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Land Resources Bulletin

SOILS AND LAND SUITABILITY OF THE MULGRAVE SECTION: BURDEKIN RIVER IRRIGATION AREA

PART B: DETAILED REPORT

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ABSTRACT

A high intensity soil survey (scale 1:25 000) and land evaluation were undertaken for the Mulgrave Section of the Burdekin River Irrigation Area (BRIA). The Mulgrave Section is situated on the Ayr side or left bank of the Burdekin River and comprises 8 580 ha.

This survey is the second in a series of high intensity surveys of the BRIA. The primary purpose of these surveys is to provide land resource and land suitability information to assist the Water Resources Commission with subdivision of land and design of irrigation farms.

The results of the survey are presented in two parts. A summary report, Part A, has been published. This report, Part B, provides more information on the physical resources and land use of the survey area. The resources are discussed in terms of climate, geology, hydrology, vegetation and soils.

Five landscape units were identified within the survey area. Seventy-six mapping units consisting of 64 soil types, nine variants and phases and three miscellaneous units were identified and mapped. The five landscape units and 64 soil types are described in detail. The 457 unique map areas (UMAs) are shown on the accompanying soil map.

Complete morphological and analytical data are presented for the 13 soil profiles which were sampled and analysed during the survey. Results of these analyses plus analyses from 10 profiles sampled from a previous survey, are used to discuss in detail the chemical and physical attributes of the major soil types of the survey area.

Land suitability was assessed for each UMA. The assessment considered furrow irrigation of sugar-cane, grain crops and small crops, low volume irrigation of mangoes and flood irrigation of rice. Maps showing the area of land suitability classes for these five crops, or crop groups, accompany this report. The total area suitable for sugar-cane is 6 277 ha, grain crops 5 154 ha, rice 5 426 ha, small crops 476 ha and mangoes 602 ha. Land suitable for all three of the crops or crop groups, sugar-cane, grain crops and rice totals 4 578 ha. A total of 1 893 ha is not suitable for any of the crops or crop groups considered because of extreme sodicity at shallow depths in the profile, excessive wetness, unacceptable flooding, severe erosion, complex soil distribution or excessive rock outcrop. The limitations affecting the suitability of the land for irrigation are discussed in detail.

Soil and land limitations and important management considerations are presented for groups of soil types with similar suitability classes and management requirements. The management of some of the soil types of this area for irrigated agriculture may be difficult. Adoption of appropriate irrigation techniques will be essential to ensure sustained economic production. Some guidelines for farm management are discussed.

Land degradation or crop loss may be caused by salinisation, flooding or erosion in susceptible areas. However, such risks can be reduced by the adoption of adequate protective measures. Guidelines for development of the area are discussed in detail.

1 INTRODUCTION

1.1 Background

The Mulgrave survey is the second in a series of high intensity (scale 1:25 000) soil surveys being undertaken in the Burdekin River Irrigation Area (BRIA) by the Queensland Department of Primary Industries (QDPI).

Previous information on some or all of the area of this survey include soil and land surveys by Skerman (1951), Hubble and Thompson (1953), Christian *et al.* (1953), Reid and Baker (1984) and Thompson *et al.* (1990). Soil and vegetation surveys which cover the area have been undertaken by Isbell and Murtha (1970), Van Wijk (1971) and Isbell and Murtha (1972). The scale of these reports varies from 1:100 000 to 1:1 000 000.

1.2 Purpose and extent of survey

The surveys of Reid and Baker (1984) and Thompson *et al.* (1990) provide information at 1:100 000 scale on the properties, distribution and general irrigation suitability of the various soils of the area. However, such surveys are considered too broad to provide the detailed information required to assist the Water Resources Commission (WRC) with subdivision of land and farm design for irrigation. The high intensity soil surveys of this series overcome the problem.

The information obtained during this survey will also assist :

- Landholders with their crop selection and management decisions. It will also provide data on soil fertility and information about limitations of their soils; and
- Extension and research staff with the soil and land use data essential for the most effective advice and research.

The Mulgrave section of the BRIA comprises 8 580 hectares on the left bank of the Burdekin River. It is located just south-west of the township of Clare, and 36 kms south-west of Ayr. A plan showing the location of the survey area is shown in Figure 1.2.1.

The results of the survey are presented in two parts. Part A (McClurg *et al.* 1988) presents a summary that will meet the immediate needs of most users. This report, Part B, provides more detail on the physical resources of the area, the morphological, chemical and physical attributes of the soils and land use implications.

