek area

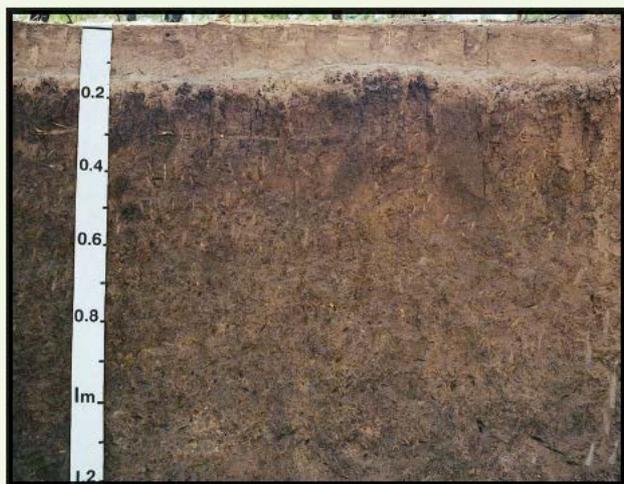
Vegetation

- layered woodland or open forest of narrow-leaved ironbark or poplar box, with bull oak, cypress pine and rusty gum
- understorey: false sandalwood



Warrego H'way, 5 km east of Miles, July 1994

SOIL CHARACTERISTICS



Gully exposure, Warrego H'way, 5 km E of Miles

| Depth | Description |
|-----------|---|
| 0-10 cm | brown, sandy loam; hardsetting, massive. Abrupt to - |
| 10-15 cm | very pale brown, sandy loam; conspicuously bleached. Sharp to - |
| 15-40 cm | reddish brown, medium clay; well structured. Gradual to - |
| 40-80 cm | brown, medium clay; weakly structured to massive; a little gravel. Gradual to - |
| 80-120 cm | mottled, brown, medium clay; massive. |

General soil features

- texture contrast soils with a sharp change between the surface soil and subsoil
- surface texture is sandy loam to loam, commonly 10 to 15 cm thick
- a bleach usually occurs in the lower part of the surface layer, indicating periodic waterlogging and sodic impermeable subsoils
- surface colours are dark reddish brown to dark brown, over reddish brown or brown clay subsoils which may be mottled
- surface soils set hard when dry
- the soil pH is acid to very strongly acid throughout the profile
- subsoils are strongly sodic with high to extreme salinity levels
- plant available water capacity in the root zone is very low (< 50 mm)
- N - very low to low, P - very low to low, K - low to medium, Cu - low, Zn - low

CHANNING

LAND USE LIMITATIONS

- suitable for grazing native pastures
- limited suitability for grazing sown pastures
- timber production may also be an option

LAND USE OPTIONS

- main limitation is the shallow effective rooting depth due to strongly sodic and relatively impermeable subsoils; these restrict water and air movement and root growth
- hollow surface soils have a very low plant available water capacity and low fertility regrowth

MANAGEMENT OPTIONS

Pasture

Native

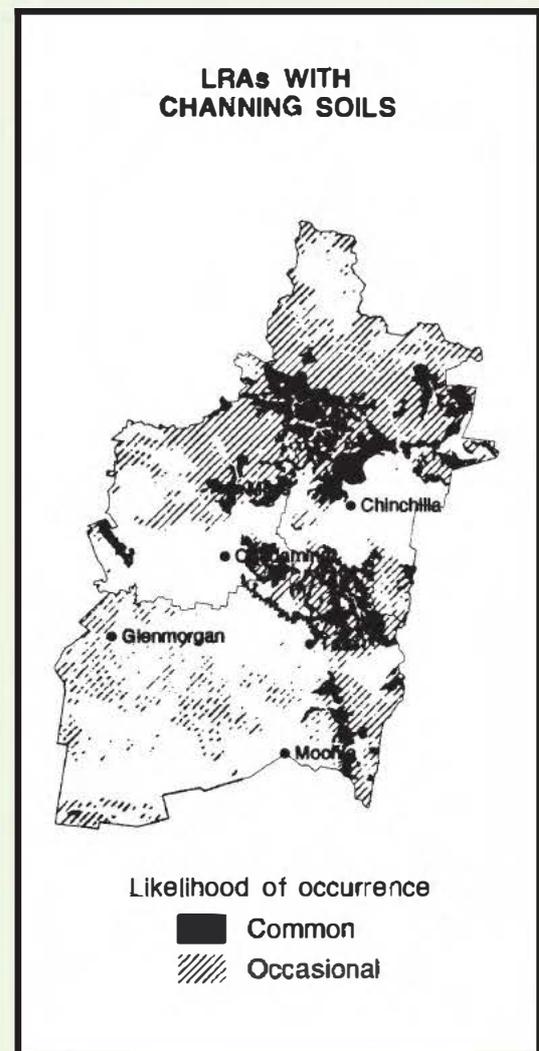
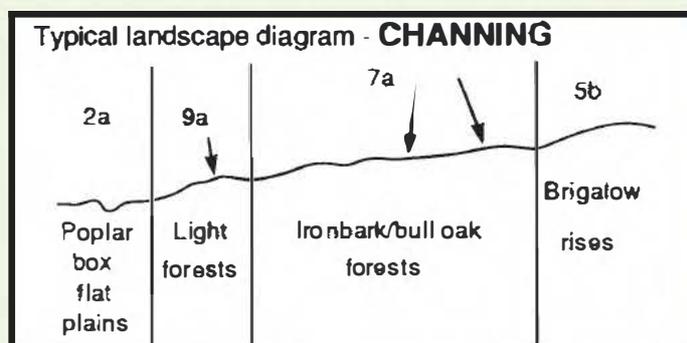
- key desirable species: forest bluegrass and pitted bluegrass
- optimal use is grazing native pasture
- timber production may also be an option
- stocking rates: 1 beast/6 to 12 ha

Sown

- suitable grass species include: Pioneer Rhodes grass
- Rhodes grass may only last 2 to 3 years, but is probably the most suitable sown pasture
- clear regrowth after 2 to 3 years in Rhodes grass
- economics of sown pasture is questionable

Cropping

- not recommended



CHINCHILLA

Brief description: Very deep, reddish brown sands

Land Resource Areas: Cypress Pine Sands (minor in Poplar Box Flat Plains and Clay Alluvial Plains)

LANDSCAPE DESCRIPTION

Landform and distribution

- terraces, sand ridges and flat alluvial plains and creek channels draining the weathered sandstone country

Vegetation

- forest of rough-barked apple, Moreton Bay ash and sally wattle; associated species include poplar box and cypress pine
- understorey: wilga and false sandalwood



Off Chinchilla-Wondai Rd, north-east of Chinchilla, Nov. 1994

SOIL CHARACTERISTICS



Borrow pit exposure, Chinchilla-Wondai Road

| Depth | Description |
|-----------|---|
| 0-30 cm | brown, sandy loam; loose. Clear to - |
| 30-80 cm | yellowish red, clayey sand, massive. Diffuse to - |
| 80-160 cm | red, loamy sand, massive. |

General soil features

- deep, sandy profiles where the textures are loamy sand to sandy loam which may increase to sandy clay loam in the very deep subsoil
- immediate surface layer, which contains most of the organic matter, varies in thickness and is usually dark reddish brown in colour
- subsoils are very deep and permeable
- surface soil pH is neutral and subsoils become more acidic with depth
- the soils are non-saline and non-sodic
- plant available water capacity in the root zone is low (50-100 mm)
- N - low to medium, P - low (cropping), high (pastures), K - medium, Cu - low, Zn - medium

CHINCHILLA

LAND USE LIMITATIONS

- main limitation of these soils is their low plant available water capacity
- although the soils have a loose to weakly structured surface under pasture, with cultivation it will often become massive and set hard or surface seal
- wind erosion when cultivated

LAND USE OPTIONS

- suitable for horticultural crops if irrigation water is available
- suitable for melons, pumpkins and grapes
- suitable for short growing season grain and fodder crops
- suitable for grazing native and sown pastures

MANAGEMENT OPTIONS

Pasture

Native

- species include: black speargrass and wiregrass
- native grasses need to be grazed prior to maturity
- if pimelea present, animal husbandry problems occur
- cottontails is becoming a serious weed
- stocking rates: 1 beast/6 to 12 ha

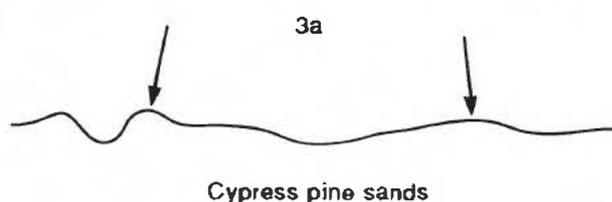
Sown

- suitable grasses and legumes include: Pioneer Rhodes grass, serradella, buffel grass, Wynn cassia, panics, Premier digit grass and lucerne
- stocking rates: 1 beast/4 to 10 ha

Cropping

- suitable grain crops: barley and millets
- suitable fodder crops: oats and forage sorghum
- suitable horticultural crops: melons, grapes, pumpkins and stonefruit
- stubble mulching is recommended to help control the hardsetting characteristics of the soil (which may develop with cultivation) and reduce erosion; stubble protects the soil surface and improves organic matter levels
- fertilizers essential for cropping; slow release fertilizers preferred to reduce losses through leaching
- nematodes can be a problem
- these soils require very careful management to reduce degradation
- windbreaks necessary to reduce wind erosion potential

Typical landscape diagram - CHINCHILLA



LRAs WITH CHINCHILLA SOILS



Likelihood of occurrence

- Common
- ▨ Occasional

COALBAH

Brief description: Hardsetting thin (< 15 cm) or moderately thick (15 to 30 cm), bleached loamy surface, over brown or greyish brown clay subsoil

Land Resource Areas: Poplar Box Rises (minor in Ironbark/bull oak Forests and Light Forests)

LANDSCAPE DESCRIPTION

Landform and distribution

- dominant on mid to lower slopes (1-3%) of a belt of plains and rises which fringe the dissected edges of the brigalow plains, lateritised sandstone remnants, the Condamine River and in some areas, the major creeks
- minor on sandstone hills and rises in the Glenmorgan area

Vegetation

- shrubby woodland or layered open forest of poplar box and silver-leaved ironbark with some bull oak, gum-topped box and dusky-leaved ironbark
- understorey, false sandalwood, wilga, myrtle tree and limebush



Mortlock Road, north of Meandarra, Nov. 1994

SOIL CHARACTERISTICS



Pit on 'Emohru', 9 km east of The Gums

| Depth | Description |
|-----------|---|
| 0-20 cm | dark brown, clay loam sandy; massive. Clear to - |
| 20-32 cm | light brown, sandy clay loam; conspicuously bleached. Sharp to - |
| 32-80 cm | brownish yellow, medium heavy clay; strong columnar structure. Clear to - |
| 80-120 cm | light yellowish brown, medium clay; massive; some carbonate nodules. |

General soil features

- texture contrast soils with a sharp change between the surface soil and subsoil
- surface texture is loam to clay loam, or occasionally sandy loam, which is brown, yellowish red or brownish black in colour
- thick surface soils usually have a conspicuously bleached layer indicating periods of waterlogging
- a partial bleach may occur at the surface soil/subsoil boundary where the surface soils are thinner, indicating poorly drained and sodic subsoils
- subsoil colours are usually brown, greyish brown or occasionally brownish grey clays, which may be mottled
- surface soils set hard when dry and subsoils are poorly structured
- surface soil pH is neutral and subsoils are strongly to very strongly alkaline
- subsoils are sodic to strongly sodic and the deep subsoil is very highly saline
- plant available water capacity in the root zone is low (50 - 100 mm)
- N - very low to low, P - very low to low (cropping), medium (pastures), K - medium, Cu - medium, Zn - low

COALBAH

LAND USE LIMITATIONS

- main limitation is the shallow effective rooting depth
- water and air movement and root growth are restricted due to sodic and relatively impermeable subsoils
- shallow surfaces have a low plant available water capacity
- germination problems may be encountered as surface sets hard when dry
- presence of a conspicuous bleach indicates periodic waterlogging with roots likely to suffer damage due to wetness and a lack of oxygen

LAND USE OPTIONS

- suitable for grazing native and sown pastures
- where surface soils are thicker, may be suitable for limited fodder cropping

MANAGEMENT OPTIONS

Pasture

Native

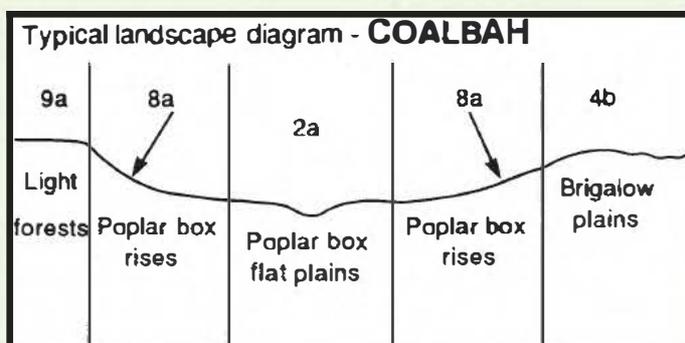
- key desirable species: pitted bluegrass, kangaroo grass, grey lovegrass, rough speargrass, slender bluegrass, fairy grass, windmill grass, tall chloris, leafy nineawn, dainty lovegrass, common fringerush, climbing saltbush, small saltbush, forest bluegrass
- stocking rates: 1 beast/6 to 12 ha

Sown

- suitable species include: buffel grass and medics
- stocking rates: 1 beast/4 to 10 ha

Cropping

- fodder crops are grown while developing and renovating land
- suitable fodder crops include: oats and forage sorghum



COMBIDIBAN

Brief description: Thick to very thick (30 to 100 cm), bleached, loose sandy surface, over mottled, brownish grey, light brown or yellowish brown sandy clay subsoil on alluvial plains

Land Resource Areas: Cypress Pine Sands (minor in Poplar Box Flat Plains, clay Alluvial Plains and Ironbark/bull oak Forests)

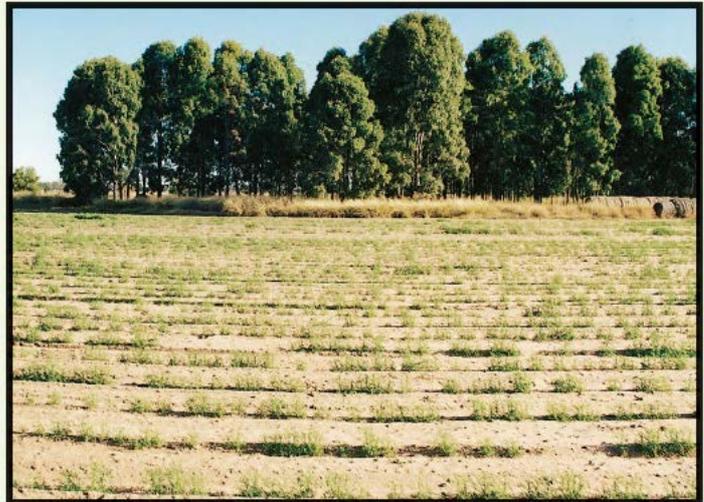
LANDSCAPE DESCRIPTION

Landform and distribution

- widespread throughout the area on sandy alluvial plains and terraces of small creeks
- also found on flat, sandy plains raised above the level of the surrounding clay plains, particularly around Moonie

Vegetation

- layered forest or open forest of cypress pine, tumbledown gum, rusty gum; associated species include rough-barked apple, poplar box and Moreton Bay ash
- understorey: wattles



'Camden', Condamine River flats, south of Condamine, June 1994

SOIL CHARACTERISTICS



Pit on 'Camden', Meandarra Rd, Condamine

| Depth | Description |
|------------|---|
| 0-10 cm | dark greyish brown, sandy loam; loose. Clear to - |
| 10-65 cm | dark yellowish brown, clayey sand; structureless. Clear to - |
| 65-85 cm | light brownish grey, loamy sand; conspicuously bleached; many ironstone nodules from 75 cm. Sharp to - |
| 85-120 cm | dark greyish brown, mottled red, light medium clay, coarse sandy; strong columnar structure. Gradual to - |
| 120-160 cm | as above, but structure blocky. |

General soil features

- texture contrast soils with a sharp change between the surface soil and subsoil
- surface texture is sand to sandy loam that is usually loose when dry; weakly developed hardsetting characteristics may occur
- an obvious feature of these soils is the variability in surface soil depth (30 to 100 cm)
- surface colours are usually brownish grey, greyish brown or greyish yellow-brown, over brownish grey, light brown or light yellowish brown, mottled clay subsoils
- surface soil pH is medium acid to neutral, with neutral subsoils
- the sandy surfaces have a high infiltration rate and may have low nutrient levels
- although the plant available water capacity in the root zone is generally very low (< 50 mm), the combination of very deep surface soils and impermeable subsoils can supply adequate moisture for crop combination of very deep surface soils and impermeable subsoils can supply adequate moisture for crop growth for considerable periods following rainfall
- N - low to very low, P - medium (cropping), high (pastures), K - medium, Cu - low, Zn - medium

COMBIDIBAN

LAND USE LIMITATIONS

- main limitations to these soils are very low levels of most nutrients, particularly N, and very low levels of available water in the shallower surface soils
- subsoils are poorly structured and sodic
- highly susceptible to wind erosion when cultivated

LAND USE OPTIONS

- suitable for grazing native and sown pastures
- suitable for fodder crops with limited suitability for winter cereals
- suitable for horticultural crops where the surface soils are deep and there is provision for adequate water