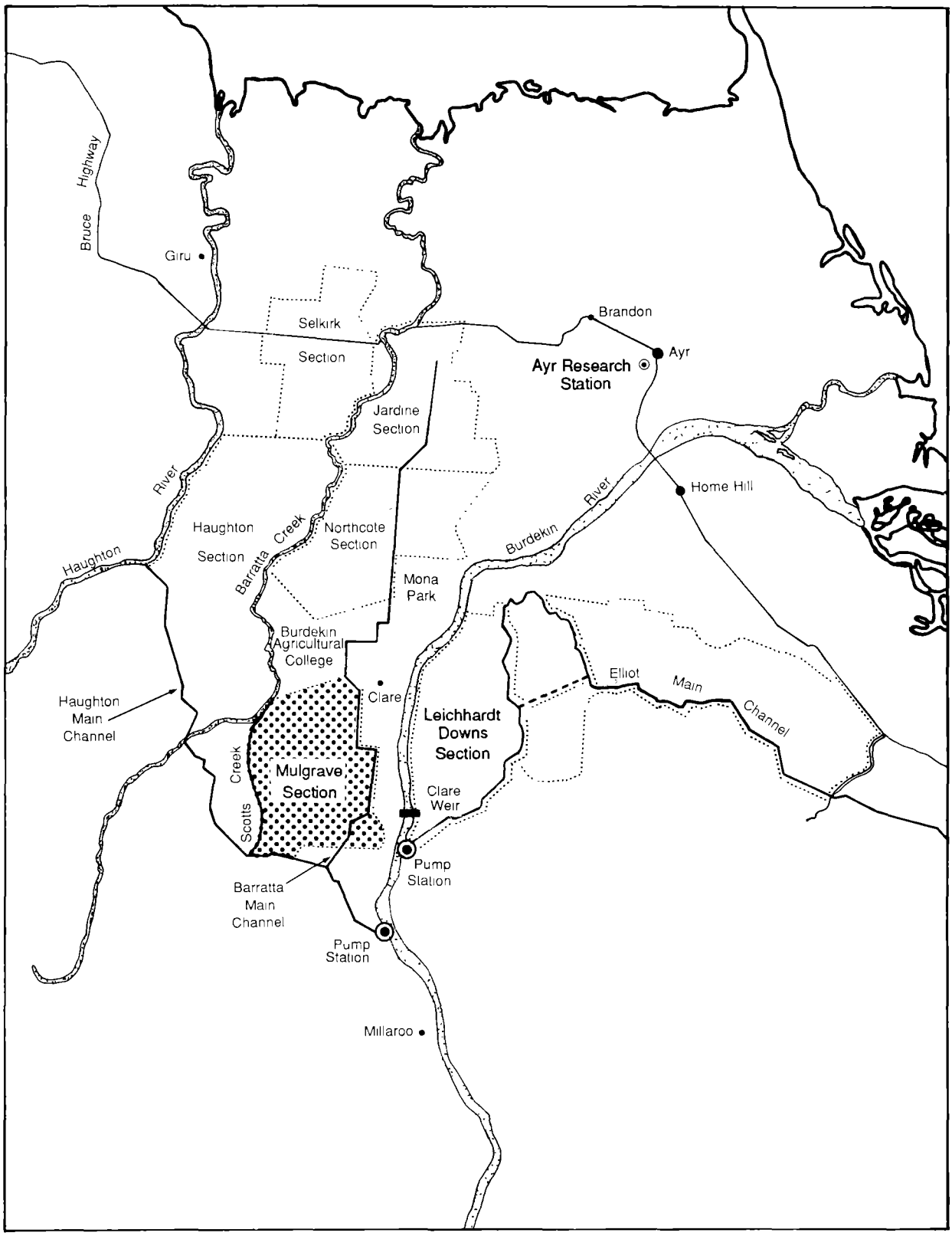

Figure 1.2.1. Locality plan, Mulgrave Section, BRIA.

2 PHYSICAL RESOURCES

2.1 Climate

The Mulgrave Section of the BRIA is located adjacent to the Leichhardt Downs Section. Hence, both sections will have similar climate. The climate of the Leichhardt Downs Section has been discussed in detail by Donnollan *et al.* (1990). The following discussion is a summary of that reported for the Leichhardt Downs Section.

The climate is described as warm and sub-humid with well defined wet and dry seasons. The average annual rainfall for the 35 years between 1952 and 1986 is 893 mm. Seventy-five percent of the total rainfall falls between December and March. Rainfall variability is high.

Average daily maximum temperatures for December are 32.5°C at Ayr and 34°C at Millaroo. Average daily minimum temperatures for July are 11.5°C at Ayr and 9.5°C at Millaroo. Frosts (screen temperatures <2°C) or heat waves (maximum screen temperatures >38°C) are rare. Two frosts have occurred in July at Ayr Research Station between 1965 and 1983, while at Millaroo 29 have occurred between June and August over the same period. The frequency of heat waves at Ayr is one every three years, while at Millaroo the frequency is 2.2 days per year. Most heat waves occur in December. Mean pan evaporation varies from 3 to 4 mm/day in July to 7 mm/day in November and December at both Ayr and Millaroo.

2.2 Geology, landscape units and geomorphology

2.2.1 Introduction

Information on the geology of the survey area can be obtained from the reports of Christian *et al.* (1953), Gregory (1969) and Paine (1972). The geomorphology of most of the area has been noted briefly in Christian *et al* (1953) and Hubble and Thompson (1953) and described in detail by Hopley (1970). Reid and Baker (1984) and Thompson *et al* (1990) have postulated the chronology and morphogenesis of the Lower Burdekin Valley.

2.2.2 Geology

The alluvial plain deposited by overbank events of the Burdekin River is generally very gently sloping and occupies 80% of the study area. These deposits have been mapped by Gregory (1969) as unit Cza - sand, silt, mud, gravel; semi-consolidated in places of the Cainozoic and Quaternary periods and Paine (1972) as unit Q - sand, silt, gravel and soil of the Quaternary period. Christian *et al.* (1953) describe the deposits as the Northcote land system - fine-textured older alluvia, flood plain and littoral deposits with some old streamlines.

In the south-east of the survey area, gently undulating rises of 10 to 15 m above the alluvial plain occur. Rock outcrops are common on the crests and upper slopes. The geology of this unit is described by Gregory (1969) as unit C-Pg and Paine (1972) as unit aCP - igneous intrusives of adamellite and granite with some minor granodiorite and fine-grained variants from the Upper Carboniferous to Lower Permian period. This unit has been described by Christian *et al.* (1953) as the Kilbogie land system - a wide range of intermediate Paleozoic rocks, Devonian volcanics and sediments, some Lower Bowen volcanics, eg. Andesites, and basic rocks of the granitoid complex.

A slight rise of 2 to 5 m above the alluvial plain occurs along the southern boundary and in the south-west of the survey area. This rise surrounds a low isolated ridge with frequent rock outcrops. It is mainly a complex of acid volcanic rocks and pediments.

A small area of the Clare land system (Christian *et al* 1953) extends into the north-east corner of the survey area and borders the northern and eastern boundaries. The Clare land system is described as bands of levee sediments of the older alluvia adjacent to the major streams.

The Millaroo fault (Gregory 1969) extends into the south of the survey area. Gladys Lagoon, which is a long, narrow, permanent swamp located on the southern boundary at AMG 519600 E, 7801800 N, follows part of the line of the fault.

2.2.3 Landscape units

Thompson (1977), Reid and Baker (1984) and Thompson *et al.* (1990) identified seven topographic forms within the Lower Burdekin Valley. As noted by Donnollan *et al.* (1986) the term landscape unit replaces topographic form and the definitions have been modified slightly to agree with the terminology of McDonald *et al.* (1984).

Five of the landscape units have been identified within the study area:

- Landscape unit 1: Local alluvial plains and associated pediments;
- Landscape unit 2: Burdekin River alluvial plain;
- Landscape unit 4: Gently undulating rises on acid intrusive rocks, pediments and prior streams;
- Landscape unit 5: Gently undulating rises on an intrusive rock complex; and
- Landscape unit 6: Miscellaneous alluvial landforms.

Landscape Unit 1. The local alluvial plains and associated pediments comprise fine-textured sediments located below the gently undulating rises. These sediments are confined to the south-east of this survey area. Occasionally they form drainage depressions within the gently undulating rises. Slopes are generally less than 0.5%. Similar sediments have been extensively mapped on the Right Bank of the Burdekin River (Thompson 1977; Donnollan *et al.* 1986). The sediments were derived from the weathering and erosion of the adjacent hills during the Pleistocene interglacial period (Hopley 1970).

Landscape Unit 2. The Burdekin River alluvial plain consists of fine-textured sediments deposited by overbank events of the Burdekin River. The sediments form a level plain (<0.5% slope) with very poor surface drainage. Most of the alluvial plain is subject to frequent wet-season waterlogging and flooding from both local run-off and overbank events of either Scotts/Barratta Creek or the Burdekin River. Hopley (1970) considers the sediments to have been deposited during the late Pleistocene and Holocene periods.

The sediments are relatively thin (1 to 3 m) and overlie a complex pattern of flood plain deposits and highly incised, sandy channel infills. Depth to bedrock varies from 5 to 27 m. The Burdekin River alluvial plain has also been known as the Burdekin River flood plain.

Landscape Unit 4. Gently undulating rises on acid intrusive rocks, pediments and prior streams occur in the south-west of the survey area and along the southern boundary. The pediments dominate the landscape unit within this survey area. No defined prior streams are evident. Slopes are usually greater than 1% and often greater than 2% and rock outcrops and stone or cobble cover are common. Within the pediments, a low isolated crest and assoicated simple slope occurs.

These rises appear to be an extension of the outwash fans from Mt Dalrymple some five kilometres to the south. Gregory (1969) considers these outwash fans to have been deposited during a wetter climate, probably the Pleistocene. Thompson *et al.* (1990) however, suggest that similar deposits to the south of this survey area were laid down during the more arid climates of the late Pleistocene which were conducive to erosion and incision.

Landscape Unit 5. This landscape unit occurs as the small outcrop of geological units C-Pg and aCP in the south-east of the survey area which has been described previously.

Landscape Unit 6. The miscellaneous alluvial landforms have been subdivided on the source of the alluvium:

. Landscape Unit 6 (A): Relict alluvial landforms; and
. Landscape Unit 6 (B): Scotts/Barratta Creek alluvial landforms.

Landscape Unit 6 (A). The relict alluvial landforms comprise medium-textured deposits almost exclusively associated with Gladys Lagoon. These deposits extend for 9 kilometres to the north-west from the end of the Lagoon and are 550 m wide at the widest point. They are often 1 to 2 m higher than the surrounding Burdekin River alluvial plain. Long, narrow units of the Burdekin River alluvial plain with buried coarse material in the soil profile before 1.5 m link the relict deposits with the present course of Barratta Creek. These units usually support vegetation more typical of the relict alluvium than the Burdekin River alluvial plain.

Two flood-outs occur within the relict alluvium. The first occurs some 2.5 kilometres from the end of Gladys Lagoon at AMG 518000 E, 7804000 N. It continues to the north-east for 1.5 kilometres. An area of Burdekin River alluvial plain overlying sand at 1.0 m is found at its end. The second flood-out occurs at AMG 517400 E, 7804200 N and

continues to the north-west for 3.5 kilometres. It can then be traced north almost to the survey boundary as a series of long, narrow units of the alluvial plain with buried coarse material in the soil profile before 1.5 m. These units support vegetation more typical of the relict alluvium than the Burdekin River alluvial plain.

Landscape Unit 6 (B). The Scotts/Barratta Creek alluvial landforms comprise medium to coarse textured sediments associated with the recent deposits of Scotts/Barratta Creek.

The largest occurrence of these deposits is in the south-west of the survey area with further scattered occurrences along the western boundary. Most of this area is subject to frequent overbank flooding.

2.2.4 Geomorphology

The discussion on geomorphology of the study area will be confined to the areas of landscape units 2 and 6 which are both of alluvial origin. These two landscape units occupy over 90% of the area. Comments on the origin of the other three landscape units can be found in section 2.2.3. The relationship between the surface features and subsurface layers and bedrock contours is also discussed.

Landscape Unit 2. Hopely (1970), Reid and Baker (1984) and Thompson *et al.* (1990) suggest the Burdekin River alluvial plain deposits are amongst the youngest in the Lower Burdekin Valley. Observations during this survey support this theory. The lower edges of the rises associated with landscape units 4 and 5 and the margins of the relict alluvial landforms have been buried by these alluvial plain deposits.

Most of the alluvia has been deposited since the Burdekin River diverted to its present course (Hopley 1970, Reid and Baker 1984). This diversion has been suggested by Hopley (1970) as just prior to the maximum Holocene transgression. However, the timing and height of this Holocene sea level is uncertain. Reid and Baker (1984) suggest maximum levels from 3 to 4 m above to slightly above current sea level at times from 7 000 to 4 000 years before present and tentatively conclude the diversion of the river occurred between 7 000 and 4 500 years before present.

Landscape Unit 6 (A). Hopley (1970) and Reid and Baker (1984) recognise Gladys Lagoon as the oldest identifiable abandoned channel of the Burdekin River. Reid and Baker (1984) suggest the late Pleistocene interglacial high sea level as the probable age of this channel and associated deposits. It seems generally accepted that this occurred 125 000 years ago when sea levels were approximately 6 m above current levels.

Landscape Unit 6 (B). This landscape unit subdivision comprises the recent alluvia associated with Scotts/Barratta Creek. Observations during this survey indicate these deposits have buried the lower edges of the rises associated with landscape unit 4.

Bedrock contours and subsurface layers. Bedrock contours have been broadly interpreted by Evans (1987) from deep cores and are shown in Figure 2.2.1. Two deeply incised, inter-connecting channels heading north to north-west have been buried by the alluvia in the northern half of the survey area (bores 11910849, 11910853, 11910851 and 12001034). These channels are interpreted as a very old channels of the Burdekin River and have a bed level below 0 m EL. AHD (mean sea level) which is 23 to 29 m below ground level.

Two small but steep rises are also buried by the alluvia. One is located in the north-west of the survey area (bores 11910850 and 11910175) where the bedrock rises to over 10 m EL. AHD or 19 m below ground level. The other rise crosses the eastern survey boundary near the electricity substation (bores 12000181, 12000179, 12001038, 12001036). The bedrock rises to over 25 m EL. AHD or 4 m below ground level, 1 kilometre east of the substation.

Schematic cross sections have also been drawn by Evans (1987). Figure 2.2.2 is an east to west cross section (A to B on the bedrock contour map) and Figure 2.2.3 is a north to south cross section (E to F on the bedrock contour map). Generally, the surface deposits are relatively thin with 1 to 3 metrers of heavy clay overlying slowly permeable brown sandy clay deposits and highly incised channel infills. These brown clay deposits vary in thickness from 4 to 12 m and may represent a relict flood plain of the Burdekin River.

The major feature of Figure 2.2.2 is the incised channel located near bore 12001034, which has stratified gravels and coarse sands from 8.5 metres to 26.7 metres below ground level overlying weathered granodiorite. The other features of this cross section are the channel infill deposits in bore 11910856 (3.7 to 8.6 m below ground level). These indurated sand layers have been cemented by carbonate and although do not appear to be consistent in aerial extent and depth over the whole area, may be of local significance. The origin of these layers is probably related to groundwater movement.

Figure 2.2.3 is more complicated than Figure 2.2.2 but shows a consistent brown sandy clay layer with scattered infills of indurated sand from 1 m below ground level. *The existence of such sandy infills at shallow depths may have a pronounced effect on subsurface drainage and water tables, particularly under flood irrigation of rice.*

The surface features of this area bear no relation to the subsurface layers or bedrock contours. Generally, the older surfaces have been buried by the alluvia. The alluvial plain has a relative relief of 10 metres from north to south in this survey area (approximately 8 kilometres). The bedrock has a relative relief of 15 to 22 m.