MANAGEMENT OPTIONS

Pasture

Native

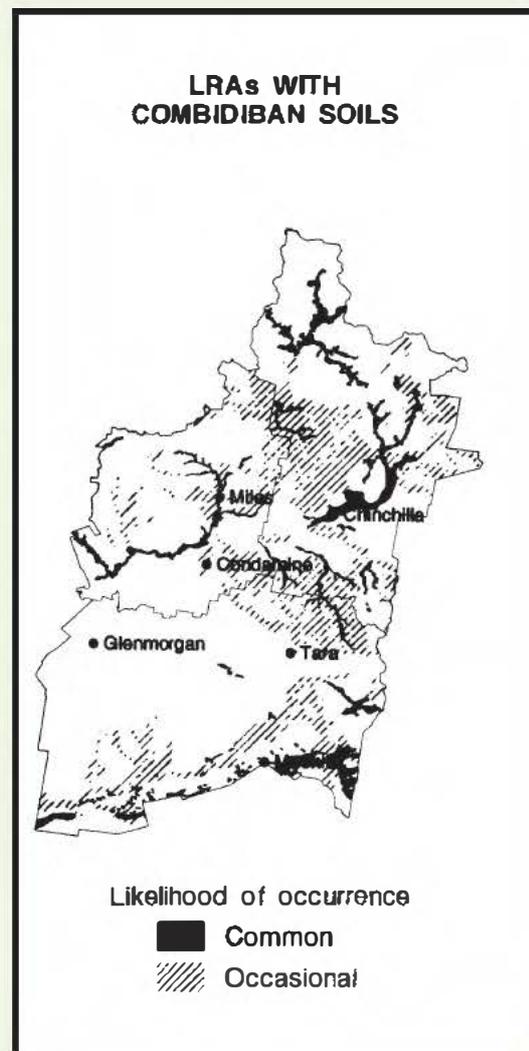
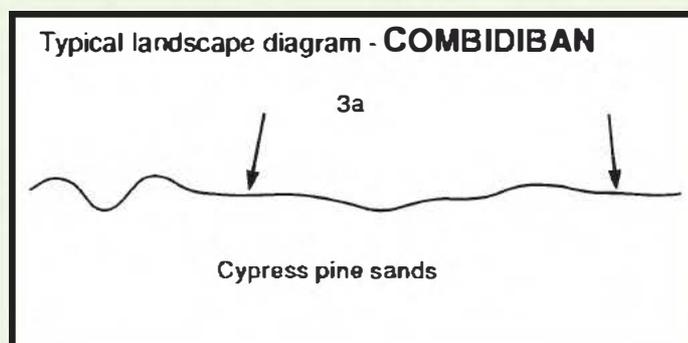
- species include: black speargrass and wiregrass
- native grasses need to be grazed prior to maturity
- if pimelea present, animal husbandry problems occur
- stocking rates: 1 beast/6 to 12 ha

Sown

- suitable sown pasture species include: Pioneer Rhodes grass, serradella, buffel grass, digit grass and wynn cassia
- stocking rates: 1 beast/4 to 10 ha

Cropping

- suitable fodder crops include: oats, forage sorghum and lab lab
- horticultural crops include: melons, pumpkins, grapes and stonefruit on the deeper soils
- suitable winter cereals include: wheat and barley



CONDAMINE

Brief description: Self-mulching, black cracking clays on alluvial plains

Land Resource Areas: Clay Alluvial Plains (minor in Poplar Box Flat Plains)

LANDSCAPE DESCRIPTION

Landform and distribution

- found on the active flood plain of the Condamine River, includes river terraces, stream banks and old river channels
- minor component on the Moonie River alluvial plains (river terraces and drainage lines)

Vegetation

- grassy open woodland or fringing woodland and open forest of coolibah, river red gum and poplar box
- understorey: sally wattle, myall and yarran



Condamine-Meandarra Road, near Fotheringhams Gully, June 1994

SOIL CHARACTERISTICS



Pit at Fotheringhams Gully, Condamine-Meandarra Rd

| Depth | Description |
|-----------|--|
| 0-5 cm | very dark greyish brown, medium heavy clay; self-mulching. Clear to - |
| 5-15 cm | very dark grey, medium heavy clay; well structured. Clear to - |
| 15-60 cm | very dark greyish brown, heavy clay; well structured; few soft carbonate segregations from 30 cm. Clear to - |
| 60-140 cm | dark greyish brown, heavy clay; well structured; very few soft carbonate segregations to 80 cm. |

General soil features

- deep, black cracking clays with fine granular, self-mulching surfaces (may occasionally be grey clays)
- surfaces are sometimes crusted, in which case sand grains are obvious on the surface
- surface colours are dark greyish brown, brown or light grey, over black or dark grey subsoils
- the soil landscape is extensively dissected by gullies close to main drainage lines
- some water-worn gravel and coarse sand grains are evident throughout the profile, particularly on terraced and old river channels
- management of these soils is aided by the ease of workability which produces a fine seedbed if there is sufficient moisture when cultivated
- the soils have a strongly alkaline pH throughout
- subsoils are sodic to strongly sodic and deep subsoils are highly to very highly saline
- plant available water capacity in the root zone is low (50-100 mm)
- N - low, P - high, K - high to very high, Cu - medium, Zn - very low

CONDAMINE

LAND USE LIMITATIONS

- main limitations to these soils are the size of areas unaffected by gullies and erosive flooding; occasional flooding may limit irrigation potential
- wetness may cause regular delays in the use of implements and a moderately reduced production potential
- difficult to wet up when dry

LAND USE OPTIONS

- suitable for dryland and irrigated cropping
- suitable for grazing native and sown pastures

MANAGEMENT OPTIONS

Pasture

Native

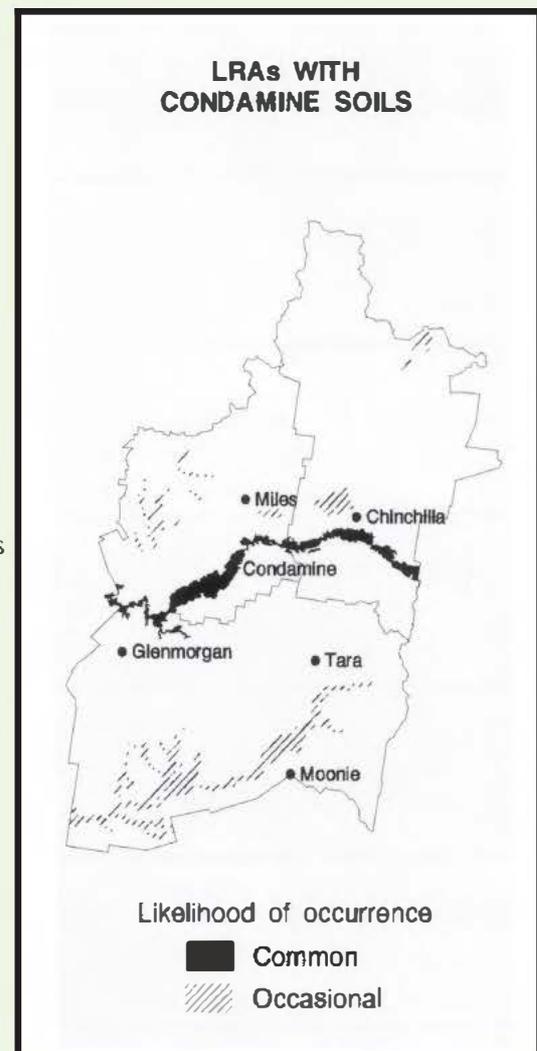
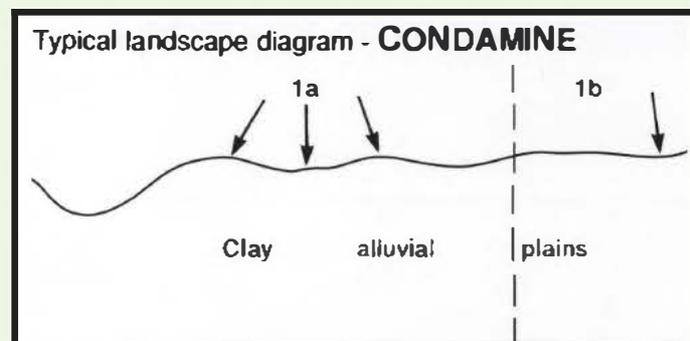
- key desirable species: Queensland bluegrass and Mitchell grass
- overgrazing native pastures may lead to invasion of Lippia
- stocking rates: 1 beast/4 to 8 ha

Sown

- suitable species include: Bambatsi, purple pigeon grass and medics
- lucerne production will be affected by infrequent erosive flooding
- pastures difficult to establish due to crumbly nature of the soil
- stocking rates: 1 beast/3 to 6 ha

Cropping

- suitable crops include: wheat, barley and sorghum
- suitable for irrigation provided there is sufficient level ground
- areas suitable for cropping occur in areas away from the stream channel not subject to severe (> 1 m) overflow flooding; avoid cultivation of breakaway gullies



CUTTHROAT

Brief description: Thick (> 30 cm), bleached, loose sandy surface, over mottled, yellowish brown sandy clay subsoil overlying sandstone

Land Resource Areas: Iron bark/bull oak Forests (minor in Light Forests, Poplar Box Rises and Poplar Box Flat Plains)

LANDSCAPE DESCRIPTION

Landform and distribution

- flat to gently undulating (0-1%) plains centred on the Kogan area and north of Chinchilla to the Divide
- slopes (0-5%) of sandstone hills south-east of Tara

Vegetation

- layered open forest of cypress pine, narrow-leaved ironbark, bull oak and yellow jacket with some rusty gum
- understorey: some beefwood and wattles



Burra Burri Forestry Road, north-west of Jandowae, Aug. 1994

SOIL CHARACTERISTICS



Pit, Greenswamp Rd, Goombi South

| Depth | Description |
|------------|---|
| 0-20 cm | dark brown, loamy sand; loose. Clear to - |
| 20-40 cm | brown, loamy sand. Clear to - |
| 40-60 cm | light grey, loamy sand; conspicuously bleached; some gravel from 58 cm. Abrupt to - |
| 60-85 cm | brown, mottled yellow and red, sandy clay; massive; some gravel. Clear to - |
| 85-120 cm | as above, without red mottle. |
| 120-140 cm | yellowish brown, coarse sandy clay loam; massive. |

General soil features

- texture contrast soils with a sharp change between the surface soil and subsoil
- surface texture is sand to loamy sand, or may be sandy loam, that is loose when dry or weakly hardsetting
- infiltration rates are high and on sloping sites the surface soils dry out rapidly
- an obvious feature is the variability in surface soil depth (30 to 100 cm)
- surface colours are brown, greyish brown or greyish yellow-brown with a very distinct near white subsurface layer
- subsoils are impermeable with a massive or weakly columnar to blocky structure and textures of sandy clay or medium to heavy clay; colours range from brown to yellowish brown or light grey, which are mottled
- surface layers have a strongly to slightly acid pH with neutral to strongly alkaline subsoils
- subsoils are sodic and the deep subsoils have low salinity levels
- plant available water capacity in the root zone is very low (< 50 mm)
- N - very low to low, P - very low to extremely low, K - low, Cu - very low, Zn - very low

CUTTHROAT

LAND USE LIMITATIONS

- main limitations are very low nutrient levels and a very low plant available water capacity
- subsoils disperse and erode if exposed; care should be taken when locating dams
- affected by subsurface waterlogging; surface soils regarded as 'spewy' when saturated which causes trafficability problems
- wattle regrowth and the quinine berry are a problem and difficult to eradicate
- wind erosion can also be a problem

LAND USE OPTIONS

- suitable for grazing native and sown pastures
- suitable for cultivation of fodder crops when establishing pasture

MANAGEMENT OPTIONS

Pasture

Native

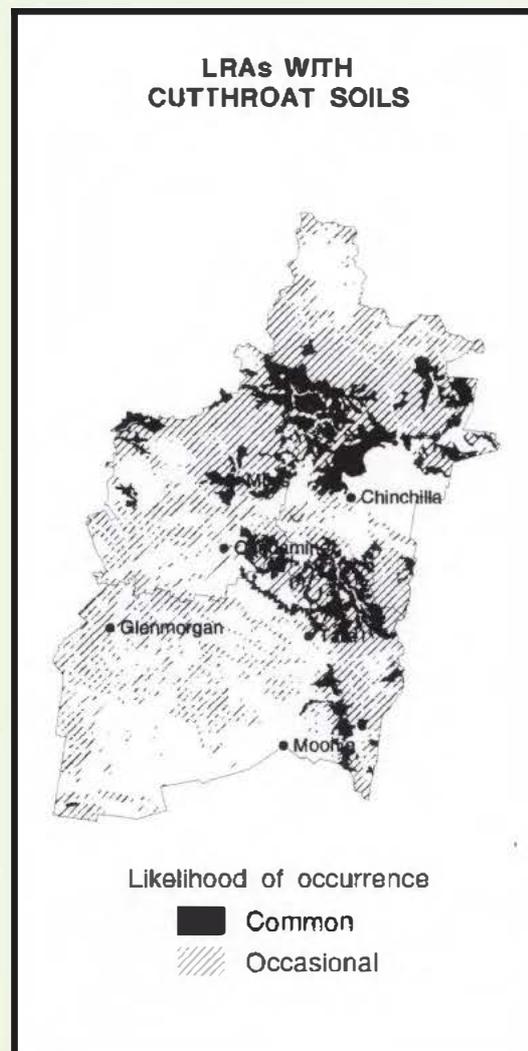
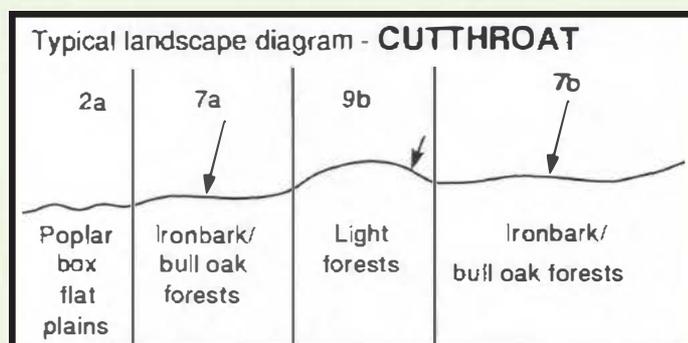
- species include: black speargrass and wiregrass
- difficult to manage
- develop in small, manageable areas; burn pulled scrub following rain, i.e. 'cool' fire
- the application of fertilizers to these soils for pasture growth is usually considered uneconomical
- stocking rates: 1 beast/6 to 12 ha

Sown

- suitable sown pasture species include: Pioneer Rhodes grass, serradella, buffel grass, and Wynn cassia
- stocking rates: 1 beast/6 to 12 ha

Cropping

- limited potential for fodder cropping, suitable fodder crops include: oats and forage sorghum when establishing pasture
- work when moist to reduce wear on machinery



DAVY

Brief description: Very deep, yellow or brown sands

Land Resource Areas: Cypress Pine Sands (minor in Poplar Box Flat Plains, Light Forests, Ironbark/bull oak Forests and Clay Alluvial Plains)

LANDSCAPE DESCRIPTION

Landform and distribution

- flat to gently undulating alluvial plains, terraces or creek banks
- found where creeks and rivers drain the sandstone hills and on the sand sheets in the Moonie area

Vegetation

- open forest of cypress pine, rough-barked apple and tumbledown gum; associated species include rusty gum, bull oak or occasionally poplar box and Queensland blue gum



Off Warrego H'way, Boonarga, near Chinchilla, Nov. 1994

SOIL CHARACTERISTICS



Roadside exposure

| Depth | Description |
|-----------|---|
| 0-15 cm | brown, sandy loam; loose. Clear to - |
| 15-40 cm | pale brown, loamy sand; conspicuously bleached; massive. Diffuse to - |
| 40-100 cm | pale yellowish brown, loamy sand; massive. |

General soil features

- deep, uniform sands which are highly permeable and very well drained
- in some instances the soils may be more coherent instead of being loose
- soil colours are usually brown, yellowish brown, brownish yellow or greyish brown
- these soils are slightly acid to neutral throughout the profile
- the soils are non-saline and non-sodic
- plant available water capacity in the root zone is low (50-100 mm)
- N - low, P - low (cropping), medium (pastures), K - medium

DAVY

LAND USE LIMITATIONS

- main limitations to these soils are their very low nutrient levels and low plant available water capacity
- severe wind erosion when cultivated

LAND USE OPTIONS

- suitable for grazing native and sown pastures
- suitable for short season fodder crops if fertilizers used
- suitable for tap rooted fodder crops such as Caloona peas
- suitable for a limited range of horticultural crops if irrigation water is available
- suitable for dryland melons, pumpkins and grapes with sound management