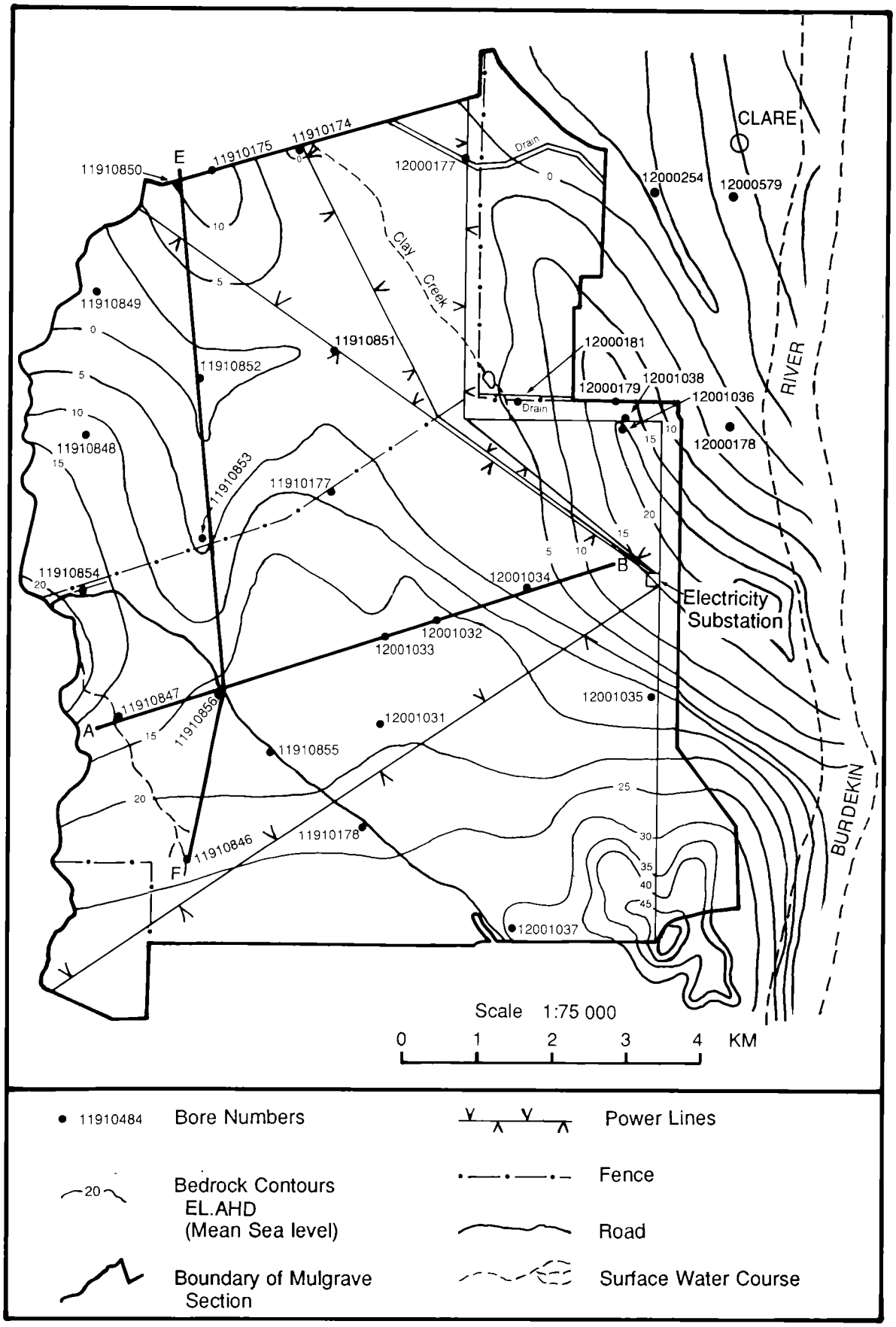

Figure 2.2.1. Bedrock contours, Mulgrave Section, BRIA. **(Source: Evans 1987).**

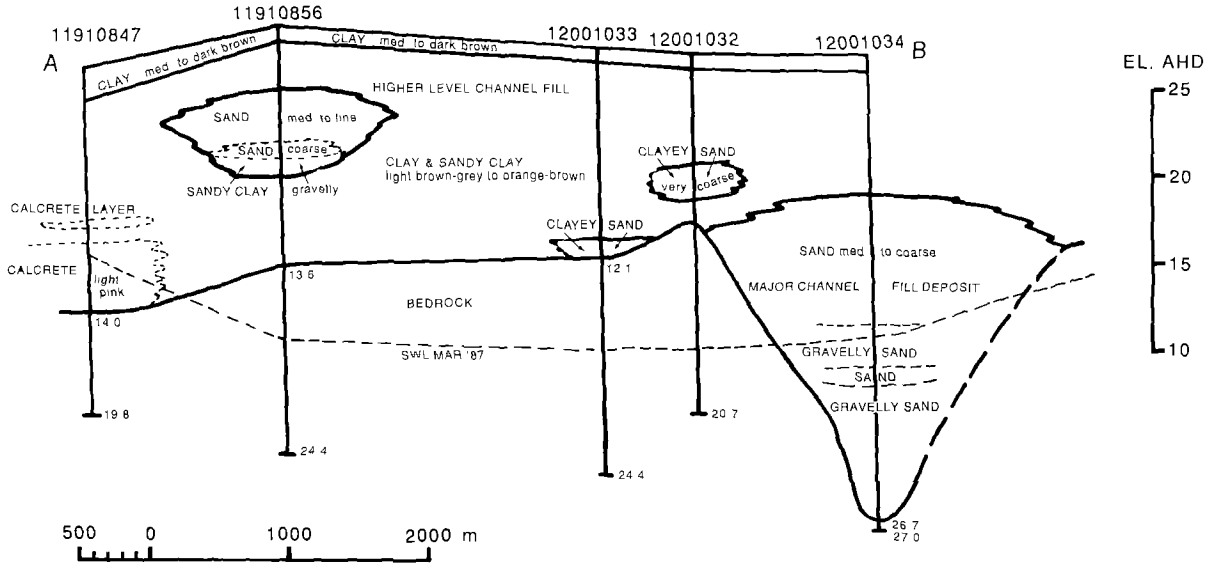

Figure 2.2.2. East-west cross section, Mulgrave Section, BRIA. **(Source: Evans 1987).**

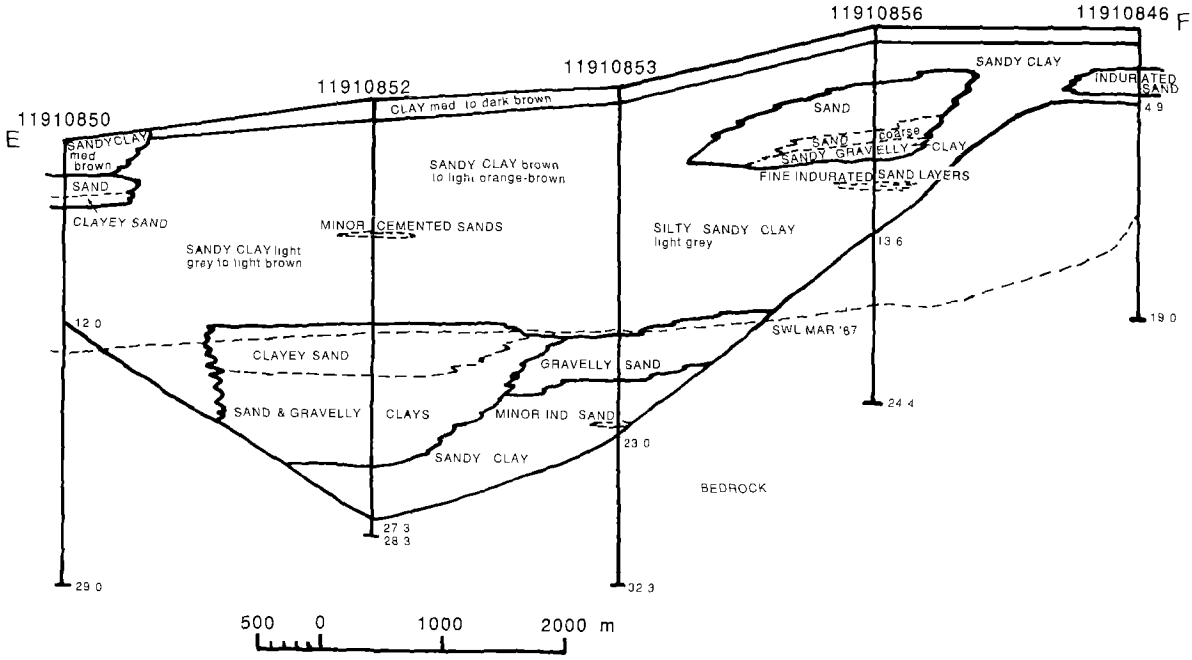

Figure 2.2.3. North-south cross section, Mulgrave Section, BRIA. **(Source: Evans 1987).**

2.3 Hydrology

2.3.1 Surface hydrology

Surface drainage. The well developed levee of the Burdekin River, to the east of the survey area, prevents local drainage from entering the river. Scotts/Barratta Creek provides local drainage to the west of the area of landscape unit 6 (A). Clay Creek in the north (see Fig. 2.2.1) drains the remainder of the survey area.

The upland area of landscape unit 5 in the south-east of the survey area is drained by broad depressions. These depressions discharge onto very broad low lying areas of the Burdekin River alluvial plain, which eventually drain north into Clay Creek.

The generally uniform slope of the area of landscape unit 4 precludes well-developed drainage lines. Drainage waters flow down the slope and onto the low lying areas of the Burdekin River alluvial plain. The well developed levee of Scotts/Barratta Creek in the vicinity of this area prevents any drainage water from directly entering Barratta creek.

Because the natural drainage system over most of the area is so poorly developed, an extensive network of drains will be an essential part of any irrigation development.

A well developed drainage line is actively eroding south-west from Barratta creek to link up with the area of landscape unit 4 (AMG 515500 E, 7803500 N). A second drainage line is actively eroding in the north-east of the survey area joining Barratta creek and the Burdekin River alluvial plain (AMG 516300 E, 7812000 N). *Both eroded areas need to be stabilised and fully rehabilitated during the development of the area to prevent further progression of eroding gully heads.*

Flooding. The area to the west of landscape unit 6 (A) will be subject to flooding from Scotts/Barratta creek. Reid and Baker (1984) suggest that the frequency of significant flooding in the Barratta Creek system is every 3 to 5 years.

During floods the outflow from Clay Creek is restricted by the height of the flow in Barratta Creek. This leads to local drainage being backed up and flooding in the low lying areas of the Burdekin River alluvial plain.

Much of the rest of the survey area is subject to inundation from either local run-off or overbank events from the Burdekin River. The Burdekin Project Assesssment Committee (1977) estimates that the Burdekin River breaks its banks and Gladys Lagoon becomes a major distributory channel when the discharge at Clare reaches 29 000 cumecs. It is estimated that the return period of this flow is 1 in 12 years. The peak discharge of the record Burdekin floods of 1940, 1946 and 1958 have been estimated at 38 000 cumecs, with a return period of 1 in 25 years.

Duration of flooding is dependent on duration of rainfall events and stream overbank flow. It is unlikely that major flooding would persist for longer than five days and flow rates would probably be slow (Reid and Baker 1984).

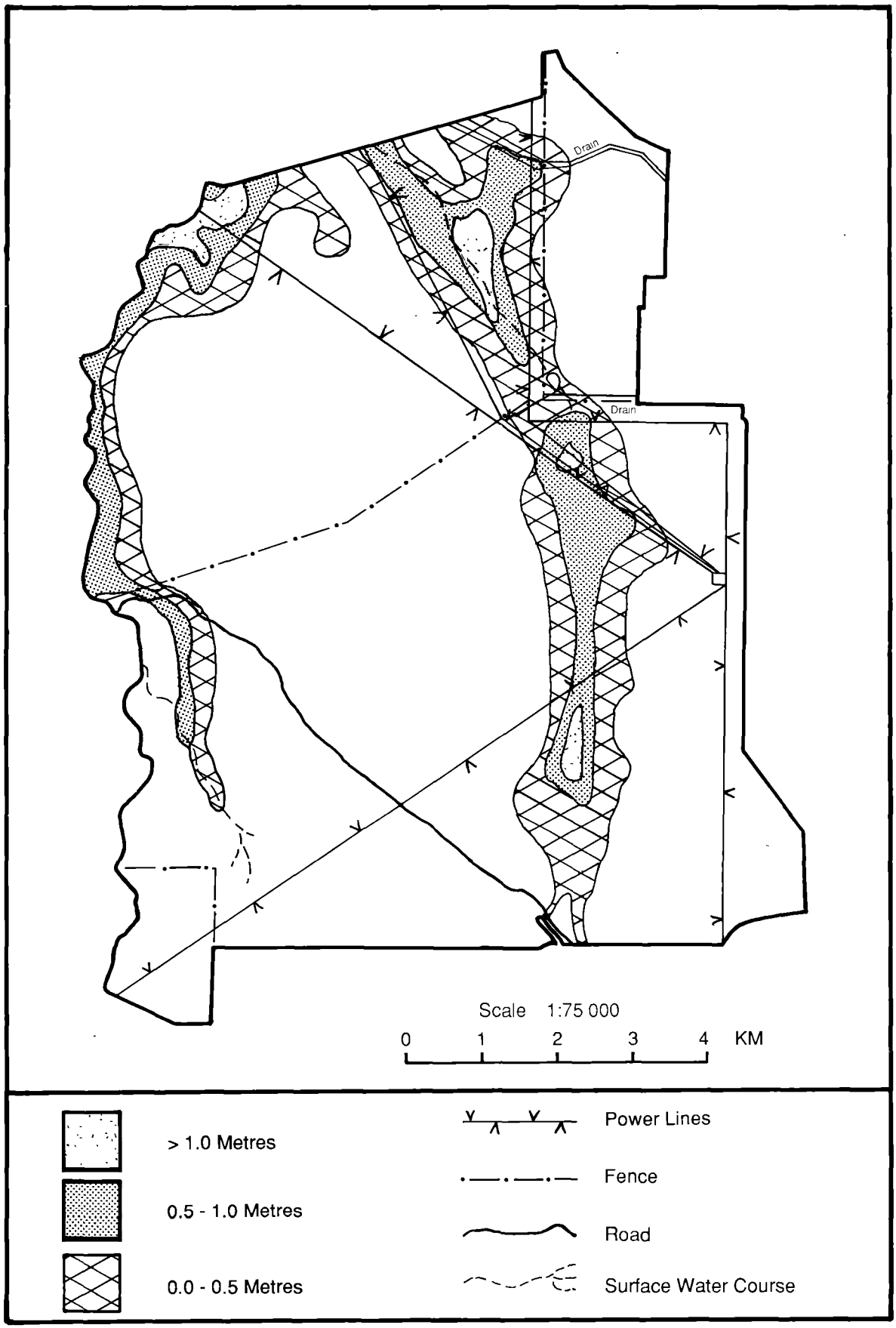

Figure 2.3.1. Depth of inundation in a 1 in 10 year flood event, pre-development, Mulgrave Section, BRIA. **(Source: Water Resources Commission).**