MANAGEMENT OPTIONS

Pasture

Native

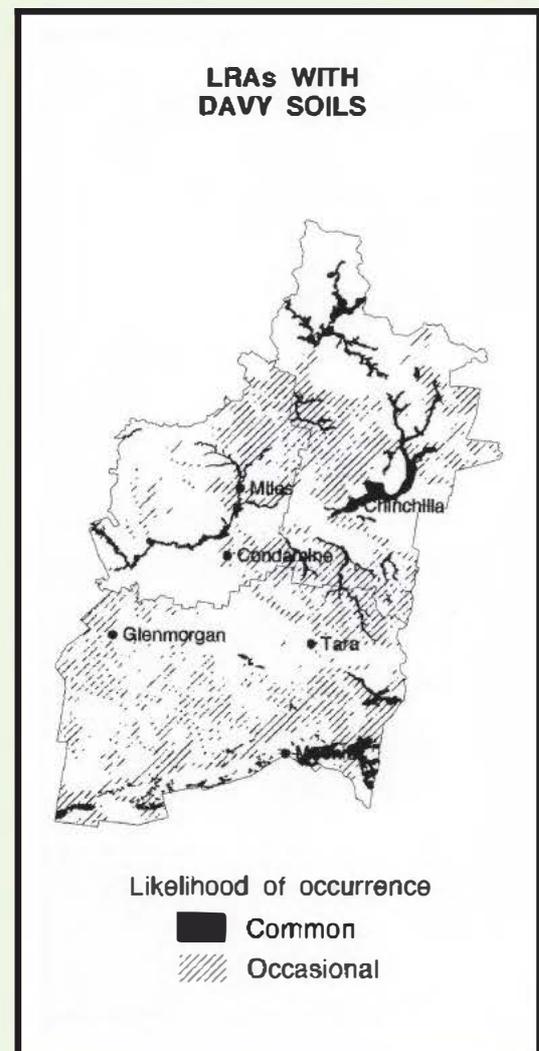
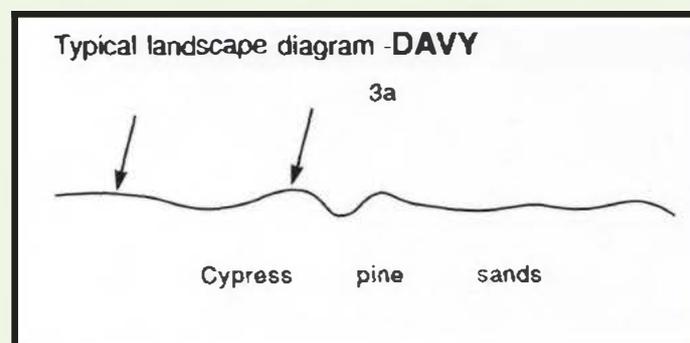
- Species include: black speargrass and wiregrass
- Native grasses need to be grazed prior to maturity
- If pimelea is present animal husbandry problems may occur e.g. St. George's disease
- Cottontails is becoming a serious weed
- Stocking rates: 1 beast/6 to 12 ha

Sown

- suitable sown pasture species include: Pioneer Rhodes grass, serradella, buffel grass, Premier digit grass, panics and Wynn cassia
- stocking rates: 1 beast/4 to 10 ha

Cropping

- suitable horticultural crops include: melons, grapes, pumpkins and stonefruit
- stubble mulching recommended to help control wind erosion
- fertilisers essential for cropping; slow release fertilisers preferred to reduce losses through leaching
- nematodes can be a problem
- these soils require a very careful management to reduce degradation
- windbreaks necessary to reduce wind erosion potential
- not suitable for flood irrigation



DULACCA

Brief description: Surface sealing, deep, brown or red cracking clays overlying siltstone and mudstone

Land Resource Areas: Rolling Downs

LANDSCAPE DESCRIPTION

Landform and distribution

- restricted in their distribution to undulating rises (slopes 1-4%) north of Dulacca and Ulimaroa

Vegetation

- on upper slopes, Mitchell grass and Queensland bluegrass grassland with scattered trees including yarran, myall, poplar box, whitewood, boonaree and wilga
- on mid to lower slopes, poplar box woodland with kurrajongs
- understorey: myall, false sandalwood and wattles



Homebush Road, north of Ulimaroa, Nov. 1993

SOIL CHARACTERISTICS



Pit, North Drillham Rd, 8 km north of Drillham

Depth

Description

| | |
|------------|--|
| 0-10 cm | dark brown, light clay; self-mulching, weak surface crust. Sharp to - |
| 10-35 cm | dark greyish brown, medium heavy clay; well structured. Clear to - |
| 35-70 cm | dark yellowish brown, heavy clay; moderate structure; some carbonate. Sharp to - |
| 70-110 cm | brown, medium heavy clay; many gypseous crystals. Clear to - |
| 110-150 cm | brown, medium heavy clay; few gypseous crystals. |

General soil features

- moderately self-mulching cracking clays which form a surface seal following rain
- surface colours are usually dark brown, yellowish brown or brown, over dark brown, or occasionally dark reddish brown or very dark greyish brown subsoils
- soils have a neutral pH at the surface and are moderately to strongly alkaline in the upper subsoil; they become strongly acid in the deep subsoil
- subsoils are highly to extremely saline and strongly sodic; gypsum is often present at depth
- plant available water capacity in the root zone is low (50 - 100 mm)
- N - low to medium, P - low (cropping), high (pastures), K - medium to very high, Cu - medium, Zn - medium

DULACCA

LAND USE LIMITATIONS

- main limitation is the surface sealing
- susceptibility to erosion
- subsoils are strongly sodic and highly to extremely saline resulting in reduced friability and permeability which may affect plant nutrition
- relatively shallow effective rooting depth limits plant available water capacity

LAND USE OPTIONS

- moderately suitable for cropping
- well suited to grazing native and sown pastures

MANAGEMENT OPTIONS

Pasture

Native

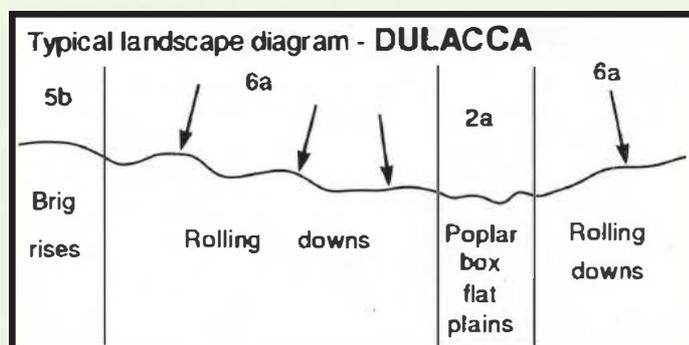
- key desirable species include: Queensland bluegrass, curly windmill grass, brigalow grass, creeping windmill grass and creeping saltbush
- highly productive Queensland bluegrass based pastures
- care needed when locating water points, fence lines and farm tracks due to erosion potential of sloping lands
- stocking rates: 1 beast/4 to 10 ha

Sown

- suitable grass and legume species include: buffel grass, Bambatsi, purple pigeon grass, lucerne and medics
- stocking rates: 1 beast/3 to 8 ha

Cropping

- if cropped, will require intensive soil conservation measures
- care needed when constructing contour banks, so that sodic subsoils are not exposed
- best suited to short-term cropping as part of a pasture rotation; P supplements required
- any concentration of water may lead to gully erosion
- less suited to long-term cropping than Ulimaroa soils; major limitations are surface sealing, susceptibility to erosion if cultivated land is not protected and strongly sodic subsoils (reduces effective rooting depth and hence plant available water capacity)



FLINTON

Brief description: Shallow to deep soils, sandy to loamy surface, with acid, red, massive subsoil overlying lateritised sandstone

Land Resource Areas: Light Forests

LANDSCAPE DESCRIPTION

Landform and distribution

- occurs on slopes (0-5%) and crests of lateritised sandstone rises, particularly in the Hannaford and Burra Burri areas
- minor component on slopes of hilly, weathered sandstone residuals

Vegetation

- woodland of poplar box and silver-leaved ironbark with some false sandalwood, wilga and quinine bush in the Hannaford area; lancewood may occur
- narrow-leaved ironbark with some wilga, spotted gum, Moreton Bay ash and quinine bush around Burra Burri,



Bullock Head Road, Inglestone, Oct. 1994

SOIL CHARACTERISTICS



Roadside Exposure, Greenswamp Rd, Goombi South

| Depth | Description |
|------------|---|
| 0-35 cm | Dark brown, sandy loam; weakly structured. Clear to - |
| 35-65 cm | Dark reddish brown, coarse sandy clay loam; massive. Clear to - |
| 65-85 cm | Red, light clay; massive; abundant ironstone gravel. Clear to - |
| 85-105 cm | Yellowish red, light clay; massive, Clear to - |
| 105-130 cm | As above, but with brown mottle |

General soil features

- soils of variable depth (< 60 cm to > 100 cm) depending on slope position
- surface texture and colour vary from a reddish brown to dark brown, sandy loam to clay loam, commonly 10 to 30 cm thick
- subsoils are permeable with textures of clay loam to light clay, or occasionally medium clay
- subsoil colours are redder on mid and upper slopes and become yellower on lower slopes
- usually occurs below *Minnabilla* in the landscape and above *Channing* (restricted drainage) and *Weengallon*, with *Arden* on footslopes; where they occur on rounded crests, *Arden* occupies the slopes
- ironstone gravels are a common feature of these soils; manganese may occur in deep subsoils
- well drained soil with very low to low plant available water capacity in the root zone (<100 mm)
- soil pH is medium acid to very strongly acid throughout
- N - medium to low, P - very low to extremely low, K - high to very high, Cu - very low, Zn - medium

FLINTON

LAND USE LIMITATIONS

- low fertility, and very low to low plant available water capacity in the root zone
- with prolonged cultivation the soil surface seals and sets hard
- susceptible to sheet, rill and some gully erosion
- minor wind erosion
- wattle, limebush and bitterbark regrowth after clearing

LAND USE OPTIONS

- suitable for grazing native and sown pastures
- suitable for short-term cropping
- sandier phase suitable for dryland horticultural crops

MANAGEMENT OPTIONS

Pasture

Native

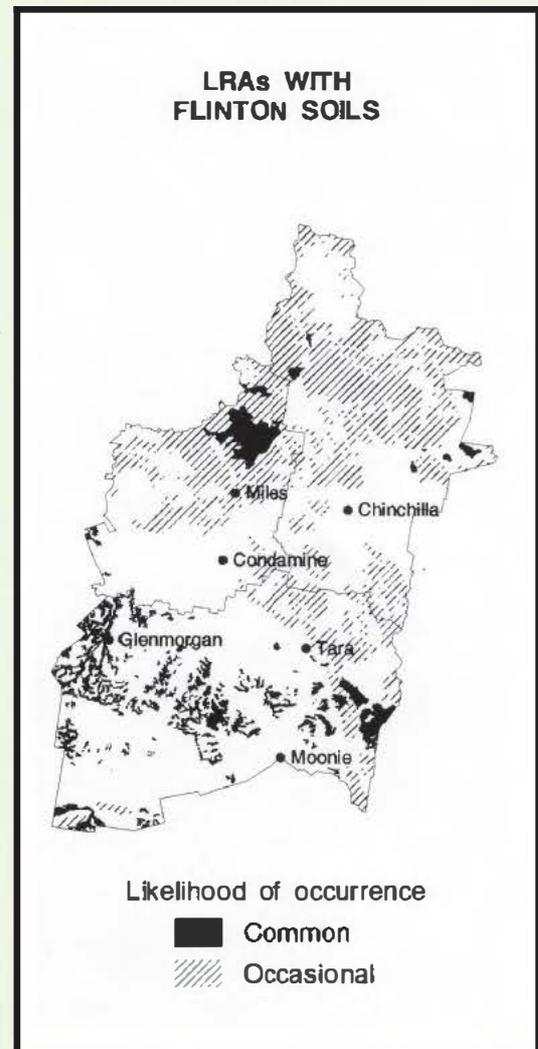
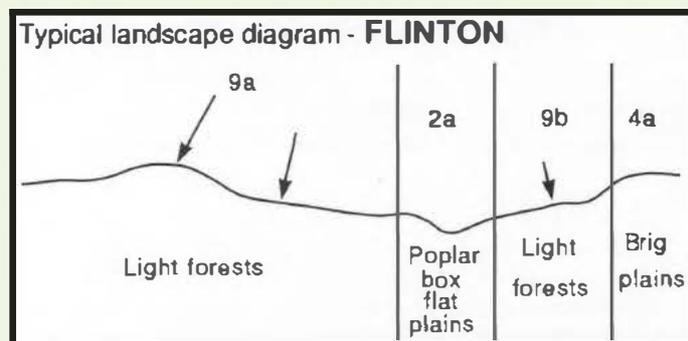
- key species include: pitted bluegrass, black speargrass, wiregrass
- avoid 'hot' fires to reduce sucker regrowth
- low P has been known to cause 'bone chewing'
- stocking rates: 1 beast/4 to 10 ha

Sown

- suitable species: Rhodes grass, creeping bluegrass, digit grass, lucerne, wynn cassia and buffel grass
- strategic grazing and spelling is required to maintain pasture vigour
- stocking rates: 1 beast/3 to 8 ha

Cropping

- short-term cropping (barley, triticale) is carried out to control regrowth and to sow pastures; peanuts may be a short-term option in some areas
- suitable fodder crops include: oats and forage sorghum
- surface structure deteriorates with cultivation, surface tends to set hard and germination problems will occur; not suited to long-term cultivation
- practices such as minimum tillage, stubble mulching and chemical weed control will maintain soil structure, reduce erosion and maximize infiltration
- a pasture phase is recommended to maintain surface structure
- will suffer water stress before the heavier clay soils, however, responds to light falls of rain
- avoid concentration of water flow to avoid gully erosion



GORDONBROOK

Brief description: Red sandy texture contrast soils on granite hills

Land Resource Areas: Granite Hills

LANDSCAPE DESCRIPTION

Landform and distribution

- slopes and crests of low hills in the far north of Chinchilla Shire; usually where the granite has been lateritised or deeply weathered

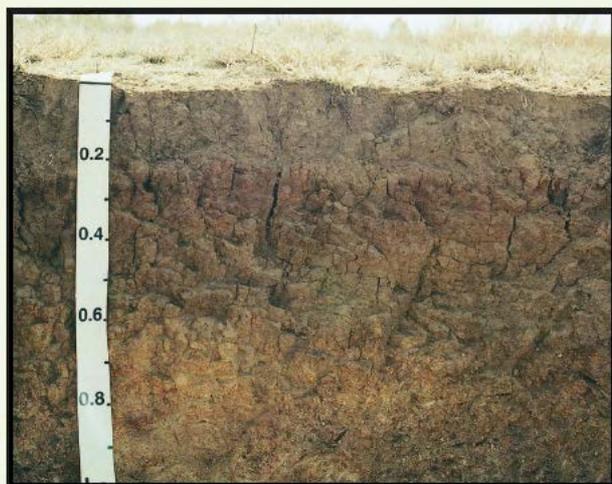
Vegetation

- tall woodland of rusty gum, Queensland blue gum or silver-leaved ironbark with some kurrajongs
- understorey: beefwood and wattles



Auburn River School Road, north of Auburn, Oct. 1994

SOIL CHARACTERISTICS



Roadside exposure, Auburn River School Rd, Auburn

| Depth | Description |
|-----------|--|
| 0-20 cm | brown, fine sandy clay loam; weakly structured to massive. Abrupt to - |
| 20-55 cm | yellowish red, medium heavy clay; well structured. Clear to - |
| 55-75 cm | brown, medium clay, coarse sandy; weakly structured. Gradual to - |
| 75-100 cm | brown, light clay, coarse sandy; massive. Grading into weathering granite. |

General soil features

- texture contrast soils with a clear change between the surface soil and subsoil
- hardsetting, structureless to weakly structured surface
- surface soils are red-brown to brown, light sandy clay loams to fine sandy clay loams over brown, red or red-brown clay subsoils
- moderate workability - in shallow surface soils clay is brought to the surface after cultivation, producing a cloddy surface which seals and sets hard; surface soil pulverizes with cultivation
- moderately well drained soils
- surface soil pH is slightly acid; subsoil pH is moderately alkaline
- soils are non-saline with sodic deep subsoils
- plant available water capacity in the root zone is low (50-100 mm)
- N - low to very low, P - very low to low (cropping), high (pastures), K - low to medium, Cu - medium, Zn - medium

GORDONBROOK

LAND USE LIMITATIONS

- surface soil will set hard and crust after cultivation
- moderate erosion hazard due to moderate erodibility and low/moderate slopes; prone to gully erosion
- surface drying may affect crop/pasture establishment
- low fertility

LAND USE OPTIONS

- suitable for grazing native and sown pastures
- suitable for short-term fodder cropping

MANAGEMENT OPTIONS

Pasture

Native

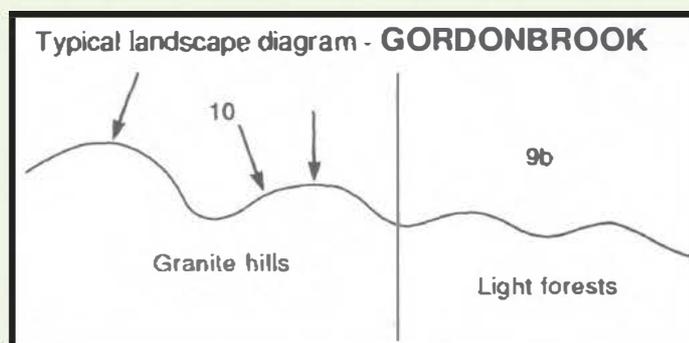
- key desirable species: black speargrass and bluegrasses
- stocking rates: 1 beast/6 to 12 ha

Sown

- suitable grass and legume species include: Katambora Rhodes grass, buffel grass (only suitable when legumes added), seca stylo, medics (if winter rain available)
- stocking rates: 1 beast/4 to 10 ha

Cropping

- short-term cropping should only be carried out to control timber regrowth and to sow pastures
- suitable fodder crops include: oats, forage sorghum, lab lab, lucerne
- soil conservation measures: contour ploughing or 'two chain strips' (banks not required for short-term cropping)



HIGHMOUNT

Brief description: Deep, reddish brown or yellowish brown sands overlying sandstone or granite

Land Resource Areas: Ironbark/bull oak Forests (minor in Light Forests and Granite Hills)

LANDSCAPE DESCRIPTION

Landform and distribution

- undulating plains associated with colluvial slopes of lateritised sandstone hills north of Dulacca and steep granite hills north of the Great Dividing Range
- slopes range from 0-5%

Vegetation

- forest or woodland of narrow-leaved ironbark, cypress pine and bull oak
- understorey: wattles; blackboys also occur on granite



Willets Road, North Dulacca, Nov. 1994

SOIL CHARACTERISTICS



Borrow pit, Willets Road, North Dulacca

| Depth | Description |
|-----------|---|
| 0-2 cm | brown, sandy loam; loose to weakly structured. Clear to - |
| 2-25 cm | light yellowish brown, sand; loose. Diffuse to - |
| 25-120 cm | very pale brown, sand; conspicuously bleached |

General soil features

- these soils are deep sands to loamy sands overlying decomposing rock; they are usually coarse sands where they overly granite
- profiles are rarely deeper than 120 cm
- soil colours vary considerably but are usually yellowish brown or reddish brown
- the soils are strongly to moderately acid throughout the profile
- the soils are non-saline and non-sodic
- plant available water capacity in the root zone is low (50-100 mm)
- N - very low, P - very low (cropping), low (pastures), K - low to very low, Cu - low, Zn - medium

HIGHMOUNT

LAND USE LIMITATIONS

- suitable for grazing native and sown pastures

LAND USE OPTIONS

- main limitations to these soils are their very low fertility and low plant available water capacity (due to excessive drainage)

MANAGEMENT OPTIONS

Pasture

Native

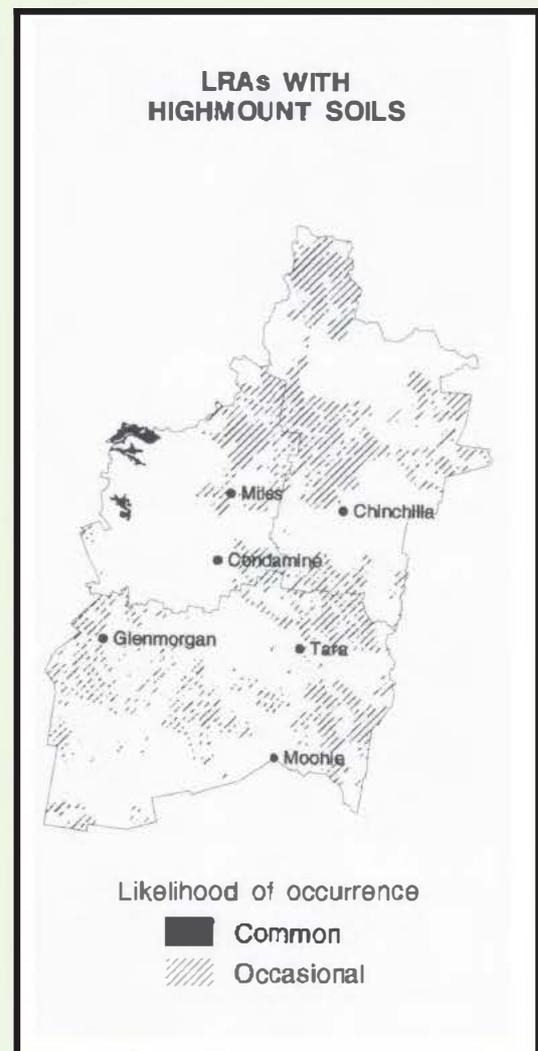
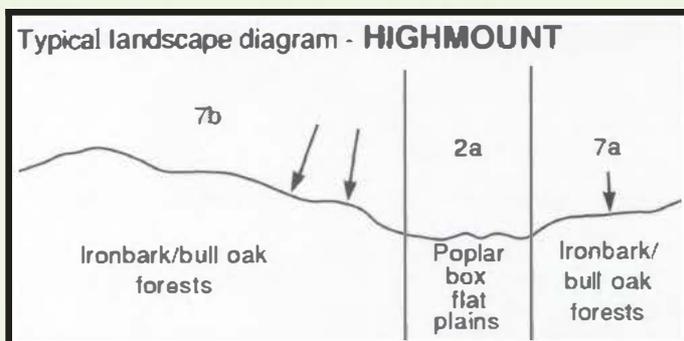
- species include: black speargrass and wiregrass
difficult to manage
- if flaxweed is present, animal husbandry problems may occur e.g. St George's disease
- clearing of timber should be restricted to low gradient slopes
- stocking rates: 1 beast/6 to 12 ha

Sown

- suitable species include: pioneer Rhodes grass, serradella, buffel grass, wynn cassia and lucerne
- the application of fertilisers to these soils is usually considered uneconomical
- stocking rates: 1 beast/6 to 12 ha

Cropping

- not recommended



INGLESTONE

Brief description: Self-mulching, black cracking clays on lower slopes and valley flats within open downs

Land Resource Areas: Rolling Downs

LANDSCAPE DESCRIPTION

Landform and distribution

- mid to lower slopes and valley flats of undulating rises in the Inglestone - Coomrith area; linear gilgai may occur
- slopes 1-5%

Vegetation

- grassland of Queensland bluegrass; open woodland of myall and coolibah on lower slopes and drainage areas



Meandarra-Talwood Road, Inglestone, Dec. 1994

SOIL CHARACTERISTICS



Pit on 'Tarewinnabar', Weir River, south of Moonie

| Depth | Description |
|----------|--|
| 0-2 cm | very dark greyish brown, medium heavy clay; self mulching. Abrupt to - |
| 2-5 cm | very dark greyish brown, medium heavy clay; moderately structured. Clear to - |
| 5-45 cm | very dark grey, heavy clay; well structured; a few carbonate nodules. Gradual to - |
| 45-90 cm | very dark grey, heavy clay; well structured; some carbonate nodules. Gradual to - |
| 90+ cm | Soft weathered sandstone and siltstone. |

General soil features

- moderately deep, moderately to strongly self-mulching, black cracking clays
- finely structured surfaces may form a weak crust after rain
- linear gilgai may occur (usually 10 to 30 cm deep and 5 to 10 m across); mounds are typically strongly self-mulching with calcium carbonate on the surface, while depressions are more coarsely structured and only moderately self-mulching
- these soils characteristically overlie soft sandstone and siltstone at a depth of 1 to 2 m; soils are deepest on lower slopes and valley flats
- non-sodic throughout with medium salinity levels in the deep subsoil
- soil pH is mildly alkaline at the surface, becoming strongly alkaline with depth
- management of these soils is aided by a medium plant available water capacity in the root zone (100-150 mm), a fine, friable seedbed, and very favourable subsoil conditions
- N - low, P - very low (cropping), extremely low (pastures), K - high, Cu - medium, Zn - low

INGLESTONE

LAND USE LIMITATIONS

- suitable for dryland grain and fodder cropping
- suitable for grazing native and sown pastures

LAND USE OPTIONS

- moderate erosion hazard
- effective rooting depth, and therefore plant available water capacity may be restricted where soils are shallow

MANAGEMENT OPTIONS

Pasture

Native

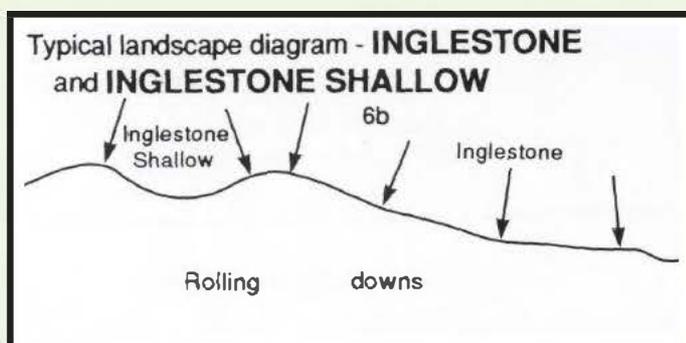
- key desirable species: Queensland bluegrass, curly Mitchell grass, hoop Mitchell grass, native millet, fairy grass, early spring grass and western rat's tail grass
- Undesirable herbs: white spear grass and yabila grass
- Stocking rates: 1 beast/4 to 8 ha

Sown

- Suitable grass and legume species include: bambatsi, snail and barrel medics and purple pidgeon grass
- Stocking rates: 1 beast/3 to 6 ha

Cropping

- suitable grain crops include: wheat, barley, gain sorghum, cotton, chickpeas
- suitable fodder crops include: oats, forage sorghum, snail medic, lucerne
- common rotations are: cereal crops rotated with alternative grain and legume crops, or 2 to 3 years under pasture legume ley



INGLESTONE SHALLOW

Brief description: Shallow to moderately deep, brown or red cracking clays on crests within open downs

Land Resource Areas: Rolling Downs

LANDSCAPE DESCRIPTION

Landform and distribution

- crests and upper slopes of undulating rises in the Inglestone - Coomrith area
- most slopes between 1 and 5%

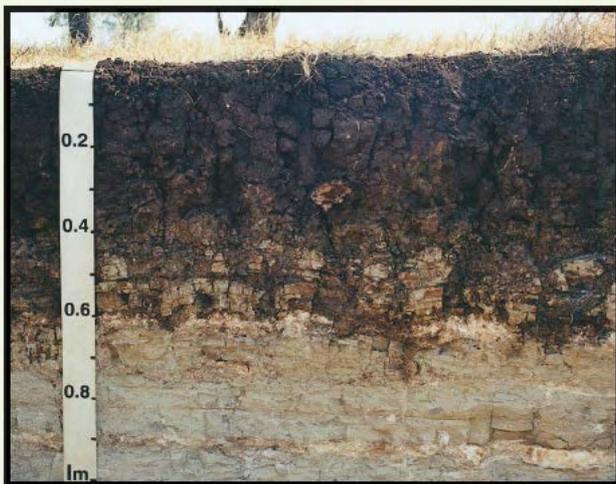
Vegetation

- open woodland of silver-leaved ironbark and poplar box with occasional mountain coolibah
- understorey: absent
- ground layer: continuous cover of Queensland bluegrass



Greenhills Road, Coomrith district, Dec. 1994

SOIL CHARACTERISTICS



Pit on 'Greenhills', Bullock Head Rd, Inglestone

| Depth | Description |
|----------|---|
| 0-5 cm | Brown, light clay; moderately structured. Clear to - |
| 5-35 cm | Reddish brown, heavy clay; well structured; Clear to |
| 35-60 cm | brown to yellowish brown, medium clay; well structured some weathered sandstone fragments. Gradual to - |
| 60+ cm | weathered sandstone and siltstone. |

General soil features

- shallow, brown or red cracking clays with a relatively coarse structured surface which seals after rain (shallow, texture contrast soils with clay loam surfaces may occasionally occur)
- restricted to upper slopes and crests; and is closely associated with Inglestone soils and forms part of a well developed catena
- these soils characteristically overlie soft sandstone and siltstone at less than 1 m depth; soil depth is usually 30 to 60 cm
- non-saline and non-sodic throughout
- surface soil pH is neutral and becomes more alkaline with depth
- management of these soils is affected by low plant available water capacity in the root zone (50-100 mm), low fertility, shallow soil depth, seedbed conditions that are less than optimal, and a high erosion risk
- N - medium to low, P - low to very low, K - high, Cu - medium, Zn - low

INGLESTONE SHALLOW

LAND USE LIMITATIONS

- low plant available water capacity (depends on soils depth, as water stored in the weathered parent material is available for plant growth)
- low fertility
- shallow soil depth
- high erosion risk because of slopes up to 5%

LAND USE OPTIONS

- suitable for grazing native and sown pastures
- suitable for dryland fodder crops while developing and renovating land

MANAGEMENT OPTIONS

Pasture

Native

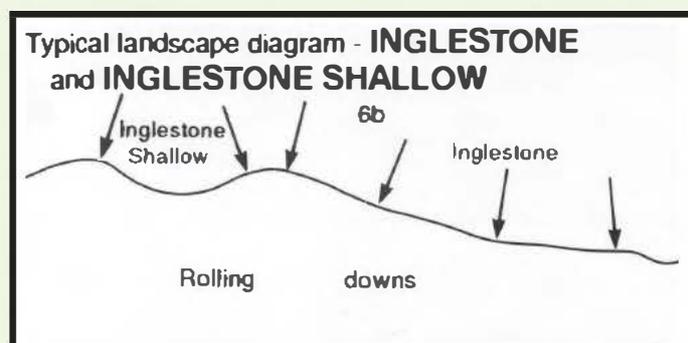
- key desirable species: Queensland bluegrass, curly Mitchell grass, hoop Mitchell grass, native millet, fairy grass, early spring grass and western rat's tail grass
- undesirable herbs: white speargrass and yabila grass
- stocking rates: 1 beast/6 to 12 ha

Sown

- suitable grass and legume species include: buffel grass and barrel medic
- stocking rates: 1 beast/4 to 10 ha

Cropping

- suitable for dryland fodder crops while developing and renovating land: oats, snail medic, peas, millets
- contour banks are required if cropping for longer periods
- undertake a short-term farming phase every 8 to 10 years to renovate sown pastures
- not suitable for summer crops



KUPUNN

Brief description: Self-mulching, grey or black cracking clays, with shallow to moderately deep gilgai, on brigalow plains

Land Resource Areas: Brigalow Plains (minor in Poplar Box Rises)

LANDSCAPE DESCRIPTION

Landform and distribution

- common in the vicinity of Condamine, east of Chinchilla, and in the Hopelands and Moonie areas
- found on broad, flat plains or the gently undulating, dissected edges of the brigalow plains south-west of Chinchilla

Vegetation

- dense brigalow-belah scrub
- understorey: wilga, limebush and some false sandalwood
- ground layer: brigalow grass and Queensland bluegrass (when cleared)



McLean Road, south of Tara, June 1994

SOIL CHARACTERISTICS



Pit, Roma-Condamine Rd, 10 km west of Condamine

| Depth | Description |
|------------|---|
| 0-5 cm | dark greyish brown light medium clay; weakly self mulching. Abrupt to - |
| 5-20 cm | dark greyish brown, light medium clay; well structured; few soft carbonate nodules. Clear to - |
| 20-70 cm | greyish brown, medium clay; moderately structured; some gravel and soft carbonate nodules. Clear to - |
| 70-120 cm | brown, medium heavy clay; weakly structured; some gravel and soft carbonate nodules. Gradual to - |
| 120-150 cm | strong brown, medium heavy clay; slickensides. |

General soil features

- deep, self-mulching, cracking clays characterised by shallow to moderately deep gilgai and well structured to thin, crusted surface soils over coarse crumbly subsoils
- on the low, flat plains the gilgai usually have large, irregular, shallow depressions and some low mounds; the difference in height between the top of mounds and bottom of depressions ranges from 15 to 30 cm
- linear gilgai, in winding patterns associated with shallow drainage depressions, are a feature of the plains in the Myall Grove area
- surfaces and upper subsoils are black or grey and it is common for subsoils to become browner with depth; some mounds may also be coloured brown; surfaces tend to be browner and lighter in texture where the vegetation is predominantly belah
- surface soils have a neutral to moderately alkaline pH with strongly alkaline upper subsoils; they grade to strongly acid in the deep subsoil
- subsoils are sodic to strongly sodic and medium to very highly saline depending on land use
- plant available water capacity in the root zone is low (50-100 mm) to medium (100-150 mm)
- N - medium to low, P - low to medium, K - high, Cu - medium, Zn - very low

KUPUNN

LAND USE LIMITATIONS

- some levelling of gilgai may be necessary for cropping to avoid ponding in depressions - loss of production may occur in the early years on areas where topsoil has been removed
- where salt levels are high, cloddy surfaces occur causing workability and establishment problems
- may be subject to flood erosion
- regrowth after initial clearing
- diversion banks may be necessary to supply water for dams

LAND USE OPTIONS

- suitable long-term cropping soils (dryland or irrigated)
- also suitable for grazing sown grasses and legumes and native pastures

MANAGEMENT OPTIONS

Pasture

Native

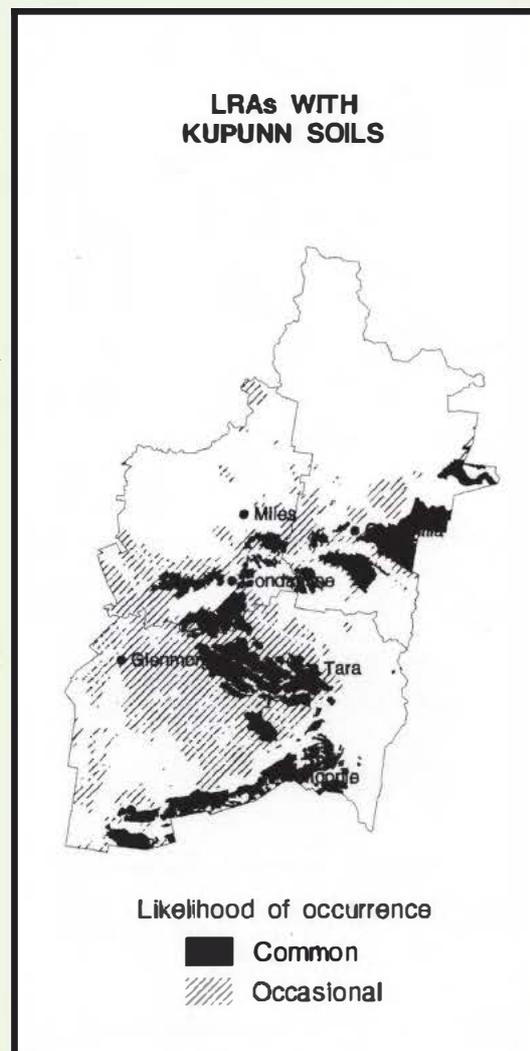
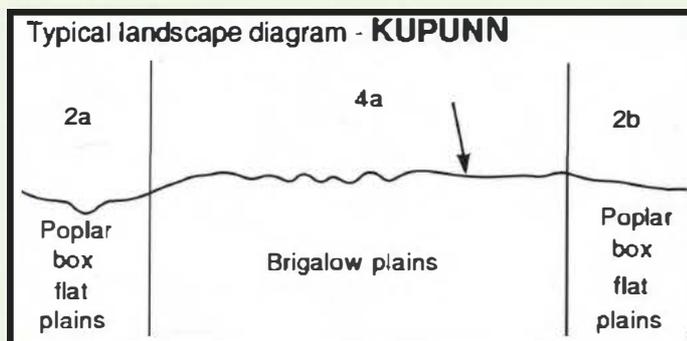
- highly productive bluegrass pastures after clearing
- withstands reasonable grazing pressure, with no significant erosion problems
- stocking rates: 1 beast/4 to 8 ha