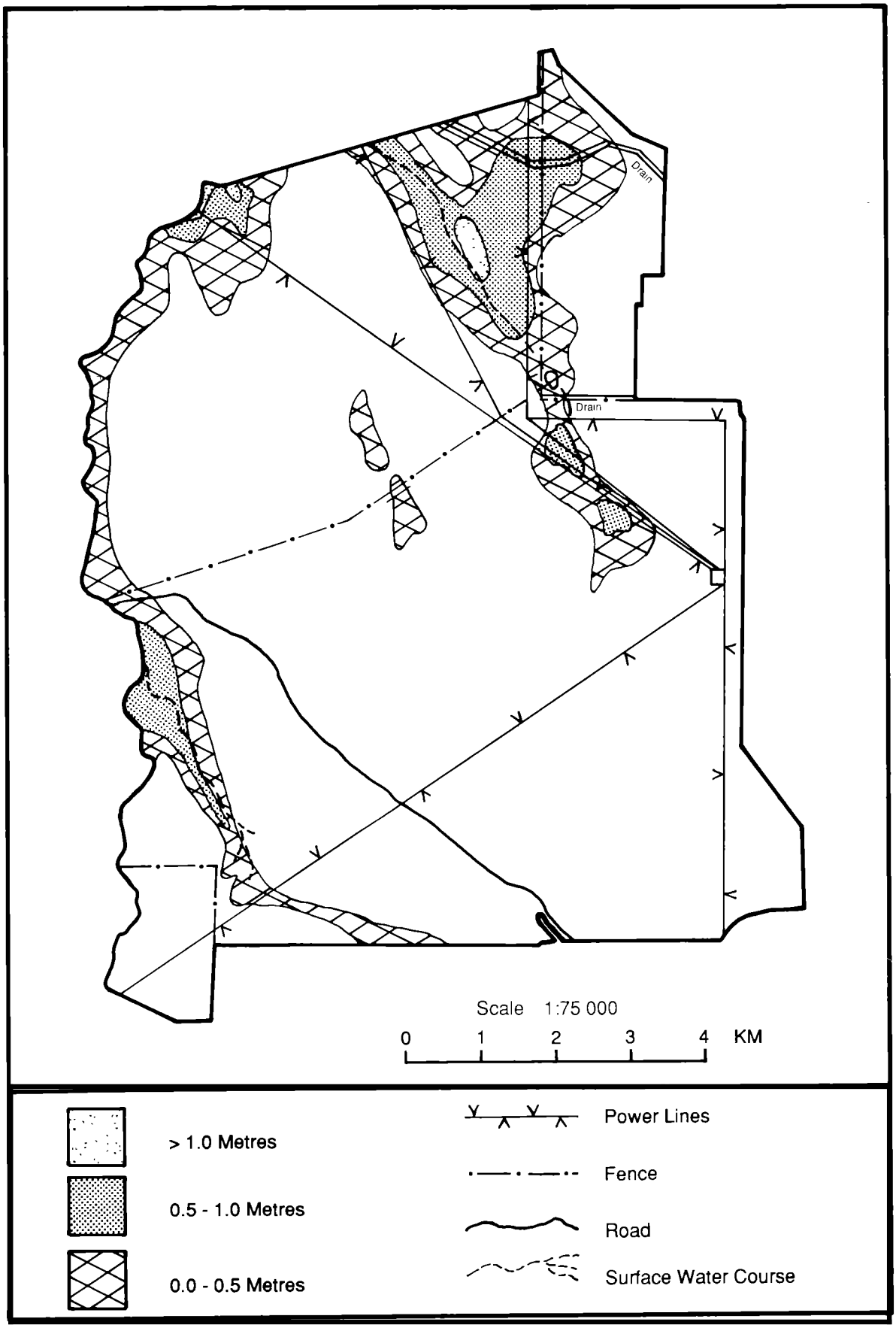

Figure 2.3.2. Depth of inundation in a 1 in 10 year flood event, post development, Mulgrave Section, BRIA. **(Source: Water Resources Commission).**

A flood model has been developed by WRC personnel to estminate the extent of local flooding in the Burdekin River Irrigation Area. Inundation maps for the Mulgrave Section have been prepared using the flood model. The depth of inundation of a simulated 1 in 10 year flood before any development has taken place is shown in Figure 2.3.1. Approximately 1 970 ha is inundated mostly in a broad strip extending north from Gladys Lagoon and along Scotts/Barratta creek. Figure 2.3.2 shows the same simulated flood after the area has been fully developed. The effect of development has been to remove the floodwater from adjacent to Gladys Lagoon. However, minimal impact has been achieved in the north-east of the survey area.

A number of flood recorders located within the survey area have been installed by WRC since 1977. Flood heights in March 1988, April 1989, April 1990 and January and February 1991 caused by overbank events of Scotts/Barratta Creek and local run-off have been recorded. The depths of inundation were 0.5 to 0.7 m near Gladys Lagoon and 0.8 to 1.7 m in the north of the survey area.

A gauging station approximately 11 kms north of the survey area on Barratta Creek has been installed by WRC personnel. Fourteen overbank events have been recorded in the 16 year period from 1975 to 1991. The highest discharge during this period was in February 1991, which was estimated at 610 cumecs. Recorded flood velocities are slow, with maximum values around 0.8 ms^{-1}.

2.3.2 Subsurface hydrology

Groundwater levels found by Evans (1987) vary from 10 to 15 m below the surface of the survey area. The water quality is very poor, with conductivities ranging from 1.3 to 11.4 dSm^{-1}. He concluded that irrigation supplies of useable quality probably could not be located beneath the Mulgrave Section.

Large areas of strongly sodic soil types of the Burdekin River alluvial plain (soil types 2Ddb[1] and 2Dba) occur adjacent to the area of landscape unit 6A. This is especially evident near Gladys Lagoon and at the end of the first flood-out (AMG 518500 E 7806000 N). Reid and Baker (1984) suggest the location of such soil types raises the possibility that groundwater movement from the higher relict levee areas with more permeable soils has caused salinisation in the adjacent areas of the Burdekin River alluvial plain. If this is so, secondary salinisation of these landscape positions may occur under irrigation. This possibility cannot be ignored. *Detailed investigations need to be undertaken to determine the likely effect of increased water additions from irrigation upon groundwater movements in such landscape positions.*

Thompson (1977, 1980), Gardner and Coughlan (1982), Shaw (1982), and Donnollan *et al.* (1990) have described the potential for secondary salinisation of areas of landscape unit 5 on the right bank of the Burdekin River. The area of landscape unit 5 in the south-east of this survey area is expected to have similar potential for secondary salinisation.