Sown

- suitable grass and legume species include: bambatsi, purple pigeon grass, buffel grass, Katambora Rhodes grass, lucerne and medics
- stocking rates: 1 beast/3 to 6 ha

Cropping

- suitable grain crops include: wheat, barley, chickpeas, sorghum, cotton, sunflowers, mungbeans and millets
- suitable fodder crops include: oats, forage sorghum and lab lab
- contour banks may be required on slopes >1%, especially long slopes
- strip cropping is used on low sloping country to achieve adequate spread of water
- high levels of surface cover (including stubble mulch) will reduce erosion and increase infiltration
- minimum tillage recommended to improve water infiltration
- pasture rotation are recommended to maintain or improve organic matter levels



MINNABILLA

Brief description: Very shallow (<45 cm), gravelly, red (may occasionally be black) soils; rock outcrop

Land Resource Areas: Light Forests and Ironbark/bull oak Forests (minor in Granite Hills)

LANDSCAPE DESCRIPTION

Landform and distribution

- found on eroded ridge tops, scarps and slopes of gently undulating plains to low hills where remnants or outcrops of lateritised sandstone occur (i.e. jumpups)
- slopes range from 0-3% on plains and rises; 3-25% on ridge tops and scarps; and 0-6% on plateaus and low hills

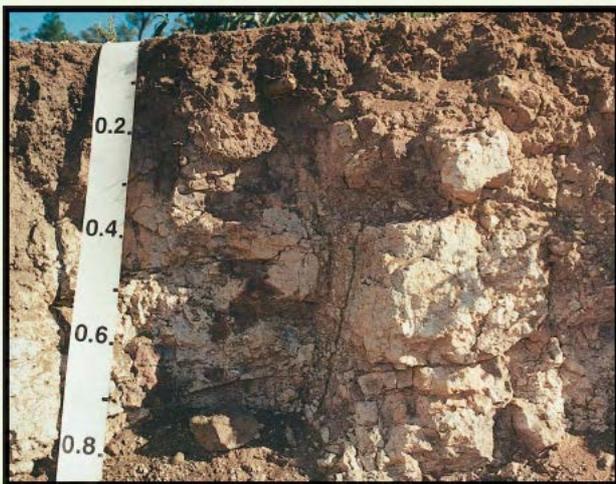
Vegetation

- open forest of ironbarks, rusty gum and spotted gum with some poplar box and cypress pine
- understorey: wattles with some false sandalwood and lancewood; grasstrees occur on granite



Dalby-Kogan Road, east of Kogan, July 1994

SOIL CHARACTERISTICS



Roadside exposure, North Dulacca Rd, Dulacca

| Depth | Description |
|----------|---|
| 0-10 cm | yellowish red, fine sandy clay loam; massive. Clear to - |
| 10-25 cm | yellowish red, fine sandy clay loam; many coarse sandstone fragments. |
| 25+ cm | weathered sandstone |

General soil features

- soil textures are gravelly sandy loams, loams or clay loams; the texture may occasionally increase with depth
- the soil profile is invariably shallow (<45 cm), with much partly decomposed rock present
- colours vary from reddish brown (may occasionally be black), loams to clay loams with massive structure on ridges, scarps and upper slopes, to reddish brown to brown sandy loams to loamy sands on mid slopes
- where the parent material is a more normal sandstone (i.e. not lateritised), colours are usually light grey-brown to yellowish brown, loose sands to loamy sands
- these soils have an acid pH throughout the profile
- non-saline and non-sodic throughout
- plant available water capacity in the root zone is very low (< 50 mm)
- N - low to medium, P - very low, K - medium

MINNABILLA

LAND USE LIMITATIONS

- very shallow and stony soils
- plant available water capacity is very low
- fertility levels very low to medium
- regrowth difficult to control

LAND USE OPTIONS

- limited to timber production and sparse grazing of poorly productive native pastures
- suitable for bee-keeping if suitable tree species are present e.g. ironbarks

MANAGEMENT OPTIONS

Pasture

Native

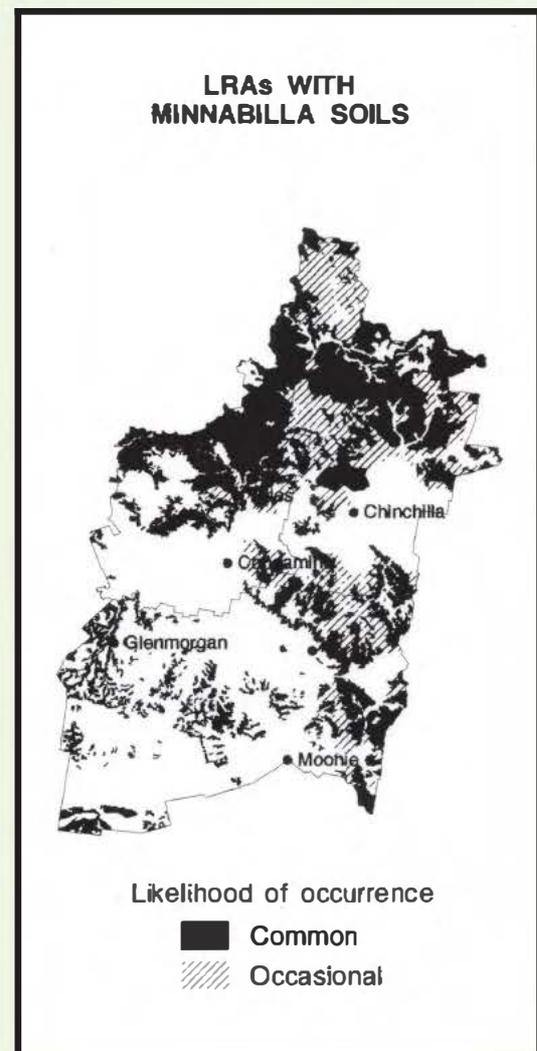
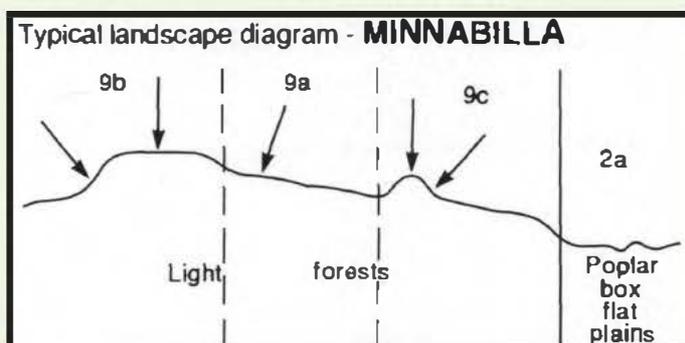
- key perennial species: hooky grass, slender panic, gilgai grass, purple lovegrass, curly windmill grass and poverty grass
- complete tree clearing and overgrazing should be avoided; three and grass cover will reduce runoff and soil loss
- stocking rates: 1 beast/20 to 30 ha

Sown

- unsuitable for development

Cropping

- not recommended



MOOLA

Brief description: Moderately deep to deep, grey or black cracking clays with very shallow gilgai overlying calcareous sandstone and shale

Land Resource Areas: Brigalow Rises

LANDSCAPE DESCRIPTION

Landform and distribution

- mid to lower slopes of undulating to rolling rises and low sandstone hills
- located in the Kragra - Cadarga area north of Chinchilla

Vegetation

- open forest of brigalow, belah and wilga with occasional poplar box and bottle trees



Cadarga Road, Cadarga district, Aug. 1994

SOIL CHARACTERISTICS



Pit on 'Overstone', Cadarga Road, Cadarga

| Depth | Description |
|------------|---|
| 0-20 cm | dark brown, light clay; moderate blocky structure; some ironstone gravel. Abrupt to - |
| 20-60 cm | dark greyish brown, medium heavy clay; well structured; some ironstone gravel. Gradual to - |
| 60-100 cm | dark yellowish brown, medium heavy clay; well structured; some ironstone gravel and carbonate nodules and soft segregations |
| 100-160 cm | mottled, pale yellow, light clay. |

General soil features

- uniform, medium to heavy clays which may develop very shallow linear gilgai; gilgai tend to disappear with cultivation
- surface soils are usually self-mulching in depressions and surface sealing on mounds
- surface colours are very dark grey, black, greyish brown or dark brown, over very dark grey, black, light grey or dark greyish brown subsoils
- ironstone gravel occurs throughout the profile and decomposing sandstone may be encountered by 60 cm or shallower on some slopes
- the soils normally have a moderately to strongly alkaline pH throughout, although the upper layers of the gilgai depressions may be neutral to slightly acid
- subsoils are sodic to strongly sodic with medium to very high salinity levels in the subsoil
- management of these soils is aided by a weakly self-mulching surface, relatively good drainage and ease of cultivation
- plant available water capacity in the root zone is medium (100-150 mm)
- N - high, P - high to very high, K - very high, Cu - medium, Zn - high

MOOLA

LAND USE LIMITATIONS

- these soils are susceptible to erosion on slopes

LAND USE OPTIONS

- suitable for grain and fodder cropping
- suitable for grazing native and sown pastures

MANAGEMENT OPTIONS

Pasture

Native

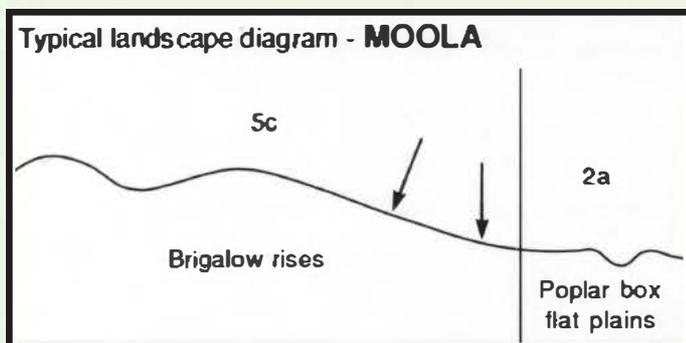
- key desirable species: brigalow and belah grasses, Chloris species, Queensland bluegrass and various herbages
- stocking rates: 1 beast/4 to 10 ha

Sown

- suitable grass and legume species include: Katambora Rhodes grass, green and Gatton panic, creeping bluegrass, purple pigeon grass, lucerne, seca stylo, desmanti and annual medics (in a good season)
- grazing native and sown pastures are regarded by many farmers as being the best use for these soils
- stocking rates: 1 beast/3 to 8 ha

Cropping

- these soils are suited to a wide range of grain and fodder crops, however, the choice is limited by low stored soil moisture in some years
- they are best suited to winter crops
- a ley pasture system will maintain and improve organic matter levels
- use reduced tillage to maintain adequate levels of stubble and crop cover (> 30%) to help minimise erosion and protect the soil surface



NUDLEY

Brief description: Hardsetting deep, reddish brown to yellowish brown loam to clay loam soils

Land Resource Areas: Minor in Poplar Box Rises and Cypress Pine Sands

LANDSCAPE DESCRIPTION

Landform and distribution

- minor on flat alluvial plains and terraces (slopes 1%) associated with the local creeks of the area and those fringing the dissected edges of the brigalow plains or the lateritised sandstone remnants

Vegetation

- poplar box woodland on alluvial plains with associated cypress pine
- understorey: false sandalwood, wilga, sally wattle, myall and beefwood
- Queensland blue gum, Moreton Bay ash and rough-barked apple occur on the creek terraces



Leichhardt H'way, Nine Mile Creek, north of Miles, July 1994

SOIL CHARACTERISTICS



Pit, Nine Mile Creek, north of Miles

| Depth | Description |
|-----------|---|
| 0-5 cm | dark greyish brown, clay loam; moderate platy structure; dark greyish brown, clay loam; moderately structured. Clear to - |
| 5-32 cm | as above, but weakly structured. Clear to - |
| 32-45 cm | light grey, clay loam; conspicuously bleached; massive. Sharp to - |
| 45-70 cm | very dark grey, medium clay; moderately structured. Gradual to - |
| 70-150 cm | dark grey, medium clay; weakly structured. |

General soil features

- very deep, loamy soils which may gradually increase in texture with depth
- surface textures are loam to clay loam which set hard when dry
- surface colours are reddish brown to yellowish brown, over reddish brown to grey, sandy clay loam to clay loam or clay subsoils
- these soils have a slightly acid to neutral surface pH and increase to mildly or moderately alkaline in the subsoil
- plant available water capacity in the root zone is low to medium (50-150 mm)
- deep subsoils are sodic with low to medium salinity levels
- N - low, P - low to medium (cropping), very high (pastures), K - high, Cu - low, Zn - medium

NUDLEY

LAND USE LIMITATIONS

- floodprone
- low to medium plant available water capacity

LAND USE OPTIONS

- suitable for grazing native and sown pastures
- suitable for short-term cropping only

MANAGEMENT OPTIONS

Pasture

Native

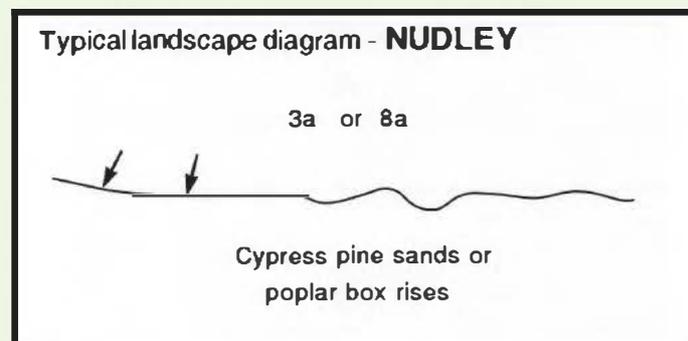
- key desirable species: Queensland bluegrass, forest bluegrass and pitted bluegrass
- stocking rates: 1 beast/6 to 12 ha

Sown

- suitable grass and legume species include: bambatsi, purple pigeon grass, Katambora Rhodes grass and medics
- stocking rates: 1 beast/4 to 10 ha

Cropping

- these are regarded as marginal cropping soils requiring good management for success
- suitable fodder and grain crops include: oats, forage sorghum, barley and wheat
- minimum tillage is recommended as opposed to zero till because of hardsetting surface soils



ROGERS

Brief description: Thin (<15 cm), bleached, loamy surface, over red or brown clay subsoil

Land Resource Areas: Minor in Brigalow Plains and Light Forests

LANDSCAPE DESCRIPTION

Landform and distribution

- minor soils associated with the fringes of the brigalow landscapes (slopes 0-2%) and lower slopes (0-5%) of lateritised sandstone remnants in the Dulacca - Ulimaroo area

Vegetation

- open forest of molly box with associated species including brigalow and belah
- understorey: false sandalwo



'Kanandah', Undulla Road, north of Glenmorgan, Oct. 1994

SOIL CHARACTERISTICS



Pit, Fairymeadow Road, Goombi

| Depth | Description |
|-----------|---|
| 0-10 cm | dark brown, clay loam; massive. Abrupt to- |
| 10-11 cm | as above, but partially bleached. Sharp to- |
| 11-30 cm | dark brown, light clay; moderate columnar structure; a little gravel; Clear to- |
| 30-90 cm | brown, light clay; massive; a little gravel. Gradual to- |
| 90-140 cm | mottled, brown, light clay; massive; a little gravel. |

General soil features

- texture contrast soils with a sharp change between the surface soil and subsoil
- surface textures vary from sandy clay loam to clay loam, commonly 10 to 15 cm thick
- subsoils are moderately permeable red or brown clays; the permeability of the subsoils decreases with depth as the sodicity increases
- these soils have a moderately acid pH in the surface layers and become alkaline with depth; deep subsoils become strongly acid
- ironstone nodules often occur throughout the surface where these soils are associated with lateritised sandstone remnants
- surface soils set hard following rain
- subsoils are sodic to strongly sodic with medium salinity levels throughout
- plant available water capacity in the root zone is very low (<50 mm)
- N - low to medium, P - low to very low (cropping), medium (pastures), K - high, Cu - medium, Zn - low

ROGERS

LAND USE LIMITATIONS

- plant available water capacity is very low and fertility is low to very low
- subsoils are impermeable due to strong sodicity
- problems may be experienced with the germination of small seeded crops and pastures due to surface sealing following rain
- structureless surface layers which set hard create problems with workability

LAND USE OPTIONS

- plant available water capacity is very low and fertility is low to very low
- subsoils are impermeable due to strong sodicity
- problems may be experienced with the germination of small seeded crops and pastures due to surface sealing following rain
- structureless surface layers which set hard create problems with workability

MANAGEMENT OPTIONS

Pasture

Native

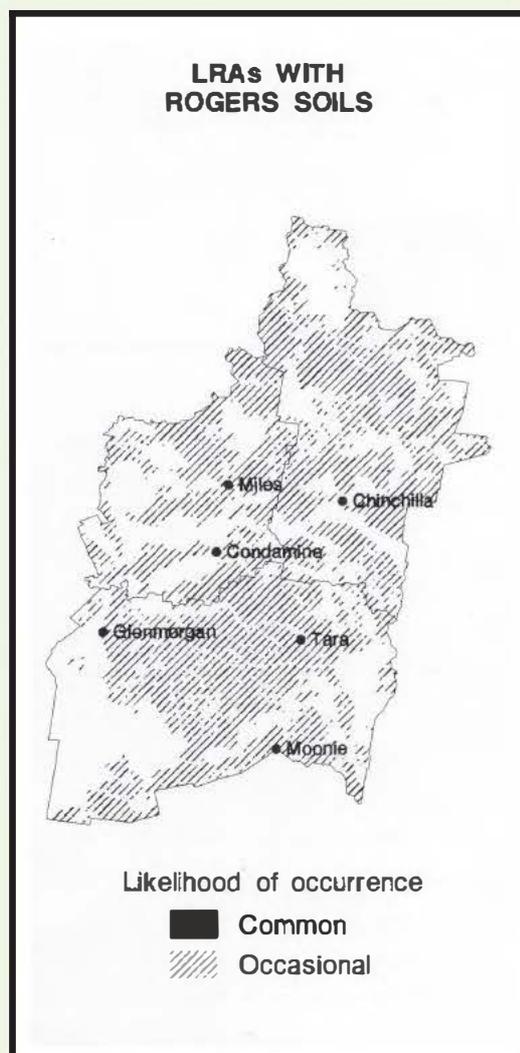
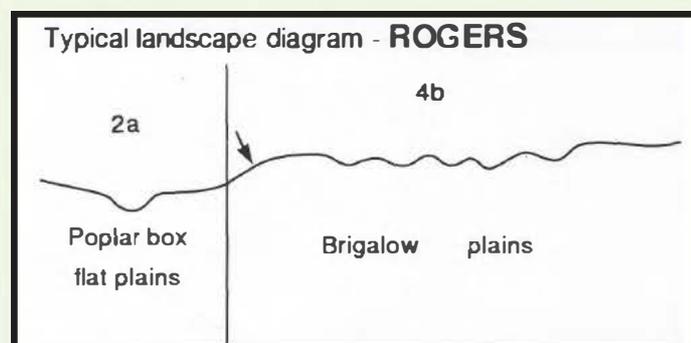
- key desirable species: Queensland bluegrass, fairy grass, curly windmill grass, brigalow grass, creeping windmill grass and creeping saltbush
- stocking rates: 1 beast/6 to 12 ha

Sown

- suitable grass and legume species include: buffel grass and medics
- stocking rates: 1 beast/4 to 10 ha

Cropping

- suitable fodder crops include: oats and forage sorghum
- fodder crops are grown while developing and renovating land
- cultivation should be carried out when the soil is moist as the hardsetting surface will create problems with



TANDAWANNA

Brief description: Hardsetting, thin clay loam surface over brown or red clay subsoil, or weakly self-mulching and non-cracking brown clays when cultivated, on belah plains

Land Resource Areas: Brigalow Plains (minor in Brigalow Rises and Rolling Downs)

LANDSCAPE DESCRIPTION

Landform and distribution

- these soils are typical of the elevated, flat or undulating plains with belah forest in the Southwood - Flinton - Glenmorgan area
- minor on slopes (0-2%) of the brigalow plains bordering the lateritised sandstone remnants west of the Moonie River, the brigalow rises around Ulimaroa, and the rolling downs in the Coomrith area

Vegetation

- belah forest, occasionally with brigalow and some poplar box
- understorey: false sandalwood and wilga



Windemere Road, south of Glenmorgan, Oct. 1994

SOIL CHARACTERISTICS



Pit on 'Narrawong', Windemere Rd, S of Glenmorgan

| Depth | Description |
|------------|--|
| 0-17 cm | dark brown, clay loam; hardsetting, massive. Abrupt to - |
| 17-18 cm | as above, but partially bleached. Sharp to - |
| 18-45 cm | dark reddish brown, heavy clay; well structured; few manganese nodules. Gradual to - |
| 45-60 cm | brown, medium heavy clay; well structured; trace amounts of soft carbonate segregations; few manganese nodules. Gradual to - |
| 60-110 cm | reddish brown, medium heavy clay; well structured. Gradual to - |
| 110-150 cm | brown, heavy clay; weakly structured. |

General soil features

- texture contrast soils with a sharp change between the surface soil and subsoil - where surface soils are very thin and the soils are cultivated, they appear to be weakly self-mulching, non-cracking clays
- surface texture is a friable clay loam, or light clay after cultivation
- a subsurface bleach may occur but its presence is dependent on conditions of restricted surface drainage
- surface colours are usually dark brown, over dark brown to dark reddish brown clay subsoils
- subsoils are more coarsely structured on lower slopes where these soils merge with the plains
- management of these soils is aided by a medium plant available water capacity, friable seedbed after tillage, well structured upper subsoil and low erosion risk
- surface soils have a neutral pH; upper subsoils are moderately to very strongly alkaline, while deep subsoils are very strongly acid
- deep subsoils are strongly sodic and very highly saline
- plant available water capacity in the root zone is medium (100-150 mm)
- N - medium to low, P - medium (cropping), high (pastures), K - very high, Cu - medium, Zn - medium

TANDAWANNA

LAND USE LIMITATIONS

- main limitations to these soils are the strongly sodic and highly to very highly saline deep subsoils - permeability decreases with depth as the subsoil sodicity increases
- these limitations will restrict water movement and root growth, particularly in flat situations
- erosion on slopes
- hardsetting surface soil restricts infiltration

LAND USE OPTIONS

- suitable for long-term dryland cropping - grain and fodder crops
- suitable for grazing native and sown pastures

MANAGEMENT OPTIONS

Pasture

Native

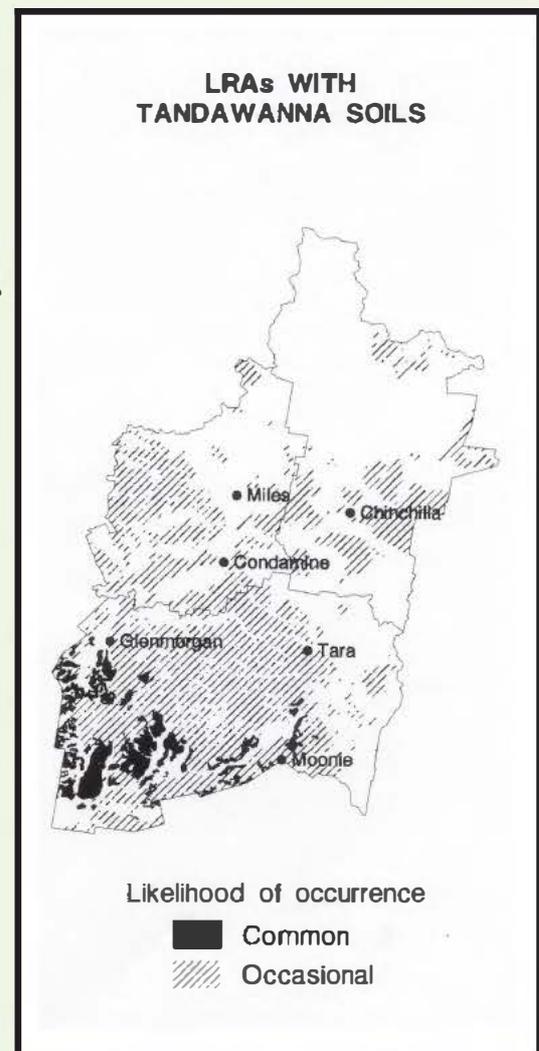
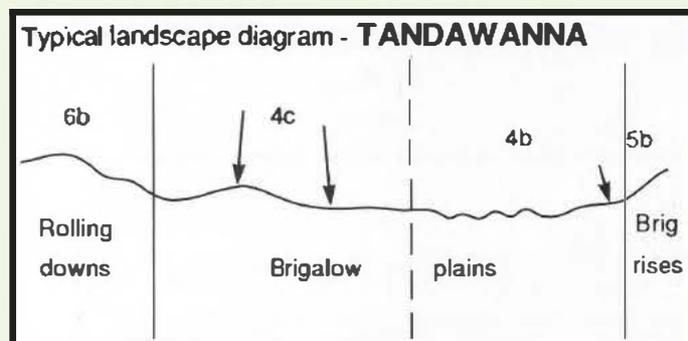
- key desirable species: Queensland bluegrass, fairy grass, curly windmill grass, brigalow grass, creeping windmill grass and creeping saltbush
- highly productive native and sown pastures
- stocking rates: 1 beast/4 to 8 ha

Sown

- suitable sown pasture species include: buffel grass, bambatsi, purple pigeon grass, lucerne and medics
- stocking rates: 1 beast/3 to 6 ha

Cropping

- suitable grain crops include: wheat, barley, chickpeas and grain sorghum
- suitable fodder crops include: oats, forage sorghum and lab lab
- during tillage, well structured clay from the upper subsoil is often incorporated with shallow surface layers, improving clay content (water storage capacity) and structure; as a result, seedbeds are friable and tend to seal, but not set hard
- pasture rotations recommended for maintenance of organic matter levels
- maximum surface cover should be retained at all times, particularly during early summer storms
- reduced tillage is recommended to preserve surface structure and increase water infiltration
- will exhibit nutrient and structure decline after 30 years of farming (plough pans may develop)



TARA

Brief description: Grey cracking clays, may be self-mulching, with moderately to very deep gilgai on brigalow plains

Land Resource Areas: Brigalow Plains

LANDSCAPE DESCRIPTION

Landform and distribution

- dominant in the southern half of the region, particularly in the area of south Undulla Creek
- occurs on flat plains, which may have slight differences in relief, and on gently undulating to level (<1%) footslopes associated with the more elevated plains north of Tara and south of Meandarra

Vegetation

- dense brigalow-belah scrub
- understorey: wilga, false sandalwood, limebush and black teatree in drainage lines



Fairymeadow Road, Goombi South, Nov. 1993

SOIL CHARACTERISTICS



Pit, Surat Development Rd, 3 km east of The Gums

| Depth | Description |
|------------|--|
| 0-10 cm | brown, light clay; loose; some carbonate nodules. Clear to - |
| 10-40 cm | light brownish grey, heavy clay; well structured; some carbonate nodules. Gradual to - |
| 40-100 cm | greyish brown, heavy clay; moderately structured. Gradual to - |
| 100-150 cm | greyish brown, medium clay; moderately structured. |

General soil features

- deep, cracking grey clays, characterised by the development of moderately deep to very deep gilgai; the difference in height between the top of the mounds and bottom of depressions ranges from 30 to 150 cm
- the gilgai patterns and soil surface characteristics vary considerably; the variations include melonhole gilgai with self-mulching surfaces, crabhole gilgai with deep depressions and a massive, hardsetting surface and a coarse blocky subsoil, or melonholes with a thin crusted surface and a coarse blocky subsoil
- soil pH is generally neutral to alkaline at the surface, becomes strongly alkaline with depth, and then grades to strongly acid in the deep subsoils; less commonly pH is strongly acid throughout
- subsoils are sodic to strongly sodic and deep subsoils are highly (depressions) to very highly (mounds) saline
- plant available water capacity in the root zone is low to medium (50-150 mm), (usually lower on mounds)
- N - low to medium (mounds), low (depressions), P - low to medium (mounds, cropping), medium (depression, cropping), high to very high (pastures), K - very high (mounds), high (depressions), Cu - medium, Zn - low (depressions), medium (mounds)

TARA

LAND USE LIMITATIONS

- main limitations to these soils are the gilgai microrelief and poor surface structure
- workability is difficult on areas with deep gilgai (with a high proportion of depressions)
- regrowth, particularly of limebush, is a problem
- effective soil depth - levelling will expose strongly sodic and highly saline subsoils which will increase plant growth problems
- difficult to blade plough effectively
- when cultivated, mounds seal readily and water runs off into depressions which drain extremely slowly

LAND USE OPTIONS

- suitable for grazing native and sown pastures
- may be suitable for limited grain and fodder cropping

MANAGEMENT OPTIONS

Pasture

Native

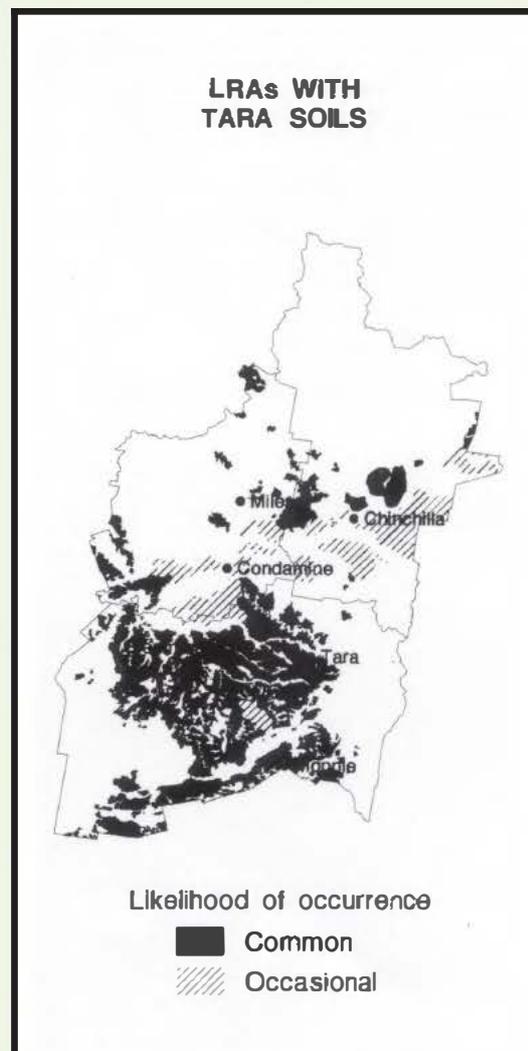
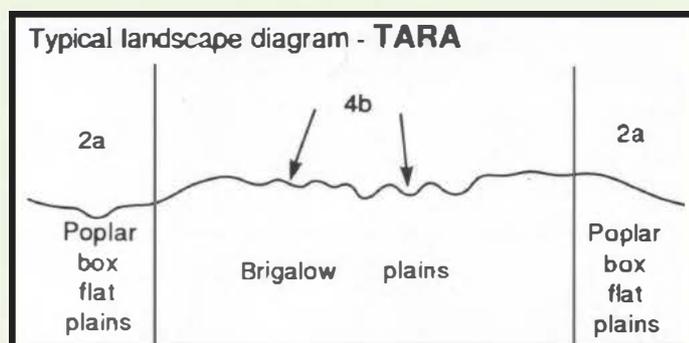
- key desirable species: Queensland bluegrass, fairy grass, curly windmill grass, brigalow grass, creeping windmill grass, creeping saltbush
- undesirable species: sedges, dog burr
- withstands reasonable grazing pressure, with no significant erosion problems
- stocking rates: 1 beast/4 to 8 ha

Sown

- suitable pasture species include: bambatsi, purple pigeon grass and Katambora Rhodes grass
- undesirable species: sedges
- use improved pasture species capable of withstanding limited periods of waterlogging
- stocking rates: 1 beast/3 to 6 ha

Cropping

- limited production of wheat, barley, oats or forage sorghum
- size of melonholes causes workability problems (during establishment and harvesting)
- land levelling will expose unsuitable subsoil conditions



ULIMAROA

Brief description: Moderately deep to deep, self-mulching, brown, grey or occasionally black cracking clays, on brigalow uplands overlying fine-grained sediments

Land Resource Areas: Brigalow Rises (minor in Rolling Downs)

LANDSCAPE DESCRIPTION

Landform and distribution

- gently undulating rises (1-4%) in the Ulimaroa and Dulacca areas

Vegetation

- dense brigalow-belah scrub on mid and upper slopes
- on lower slopes grades into an open forest of brigalow-belah or a poplar box shrubby and grassy woodland
- understorey: wilga, false sandalwood, myall, emu apple and occasionally bottle tree



Warrego Hwy, Ulimaroa, March 1994

SOIL CHARACTERISTICS



Pit, South Drillham Rd, 1 km south of Drillham

| Depth | Description |
|------------|---|
| 0-10 cm | very dark greyish brown, medium clay; self-mulching. Clear to - |
| 10-40 cm | greyish brown, heavy clay; well structured. Clear to - |
| 40-100 cm | brown, heavy clay; well structured; few carbonate nodules. Gradual to - |
| 100-150 cm | yellowish red, heavy clay; moderately structured. |

General soil features

- self-mulching, brown, grey or occasionally black cracking clays which overlie soft siltstone and sandstone between 50 and 200 cm
- finely structured surfaces form a weak surface crust after rain
- in general, brown to dark brown soils are developed on the crests of the ridges and the upper slopes; these become very dark grey to greyish brown in colour and become deeper down the slope
- surface soils have a mildly alkaline pH, while the subsoils are strongly alkaline; deep subsoils are very strongly acid
- management of these soils is aided by a well structured upper subsoil; although friable, seedbeds tend to form a weak crust following rain
- subsoils are sodic to strongly sodic and medium to very highly saline
- plant available water capacity in the root zone is low (50-100 mm)
- N - low to medium, P - low to medium (cropping), high (pastures), K - very high, Cu - medium, Zn - low

ULIMAROA

LAND USE LIMITATIONS

- long slopes (>100 m) and large catchment sizes increase the risk of erosion when cultivated
- dam bywash a problem
- lower subsoils are strongly sodic and very dispersible with medium to very high levels of salinity - these conditions reduce the actual rooting depth and hence the available water and nutrients

LAND USE OPTIONS

- suitable long-term cropping soils - grain and fodder crops
- suitable for grazing native and sown pastures