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[1]See section 3.3

Shaw (1988) calculated that the water table would be expected to rise at a rate of 750 mm/year on the left bank of the river, assuming 30 000 ha of irrigation. This could lead to problems with surface salting and soil waterlogging after 12 years. However, the problems could be significantly reduced with conjunctive groundwater use of less than 20% of the irrigation water allocation per irrigated hectare.

2.4 Vegetation

2.4.1 Introduction

The study area is within the areas covered by Isbell and Murtha (1972) and Reid and Baker (1984) who described the general relationships between vegetation and soils. The most common structural formation (Walker and Hopkins 1984) and species composition occuring on each soil type are included in Table 4.1.1. Common and botanical names of the species found within the survey area are given in Appendix I.

2.4.2 Structural formation

The most common structural formation occuring throughout the area is low to mid-high open woodland. Other structural formations found in the area include low to tall woodland, mid-high to tall open forest, isolated tall trees, low to tall shrubland and very tall tussock grassland.

Low to mid-high open woodland to woodland is found on most of the cracking clays and solodic solodized-solonetz within the survey area. The exceptions are soil types 2Ugf* which has low to mid-high open woodland to open forest, and 2Ugh, 5Uga,c and d which have isolated trees to low to mid-high open woodland to tussock grassland. Low to tall open to sparse shrubland is common on the more sodic soils.

Generally, the tallest and most dense trees found in the survey area occur on the uniform sands, podzolic soils and red-brown earths of landscape units 4 and 6. The structural formation on these soils ranges from mid-high to tall open woodland to tall open forest.

2.4.3 Species Composition

Poplar gum, cabbage gum and carbeen are the most common species of the survey area, occuring on all landscape units. Beefwood grows on all solodic-solodized solonetz and occasionally on soil type 2Uge. Broad leaf tea-tree occurs on the cracking clays, especially in wetter areas. False sandalwood may be found on the strongly sodic soils.

* See section 3.3

The tree species composition found on landscape units 4, 5 and 6 is usually indicative of the landscape unit. Poplar gum, cabbage gum, carbeen, grey ironbark, grey bloodwood, cocky apple and quinine bush are found on landscape unit 4. On the poorly drained areas broad leaf tea-tree is common. Pandanus may be present on soil types with sandy A horizons.

Grey ironbark, red and grey bloodwood, poplar gum, carbeen and cabbage gum are found on landscape unit 5. Carbeen, cabbage gum, poplar gum, red and grey bloodwood and cocky apple are common on soil types of landscape unit 6 while Burdekin plum, dead finish, chinee apple and whitewood are less common.

Blue grasses and black spear grass are the most commonly occuring grasses in the survey area. Cane grass is usually found on all cracking clays with A horizon textures of medium to heavy clay. Purple top Rhodes grass and button grass are usually found on strongly sodic soil types of all landscape units. Giant spear grass or brown sorghum usually occurs on soil types with sandy A horizons. Other grass species occuring within the survey area include kangaroo grass, golden beard grass and red natal grass.

Para grass grows in many wet depressions. Rubber vine, Jerusalem Thorn and Prickly acacia have invaded some areas, particularly creek lines and where the natural vegetation has been cleared. Sedges are common in wetter areas on a seasonal basis.

3 SOIL SURVEY METHOD

3.1 Introduction

The basis for classifying soils in this survey were the soil types defined during the Leichhardt Downs survey (Donnollan *et al.* 1990). Thirteen soil types were identified in this survey area that were not defined by Donnollan *et al.* (1990). These soil types were based on the soil profile classes of Thompson and Reid (1982).

3.2 Survey procedures

Full rectified colour aerial photographs at a scale of 1:10 000 were used in the field to assist in location of soil boundaries. WRC surveyors took levels on the basis of a 250 x 100 m grid and these established lines were used to assist in precise location of field mapping sites. For convenience, mapping sites were generally located along these lines, with sites located between the lines when dictated by soil distribution. A description of the soil profile and information on vegetation, surface characteristics, gilgai and slope where necessary were recorded at each mapping site using the terminology and codes of McDonald *et al.* (1984).

The soil profile descriptions at each mapping site were compared to the established soil type descriptions of Donnollan *et al.* (1990) or soil profile classes of Thompson and Reid (1982). Modifications, where necessary, were made to the existing descriptions to account for the additional variability found with the greater density of ground observations or to minimise the overlap between soil types.

Mapping site intensity varied with the complexity of the landscape. The intensity was lowest in areas of cracking clay and highest in areas of landscape unit 6. A total of 1 502 mapping sites were described and stored on computer in a mapping site data file. This approximates to a site intensity of one site per 6 hectares. The AMG co-ordinates were determined for each mapping site and added to the mapping site data file. Many less detailed observations were noted and used to define soil boundaries.

3.3 Soil types

The nomenclature used during this survey was consistent with that used by Thompson (1977), Thompson and Reid (1982), Reid and Baker (1984), Donnollan *et al.* (1990) and Thompson *et al* (1990). Each soil type was identified by an alphanumeric code: a number for the landscape unit, the appropriate subdivision of the primary profile form (Northcote 1979), and a letter to separate each soil type within that landscape unit and primary profile form subdivision. For example, for soil type 2Ugd, "2" denotes Landscape Unit 2 (Burdekin River alluvial plain), "Ug" indicates a subdivision of the primary profile form (cracking clay) and "d" separates this soil type from other cracking clays of the Burdekin River alluvial plain. This last subdivision is usually on the basis of important soil properties for irrigated crop management or growth. However, some soil types are distinguised purely on morphological characteristics.

Appendix II gives the relationship between the soil nomenclature used during this survey and the earlier soil series nomenclature of Hubble and Thompson (1953). Some of the soil series names are locally used for groups of soils within the same landscape unit that have similar morphology. For example, "Dowie soil" refers to solodic-solodized solonetz soils of landscape unit 2 with shallow A horizons (<0.12 m) and strongly alkaline pH by 0.3 m (soil types 2Dba and 2Ddb).

One new soil type (2Ugk) was established to accommodate soil profiles which had morphological characteristics different to any existing soil type or soil profile class and collectively occupied areas mappable at 1:25 000 scale.

Variants were used to distinguish profiles which were similar to an existing soil type in most respects but differed in one or more soil properties which have important land use significance. A number after the soil type symbol distinguishes each variant and these are defined in the map legend.

3.4 Mapping units

During the mapping phase, each soil profile described was assigned to a soil type or variant. This information was stored in the mapping site data file. After undertaking boundary checking, soil boundaries were marked on the aerial photographs in the field. Two types of mapping units were used. A simple mapping unit was used when the dominant soil type occupied 70% or more of an area, while a compound mapping unit defined areas in which the dominant soil type occupied less than 70%. A simple mapping unit was identified by the code of the dominant soil type and the compound unit by the codes for the two most commonly occurring soil types, with the one occupying the greatest area being named first.

Those areas in which land use or management is affected by certain land attributes not normally associated with the mapping unit were identified as phases. A capital letter after the soil type symbols distinguishes the phases and these are defined in the map legend.