MANAGEMENT OPTIONS

Pasture

Native

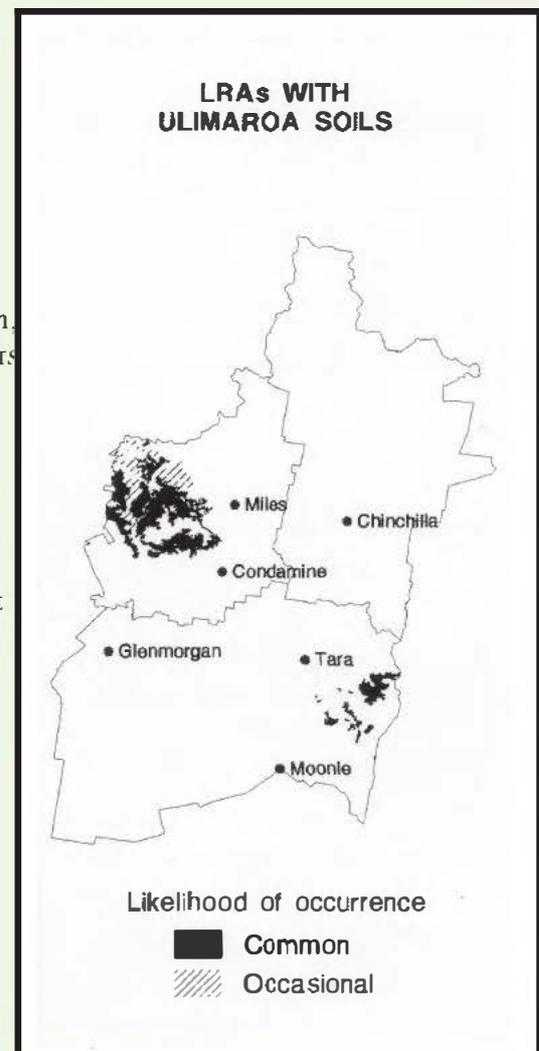
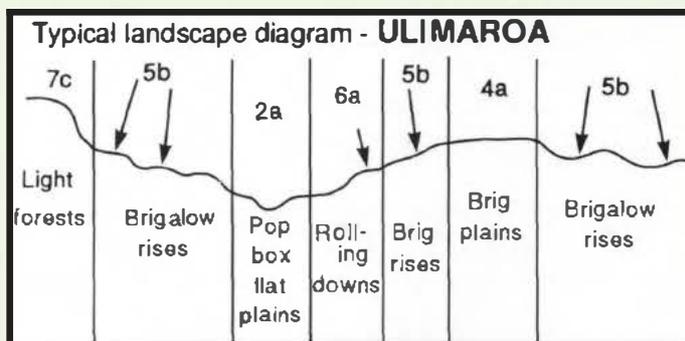
- key desirable species: Queensland bluegrass, fairy grass, curly windmill grass, brigalow grass, creeping windmill grass, creeping saltbush
- highly productive, cleared native pasture
- stocking rates: 1 beast/4 to 8 ha

Sown

- suitable species include: buffel grass, bambatsi, purple pigeon grass, lucerne and medics
- care needed when locating water points, fence lines and tracks due to erosion potential of slopes
- stocking rates: 1 beast/3 to 6 ha

Cropping

- suitable grain crops include: wheat, barley, grain sorghum, cotton, chickpeas, grain millet, mungbeans and sunflowers
- suitable fodder crops include: oats, forage sorghum and lab lab
- waterways need to be adequately grassed before establishing contour banks
- do not cultivate slopes >6%
- with cropping, subsoil salts will be leached downward, increasing the effective rooting depth and hence the plant available water capacity



WEENGALLON

Brief description: Moderately thick (10 to 30 cm), clay loam surface, over red clay subsoils associated with alluvial plains and lateritised sandstone landscapes

Land Resource Areas: Poplar Box Rises (minor in Ironbark/bull oak Forests, Light Forests, Rolling Downs and Brigalow Plains)

LANDSCAPE DESCRIPTION

Landform and distribution

- common in the Hannaford, Undulla, Glenmorgan and Meandarra areas on gently undulating alluvial plains (slopes 0-2%) or colluvial slopes derived from numerous lateritic remnants; on slopes they are closely associated with the Flinton soils

Vegetation

- grassy woodland of poplar box, may have clumps of brigalow and belah; silver-leaved ironbark dominates where these soils are associated with Flinton soils
- understorey: false sandalwood with some limebush



Glenmorgan Road, Coomrith district, Dec. 1994

SOIL CHARACTERISTICS



Roadside exposure, South Drilham Road

| Depth | Description |
|------------|--|
| 0-15 cm | dark reddish brown, sandy clay loam; massive. Clear to - |
| 15-25 cm | brown, sandy clay loam; partially bleached; massive. Sharp to - |
| 25-65 cm | dark reddish brown, medium clay; moderate columnar structure. Clear to - |
| 65-100 cm | brown, light medium clay; weakly structured; some soft carbonate. Clear to - |
| 100-120 cm | mottled, yellowish brown, light medium clay; massive. |

General soil features

- texture contrast soils with a sharp change between the surface soil and subsoil
- surface texture is clay loam, or occasionally loam, commonly 10 to 30 cm thick
- surface soils are structureless which produce a cloddy seedbed when cultivated, but pulverise with excessive cultivation; they seal and set hard after rain and dry rapidly
- surface colours are reddish brown to light reddish brown, over reddish brown clay subsoils
- surface soils have a slightly to strongly acid pH, it then rises to strongly alkaline in the subsoil; some profiles may become strongly acid in the deep subsoil indicating the presence of deeply weathered lateritic material
- subsoils are strongly sodic and the deep subsoils are medium to highly saline
- plant available water capacity in the root zone is low (50-100 mm)
- N - very low, P - low (cropping), high (pastures), K - medium, Cu - medium, Zn - low

WEENGALLON

LAND USE LIMITATIONS

- management of these soils is affected by low plant available water capacity, seedbed conditions that are less than optimal and a high erosion risk; problems with soil erosion occur because of the high erodibility of the surface soil
- management of woody weed regrowth is difficult because control measures are usually not cost effective

LAND USE OPTIONS

- suitable for grazing native and sown pastures
- fodder crops are grown while developing and renovating land

MANAGEMENT OPTIONS

Pasture

Native

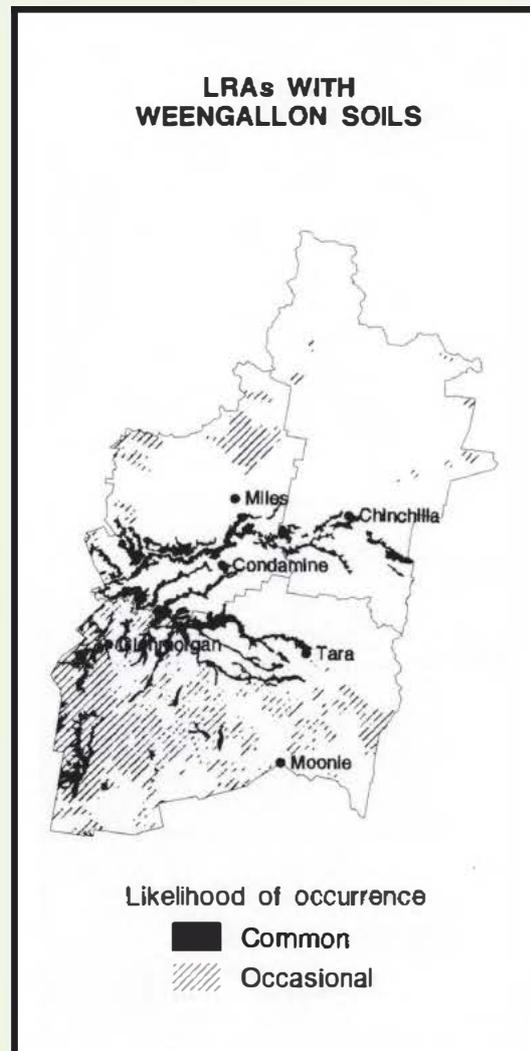
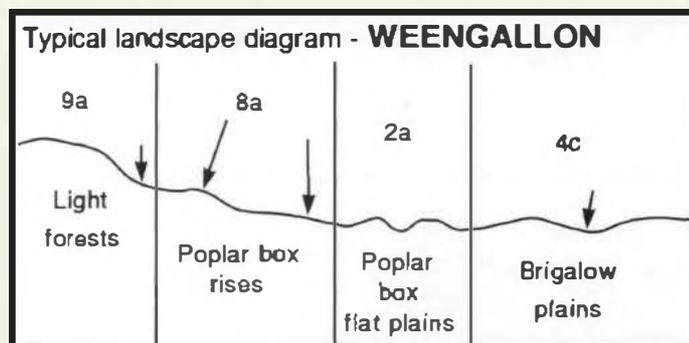
- key desirable species: pitted bluegrass, kangaroo grass, grey lovegrass, rough speargrass, slender bluegrass, fairy grass, katoora, windmill grass, tall chloris, leafy nineawn, dainty lovegrass, common fringerush, climbing saltbush, small saltbush, forest bluegrass
- stocking rates: 1 beast/6 to 12 ha

Sown

- suitable species include: buffel grass and medics
- poplar box regrowth problems common
- stocking rates: 1 beast/4 to 10 ha

Cropping

- fodder crops are grown while developing and renovating land
- suitable fodder crops include: oats and forage sorghum



WERANGA

Brief description: Hardsetting thin (< 15 cm), bleached sandy surface, over mottled greyish brown, grey or yellowish brown sandy clay subsoil overlying sandstone

Land Resource Areas: Poplar Box Rises and Poplar Box Flat Plains (minor in Ironbark/bull oak Forests)

LANDSCAPE DESCRIPTION

Landform and distribution

- slopes and rounded hilltops (0-3%) of gently undulating plains to low hills in the Weranga area east of Tara
- lower slopes (0-3%) of gently undulating plains in the Weranga to Kogan area; these plains are located between local drainage lines and the colluvial lower slopes of lateritised sandstone hills and rises

Vegetation

- shrubby woodland of poplar box with some cypress pine, bull oak and narrow-leaved ironbark
- understorey: false sandalwood



Bens Gully, Dalby-Kogan Road, Kogan, Nov. 1994

SOIL CHARACTERISTICS



Gully exposure, Bens Gully, Dalby-Kogan Rd

| Depth | Description |
|----------|--|
| 0-5 cm | brown, sandy loam; massive. Abrupt to - |
| 5-6 cm | light grey, loamy sand; conspicuously bleached; massive. Abrupt to - |
| 6-40 cm | mottled, yellowish brown, light medium clay, coarse sandy; strong columnar structure. Gradual to - |
| 40-80 cm | mottled, pale brown, light medium clay; massive. |

General soil features

- texture contrast soils with a sharp change between the surface soil and subsoil
- surface soils are thin (generally 10 to 15 cm) with textures varying from loamy sand or sandy loam, to sandy clay loam (may occasionally be clay loam)
- a thin bleach occurs above the impermeable subsoil
- surface colours are usually very dark greyish brown to dark brown, over greyish brown, brownish grey or light yellowish brown clay subsoils; the colour and degree of mottling vary considerably
- these soils have a slightly acid pH in the surface with neutral to alkaline subsoils
- surface soils set hard after rain
- plant available water capacity in the root zone is very low (< 50 mm)
- subsoils are strongly sodic and the deep subsoils are highly saline
- N - low, P - very low (cropping), low (pastures), K - medium, Cu - low, Zn - low

WERANGA

LAND USE LIMITATIONS

- main limitation is the shallow depth of the surface soil
- cultivation will interfere with and often lead to exposure of the impermeable, dispersible and highly erodible subsoil
- rapid and severe gully erosion will occur if the dispersible subsoil is exposed
- soil nutrient status and the moisture storage capacity of these soils are too low to justify cropping

LAND USE OPTIONS

- suitable for grazing native pastures
- limited suitability for grazing sown pastures

MANAGEMENT OPTIONS

Pasture

Native

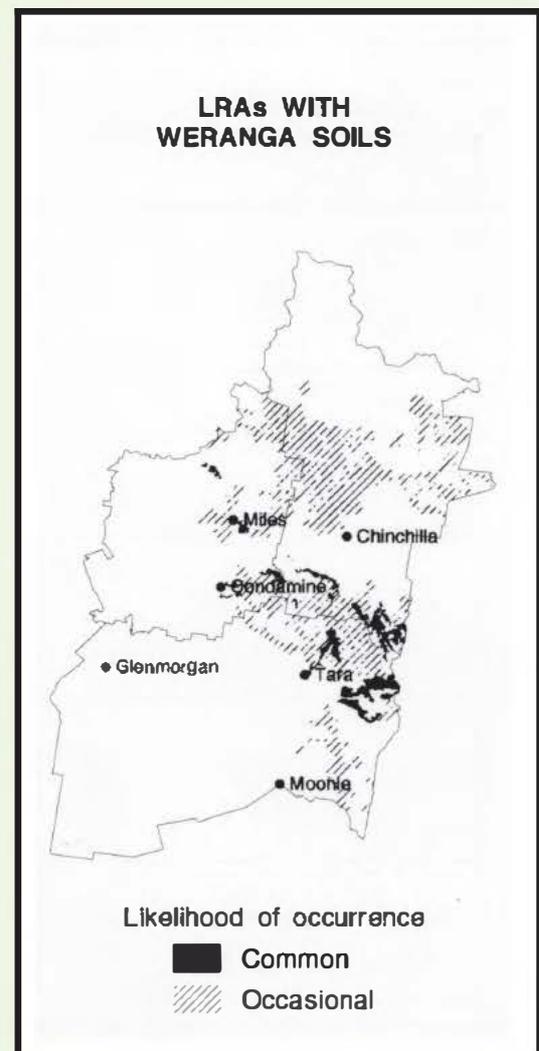
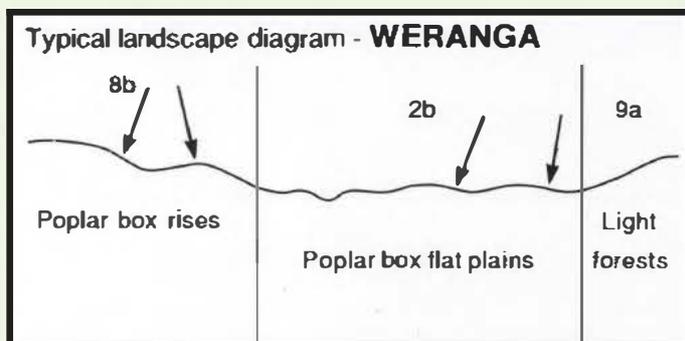
- key desirable species: pitted bluegrass, kangaroo grass, grey lovegrass, rough speargrass, slender bluegrass, fairy grass, windmill grass, tall chloris, leafy nineawn, dainty lovegrass, common fringerush, climbing saltbush, small saltbush, forest bluegrass
- clearing of timber should be restricted to low gradient slopes
- stocking rates: 1 beast/6 to 12 ha

Sown

- suitable grass species include: pioneer Rhodes grass
- Rhodes grass may only last 2 to 3 years, but is probably the most suitable sown pasture
- economics of sown pastures questionable
- stocking rates: 1 beast/4 to 10 ha

Cropping

- not recommended



GLOSSARY

- A horizon* See *Soil horizon*.
- A₂ horizon* See *Subsurface soil; Bleach*.
- Acid clay* Clay subsoils of low pH that occur under brigalow-belah vegetation.
- Acid soil* A soil giving an acid reaction throughout most or all of the soil profile (precisely, below a pH of 7.0; practically, below a pH of 6.5). Generally speaking, when the pH drops below 5.5 the following specific problems may occur - aluminium toxicity, manganese toxicity, calcium deficiency and/or molybdenum deficiency. Such problems adversely affect plant growth and root nodulation, which may result in a decline in plant cover and increase in erosion hazard. See *pH*.
- Aeolian sediments* See *Sedimentary rocks*.
- Alkaline soil* A soil giving an alkaline reaction throughout most or all of the soil profile (precisely, above a pH of 7.0; practically, above a pH of 8.0). Many alkaline soils have a high pH indicated by the presence of calcium carbonate, and are suitable for agriculture. However, others are problem soils because of salinity and/or sodicity. Soils with a pH above 9.5 are generally unsuitable for agriculture. See *pH*.
- Alluvial plain* A plain formed by the accumulation of alluvium on a floodplain over a considerable period of time; this accumulation may be still occurring at present (recent alluvium) or may have ceased (relict alluvium).
- Alluvium (pl. alluvia)* Deposits of gravel, sand, silt, clay or other debris, moved by streams from higher to lower ground.
- B horizon* See *Soil horizon*.

- Backplain*** Large alluvial flat occurring some distance from the stream channel; often characterised by a high water table and the presence of swamps or lakes.
- Basalt*** See *Volcanic rocks*.
- Bleach*** Subsurface soil (A₂ horizon) that is white, near white or much paler than adjacent soil layers. It occurs in varying proportions:
- conspicuous bleach - 80% or more of the layer is white or almost so, when the soil is dry.
- sporadic or partial bleach -the bleaching occurs irregularly through the subsurface layer, or as blotches or, as nests of bleached grains of soil material often at the interface of the surface and subsoil layers.
- C material*** Layer(s) below the B horizon which may be weathered parent material, not bedrock, little affected by soil-forming processes.
- Chlorotic*** An abnormal yellow colour of a plant.
- Clays*** Soils with a uniform clay texture throughout the surface soil and subsoil.
- *cracking* Clay soils that develop vertical cracks when dry.
- *non-cracking* Clay soils that do not develop vertical cracks when dry.
- Colluvium (pl. colluvia)*** Slope deposits of soil and rock material.
- Colour*** See *Soil colour*.
- Concretion (in soil)*** See *Segregation*.

- Consistence (of soil)*** Refers to the degree of resistance to breaking or deformation when a force is applied.
- Crabholes*** See *Gilgai - crabhole*.
- Cracking clays*** See *Clays, cracking*.
- Deep weathering*** The process by which earthy or rocky materials are slowly broken down into finer particles and soil by chemical processes over a long period of time. The chemical alteration of the rocks involved:
- leaching of the calcium-rich cement which previously bound the constituent particles together to form the rocks;
 - a progressive transformation of feldspar minerals, clay minerals and labile fragments to form a new matrix of kaolinite white clay;
 - the alteration of iron-rich minerals to form iron oxides (red colour); and
 - mobilising and recrystallising of silica produced from the breakdown of minerals; more resistant quartz grains were relatively unaffected. See *Laterite*.
- Dispersion*** The process whereby soils break down and separate into their constituent particles (clay, silt, sand) in water. Dispersible soils tend to be highly erodible and present problems for earth works. Dispersion is associated with sodicity levels. See *Sodicity*. The dispersion ratio, R₁, and its interpretation are discussed in Section 5.4.4.
- Dissection*** The process of streams or erosion cutting the land into hill, ridges and flat areas.
- Drainage (soil profile)*** The rate of downward movement of water through the soil, governed by both soil and site characteristics. Categories are as follows:
- Very poorly drained: free water remains at or near the surface for most of the year.
 - Poorly drained: all soil horizons remain wet for several months each year.

- Imperfectly drained: some soil horizons remain wet for periods of several weeks.
- Moderately well drained: some soil horizons remain wet for a week after water addition.
- Well drained: no horizon remains wet for more than a few hours after water addition.
- Rapidly drained: no horizon remains wet except shortly after water addition.

Dry sclerophyll forest Trees, typically found in low rainfall areas, with tough leaves (e.g. eucalypts) which help to reduce water loss.

Duplex soil See *Texture contrast soil*.

Duricrust A cemented layer at or near the surface resulting from the concentration of breakdown products of rock weathering.

Earths Soils with a sandy to loamy (including clay loam) surface soil, gradually increasing to a loamy to light clay subsoil.

- *massive* Earths in which the subsoil is not arranged into natural soil aggregates and appears as a coherent, or solid mass.

- *structured* Earths in which the subsoil is arranged into natural soil aggregates which can be clearly seen.

Effective rooting depth (ERD) Depth to which most plant feeder roots will penetrate. This is taken here to be the depth either to which salts have been leached and have therefore accumulated, or to an impeding layer. This represents the long-term depth of wetting.

Electrical conductivity (EC) A measure of the conduction of electricity through water, or a water extract of soil. The value can reflect the amount of soluble salts in an extract and therefore provide an indication of soil salinity.

Erodibility (soil) The susceptibility of a soil to the detachment and transportation of soil particles by erosive agents. It is a function of the mechanical, chemical and physical characteristics of the soil, and is independent of the other factors influencing soil erosion such as topography, land use,

rainfall intensity and plant cover. It may be changed by management.

Erosion hazard

The susceptibility of a parcel of land to the prevailing agents of erosion. It is dependent on a combination of climate, landform, soil, land use and land management factors.

ESP

Exchangeable sodium percentage. See *Sodicity*.

Gilgai

Surface microrelief associated with soils containing shrink-swell clays. Characterised by the presence of mounds and depressions.

- crabhole

Irregularly distributed small depressions and mounds, separated by a more or less continuous shelf. Vertical interval usually less than 0.3 m. Horizontal interval usually 3-20 m, surface almost level.

- linear

Long, narrow, parallel, elongate mounds and broader, elongate depressions more or less at right angles to the contour; usually in sloping lands.

- melonhole

Large depressions, usually greater than 3 m diameter and deeper than 0.3 m, which have a sub-circular or irregular shape and are separated by elongate mounds or set in an almost level surface.

- normal

Small, irregularly distributed mounds and sub-circular depressions, usually with less than 0.3 m vertical interval between the mound tops and bottom of depressions.

Granite/granitic rocks

Coarse-grained, *igneous* rock formed well below the Earth's surface in which quartz constitutes up to 50% of the minerals. Other minerals included are feldspars and micas.

Gypsum

A naturally occurring soft crystalline material which is a hydrated form of calcium sulphate. Gypsum contains approximately 23% calcium and 18% sulfur. It is used to improve soil structure and reduce crusting in hard setting clayey soils.

| | |
|---------------------------------|---|
| <i>Hard setting</i> | Surface soil that becomes hard and apparently structureless on the periodic drying of the soil. |
| <i>Horizon</i> | See <i>Soil horizon</i> , also <i>Soil horizon boundary</i> . |
| <i>Igneous rocks</i> | Rock crystallised from molten rock material (magma). It may be extruded to the Earth's surface (<i>volcanic</i>) or cool at variable depths below the surface (intrusive, and plutonic). |
| <i>Infiltration</i> | The movement of water through the soil surface. Soils with a high infiltration capacity allow more rain to enter the soil than soils with a low capacity. Runoff will occur when the rate of rainfall exceeds the soil's infiltration capacity. Surface soil structure and texture are important determinants of the infiltration capacity of a soil. |
| <i>Jumpups</i> | Local term used to describe stony, lateritised ridges and scarps. |
| <i>Kaolinisation</i> | Breakdown of minerals (particularly feldspars) under intense weathering to form kaolinite clay (china clay). See also <i>Laterite</i> . |
| <i>Laterite</i> | A profile formed by intense weathering. Many deeply weathered profiles termed 'lateritic' exhibit a distinct series of layers including a surface duricrust, ironstone and mottled and pallid (kaolinised) zones. The word laterite is used for any profile in which ironstone is a major feature. See <i>Duricrust</i> . |
| <i>Lateritised rocks</i> | Rocks which have been partially or completely weathered to laterite. |
| <i>Levee</i> | A very long, very low, nearly level ridge immediately adjacent to a stream channel, built up by over-bank flow. |
| <i>Local relief</i> | The altitude difference between the base and crest of slopes in undulating or hilly areas. |
| <i>Massive earths</i> | See <i>Earths, massive</i> . |
| <i>Massive structure</i> | See <i>Soil structure, apedal</i> . |

| | |
|---|---|
| <i>Melonholes</i> | See <i>Gilgai - melonhole</i> . |
| <i>Metamorphic rocks</i> | Rocks that were originally igneous or sedimentary that have been physically and/or chemically altered by high temperatures and/or pressures beneath the Earth's surface. |
| <i>Mineralisation</i> | The breakdown of soil organic matter and crop and animal residues by micro-organisms to inorganic (available) forms. |
| <i>Mottle</i> | Spots, blotches or streaks of subdominant colours different from the main soil colour. |
| <i>Mycorrhizae</i> | Soil fungi which act as rootlets and increase the amount of nutrients (particularly phosphorus and zinc) available to plants. Following, excessive tillage and soil fumigation can cause mycorrhizae to die out. Plants growing with mycorrhizae are generally healthier and more resistant to disease, particularly root rots. |
| <i>Nodules (in soil)</i> | See <i>Segregation</i> . |
| <i>Non-cracking clays</i> | See <i>Clays, non-cracking</i> . |
| <i>Pans</i> | A hard and/or cemented soil horizon e.g. cultivation pan. |
| <i>Permeability</i> | The capacity for transmission under gravity of water through soil or sediments. |
| <i>Plant available water capacity (PAWC)</i> | The quantity of water held in a soil that can be extracted by plant roots. It is expressed as millimetres of plant available water within the root zone. |
| <i>pH</i> | A measure of the acidity or alkalinity of a soil. A pH of 7.0 indicates neutrality, higher values indicate alkalinity and lower values indicate acidity. Each unit change in pH represents a 10-fold change in either the acidity or alkalinity of the soil. For example, a pH of 5.0 is 10 times more acid than a pH of 6.0. Soil pH affects the amount of different nutrients that are soluble in water and therefore the amount of nutrient available to plants. |

Porosity (of soil)

The degree of pore space in a soil (i.e. the percentage of the total space between solid particles). The extent and type of soil porosity indicates the ease with which water, air and roots can move through the soil. Without sufficient pores of the right size, soil is unproductive because plant roots cannot move through the soil easily, air and water movement are poor, and there is insufficient water for plant growth.

There are two types of pores. Macropores are large pores, greater than 0.03 mm in diameter, and most can be seen by the naked eye. They include the spaces between soil aggregates caused by cultivation, shrinking and cracking, channels made by roots of plants, and earthworm and other animal and insect tunnels. Macropores are vitally important in allowing water and air to move freely, but provide little water for plant uptake because they are readily drained.

Micropores are small pores less than 0.03 mm in diameter occurring mainly within aggregates. Water drains through them very slowly so they act as water reservoirs for plant roots.

Salinity

The presence of sufficient soluble salts to adversely affect plant growth and/or land use. The main salt involved is sodium chloride, but sulfates, carbonates and magnesium salts occur in some soils. It is expressed as a level of electrical conductivity (EC). See *Electrical conductivity*.

Sands

Soils with a uniform sand (including sandy loam) texture throughout the surface soil and subsoil.

Sedimentary rocks

Rocks formed from the accumulation of material which has been weathered and eroded from pre-existing rocks, then transported and deposited as sediment by wind (aeolian) or water (fluvial, marine).

Sedimentary rocks have been classified according to grain size and constituent minerals:

| | | |
|-------------------|---------------------|---------------------|
| Sedimentary rocks | Clay-sized grains | Mudstone |
| | Silt-sized grains | Siltstone |
| | Sand-sized grains | Sandstone |
| | Gravel-sized grains | Conglomerate |

Sandstone is further subdivided on the basis of the dominant minerals making up the clasts (solid inclusions) or the matrix which cements the clasts together:

| | | |
|-----------|-------------------------------------|----------------------------|
| Sandstone | 90% or more of grains are quartz: | Quartzose sandstone |
| | less than 75% of grains are quartz: | Labile sandstone |

Segregation

Discrete accumulations of minerals in the soil because of the concentration of some constituent, usually by chemical or biological action. Segregations are described by their nature, abundance and form.

| | | |
|---------------------|--|---|
| <i>1) nature</i> | for example, calcareous (carbonate), gypseous (gypsum), manganiferous (manganese) and ferromanganiferous (iron-manganese). | |
| <i>2) abundance</i> | very few (trace or occasional) | <2% |
| | few (slight) | 2-10% |
| | common (light) | 10-20% |
| | many (moderate) | 20-50% |
| | very many (heavy) | >50% |
| <i>3) form</i> | concretions | - spheroidal formations (concentric in nature). |
| | nodules | - irregular rounded formations (not concentric or symmetric). Can have a hollow interior. |
| | fragments | - broken pieces of segregations. |
| | crystals | - single or complex clusters of visible crystals. |
| | soft segregations | - finely divided soft segregations accumulated in the soil through chemical |

action with water. They contrast with surrounding soil in colour and composition but are not easily separated from the soil as separate bodies.

Self-mulching

A condition of well-structured surface soil, notably of clays, in which the aggregates fall apart naturally as the soil dries to form a loose mulch of soil aggregates.

In cultivated soils, ploughing when wet may appear to destroy the surface mulch which, however, will re-form upon drying.

Sodicity

A characteristic of soils (usually subsoils) containing exchangeable sodium to the extent of adversely affecting soil stability, plant growth and/or land use. It is measured as a percentage of the cation exchange capacity of the soil.

The classes are defined as follows:

| | |
|----------------|----------------------|
| non-sodic | - less than 6% |
| sodic | - between 6% and 15% |
| strongly sodic | - more than 15% |

Sodic or strongly sodic soils would be dispersible and may be improved by the addition of gypsum.

***Soft segregations
(in soil)***

See *Segregation*.

Soil colour

The colour of soil material is determined by comparison with a standard Munsell soil colour chart. The colours are described for moist soils unless otherwise stated.

Soil depth

The following depth ranges are used in this manual to describe the soil surface and soil profile depths.

| | | |
|-------------------------------|------------------|----------|
| <i>1) soil surface</i> | thin | 0-15 cm |
| | moderately thick | 15-30 cm |
| | thick | 30-60 cm |
| | very thick | > 60 cm |

| | | |
|------------------------|-----------------|----------|
| 2) <i>soil profile</i> | shallow | 0-30 cm |
| | moderately deep | 30-60 cm |
| | deep | 60-90 cm |
| | very deep | >90 cm |

Soil horizon A layer of soil material within the *soil profile* with distinct characteristics and properties produced by soil-forming processes, and which are different from those of the layers above and/or below. The three main horizons are: A (topsoil); B (subsoil); C (see C material).

Soil horizon boundary Boundaries between horizons take many forms. The terms used in the soil descriptions of the Field Manual soil photographs and Appendix 3 (Resource Information) are:

Sharp - less than 5 mm wide; **Abrupt** - 5 to 20 mm wide;
Clear - 20 to 50 mm wide; **Gradual** - 50 to 100 mm wide;
Diffuse - more than 100 mm wide.

Soil profile A vertical cross-sectional exposure of a soil, from the surface to the parent material or *Substrate*.

Soil reaction trend The general direction of the change in pH with depth.

Soil structure The arrangement of natural soil aggregates that occur in soil; structure includes the distinctness, size and shape of these aggregates.

1) distinctness

- *strong* The natural soil aggregates are quite distinct in undisplaced soil; when displaced more than two-thirds of the soil material consists of aggregates (i.e. well structured).

- *moderate* Natural soil aggregates are well formed and evident but not distinct in undisplaced soil; when displaced more than one-third of the soil material consists of aggregates (i.e. moderately structured).

- *weak* The natural soil aggregates are indistinct and barely observable in undisplaced soil; when displaced up to one-third of the soil material consists of soil aggregates (poorly structured).

2) *size*

- *coarse* The natural soil aggregates are relatively large; an average size of 20 mm or more is coarse for the purposes of this manual.
- *medium* The average size of the natural soil aggregates is between fine and coarse.
- *fine* The natural soil aggregates are relatively small; an average size of 5 mm or less is fine for the purposes of this manual.

3) *shape*

- *apedal* There are no observable natural soil aggregates (structureless); the soil may be either a coherent mass (massive) or a loose, incoherent mass of individual particles such as sand grains (single grain).
- *blocky* The natural soil aggregates have the approximate shape of cubes with flat and slightly rounded sides.
- *prismatic* The natural soil aggregates have the approximate shape of elongated blocks.
- *columnar* The natural soil aggregates are like those of *prismatic* but have domed tops.
- *polyhedral* The natural soil aggregates are irregular, many sided and multi-angled.
- *lenticular* The natural soil aggregates are like large vertical lens shapes with curved cracks between the aggregates.
- *platy* The soil particles are arranged around a horizontal plane and bounded by relatively flat horizontal faces.

Soil texture

The coarseness or fineness of soil material as it affects the behaviour of a moist ball of soil when pressed between the thumb and forefinger. It is generally related to the proportion of clay, silt and sand within a soil. Texture classes used in this manual are defined primarily by the total clay content:

| | Group | Clay content (%) |
|--------|-----------------|-------------------------|
| Coarse | Sand | less than 5 |
| | Loamy sand | 5 to 10 |
| | Sandy loam | 10 to 20 |
| Medium | Loam | ≈ 25 |
| | Sandy clay loam | 20 to 30 + sand |
| | Clay loam | 30 to 35 |
| Fine | Sandy clay | 35 to 40 + sand |
| | Light clay | 35 to 40 |
| | Medium clay | 40 to 50 |
| | Heavy clay | more than 50 |

Solodic soils

Soils with strong texture contrast between A horizons and sodic B horizons which are not strongly acid.

Stoloniferous

Producing stolons. Stolons are runners or shoots, which take root at their tips and eventually develop into new plants.

Structural formation class (of vegetation)

Vegetation grouping based on attributes of the tallest layer e.g. growth form, crown separation and height.

Structured earths

See *Earths, structured*.

Subsoil

Soil layers below the surface with one of the following attributes:

- a larger content of clay, iron, aluminium, organic material (or several of these) than the surface and subsurface soil;
- stronger colours than those of the surface and subsurface soil above, or the *substrate* below. The B horizon.

- Substrate*** The material below the soil profile which may be the parent material or may be unlike the material from which the soil has formed; substrate which is not parent material for the soil above may be layers of older alluvium, rock strata unrelated to the soil or the buried surface of a former landscape.
- Subsurface soil*** Soil layers immediately under the surface soil which usually have less organic matter, paler colours and may have less clay than the surface soil. The A₂ horizon.
- Surface crust*** Distinct surface layer, often laminated, ranging in thickness from a few millimetres to a few tens of millimetres, which is hard and brittle when dry and cannot be readily separated from and lifted off the underlying soil material.
- Surface soil*** The soil layer extending from the soil surface down which has some organic matter accumulation and is darker in colour than the underlying soil layers. The A horizon.
- Terrace*** Any long, relatively level or gently sloping surface, generally narrower than a plain and bounded by a steeper ascending slope on one edge and a steeper descending slope on the other. Often associated along the margin and above the level of a body of water e.g. stream.
- Texture*** See *Soil texture*.
- Texture contrast soil*** A soil in which there is a sharp change in soil texture between the A and B horizons (surface and subsoil) over a distance of 10 cm or less. Also known as a duplex soil.
- Uniform clays*** See *Clays*.
- Volcanic rocks*** Igneous rocks which have cooled from magma extruded to the Earth's surface. The size of the rock crystals depends on its duration of cooling - rapid cooling forms very fine crystals or even volcanic glass.
- acid*** Contain 10% or more quartz and proportions of magnesium, iron and calcium. Usually light coloured.

- *basic* Basalt or basaltic rocks containing minimal or no quartz. Usually dark coloured because of a high proportion of iron and manganese minerals.

- *intermediate* Contain less than 10% quartz and mixed amounts of other minerals that are intermediate between the typical acid and basic igneous rocks.

Waterlogged

An area in which all the pores in the soil have filled with water. Excess water may lie on the surface of the soil. All the air in the pores has been displaced by water, so no oxygen is available to plant roots or for soil microbial activity. If waterlogging continues for a long period, plants die. Under waterlogged conditions, nitrate, the most available form of nitrogen, breaks down and is lost as a gas.

Workability

The ease or otherwise of working the soil with machinery.