Each occurrence of a mapping unit was named a unique map area or UMA (after Basinski 1978) and given a number. Information for each UMA, including the dominant and/or co-dominant soil type with variant or phase, if appropriate, and minor soil types were stored on computer in a UMA data file. The UMA name and number relevant to each mapping site description were added to the mapping site data file.

The UMA boundaries, numbers and names were copied from the aerial photographs on to a 1:10 000 plan and used as part of the base information for the subdivision of irrigation farms. A 1:25 000 soils map that accompanies this report was produced by computer assisted drafting techniques after first digitising the boundary of each UMA directly from the rectified aerial photographs. The area and centroid located with A.M.G. reference of each UMA were generated by computer. Both were added to the UMA data file.

The area and frequency of occurrence of each mapping unit in the Mulgrave Section of the BRIA is presented in Table 3.4.1.

Table 3.4.1 The area and frequency of occurrence of mapping units, Mulgrave Section, BRIA.

Mapping Unit	Area (ha)	Frequency
1Dda	11.8	1
1Dyb	1.9	1
1Dyc3	9.8	2
Total	**11.7**	**3**
1Uga	43.3	2
1Uga1	18.9	1
1Ugf	48.8	5
Total	**111.0**	**8**
Total LU* 1	**134.5**	**12**
2Dba	255.0	15
2Dba2	9.6	1
2DbaE	2.0	1
2Dbb	64.2	6
2Dbb2	18.7	2
2DbbE	0.7	1
2Dbc	3.9	3
2Dbd	31.5	7
2Dbd2	8.1	1
2Dbe	48.4	6
Total	**442.1**	**43**
2Dda	9.7	2
2Ddb	316.4	26
2Ddb2	9.4	1
2Ddb3	5.1	1
2Ddc	30.6	2
Total	**371.2**	**32**
2Dya	544.4	38
2Dya2	48.6	2
2Dya3	17.8	1
2DyaE	13.6	3
2Dyb	807.3	33
2Dyb2	6.1	2
2DybE	3.4	1
2Dyc	57.6	7
2Dyc2	27.9	2
2DycE	0.8	1
Total	**1 527.5**	**90**
2P	15.4	2

Mapping Unit	Area (ha)	Frequency
2Ugc	194.1	7
2UgcW	12.1	2
2Ugd	335.0	14
2Ugd1	15.6	1
2Ugd2	63.6	2
2Uge	1 205.3	29
2Uge2	55.0	6
2Ugf	59.9	3
2Ugf2	3.1	1
2UgfW	164.1	2
2Ugg	537.0	27
2UggW	25.8	1
2Ugh	839.0	13
2Ugh7	10.5	3
2UghE	2.8	1
2Ugk	985.9	14
Total	**4 508.8**	**126**
Total LU 2	**6 865.0**	**293**
4Dga	22.7	2
4Dya3	2.7	1
4Dyd	13.5	2
4Dyd3	48.1	3
4DydE	0.7	1
4Dye	1.2	1
4Dyg	106.5	2
4DygE	29.0	1
4Dyh	16.8	1
4Dyk	22.5	1
Total	**263.7**	**15**
4Gna2	1.0	1
4R	0.1	1
4Ucf	15.0	1
Total LU 4	**279.8**	**18**
5Dra	28.9	11
5Dra1	55.5	2
5DraR	32.4	1
Total	**116.8**	**14**

Table 3.4.1 (Continued)

Mapping Unit	Area (ha)	Frequency
5Dya	17.2	1
5Dya1	6.2	1
5Dyb	22.5	4
5Dyc	230.3	3
5DycE	0.7	2
5Dyd	5.2	2
5Dye	9.0	2
Total	**291.1**	**15**
5R	3.6	1
5Uga	5.4	2
5Ugc	18.7	2
Total	**24.1**	**4**
Total LU 5	**435.6**	**34**
6Dba	16.7	2
6Dba2	3.3	1
6Dbb	21.9	1
6Dbe	17.1	2
6Dbh	185.5	11
6Dbh7	1.7	1
Total	**246.2**	**18**
6Dda	72.0	8
6Drb	13.7	3
6Drc	131.8	7
Total	**145.5**	**10**
6Dya5	3.5	1
6Dyb2	9.8	2
6Dyc	2.4	1
6Dyd	0.4	1
6Dyf	126.0	6
6Dyf2	19.4	2
6DyfE	2.6	1
6Dyg	26.9	7
6Dyg2	19.2	1
6Dyg3	3.2	1
6DygE	2.7	1
6Dyh	61.2	2
6Dyj	18.9	2
6Dyj2	1.7	1
6DyjE	3.0	1
Total	**300.9**	**30**
6Gnd	5.7	1
6Gne	8.3	3
6Gne3	1.2	1
Total	**15.2**	**5**
6Uca	4.5	2
6UccC	2.9	1
Total	**7.4**	**3**
6Uga	16.0	6
6Uga2	2.1	1
6UgaC	4.4	1
6Ugc	16.1	2
Total	**38.6**	**10**
6Umb2	39.3	2
Total LU 6	**865.1**	**86**
Total	**8 580.0**	**457**

* Landscape unit

4 SOILS - MORPHOLOGY

4.1 Introduction

A brief description of the morphology of each of the 64 soil types identified within this survey area appears in Table 4.1.1. The major distinguishing attributes as well as the landscape unit, landform element and predominant natural vegetation of each soil type as found in the Mulgrave Section are given in this table. The detailed descriptions of the full range of morphological attributes of these soil types within the Lower Burdekin Valley is given in Appendix IV. It should be noted that the full range of morphological attributes of any soil type may not necessarily occur in this area.

A general description of the soil types of each landscape unit identified within the Mulgrave Section is given below.

4.2 Soils of landscape unit 1 (Local alluvial plains and associated pediments)

Cracking clays (1Uga and f) occupy broad drainage depressions and low lying flats adjacent to landscape unit 5 and in one locality landscape unit 4. These soils are seasonally waterlogged and subject to local flooding because of their landscape position.

Solodic-solodized solonetz (1Dyb, 1Dyc3 and 1Dda) are found on pediments and slightly elevated flats adjacent to landscape unit 5 and in one locality landscape unit 4. All have shallow A horizons (<0.15 m) over grey, dark or yellow-brown B horizons. Most are strongly alkaline (pH > 8.5) at 0.3 to 0.9 m.

4.3 Soils of landscape unit 2 (Burdekin River alluvial plain)

Grey clays (2Ugc,d,e,f,g,h and k) and a solodic-solodized solonetz (2Dyc) occupy low lying flats and broad drainage depressions which are subject to seasonal waterlogging and flooding in most localities. Surface texture, self mulching characteristics and depth at which pH becomes strongly alkaline are used to separate these clays. Soil types 2Ugc,d and e have light to light-medium clay surfaces that either set hard or have weak self mulching characteristics. However, soil types 2Ugf,g,h and k have medium to heavy clay surfaces usually with moderate to strong self mulching characteristics.

Solodic-solodized solonetz (2Dba,b,c,d,e,2Dya,b,2Dda and b) occur on slightly elevated flats. All have grey, dark or brown upper B horizons of strong consistence and coarse macro-structure. The depth of the A horizon and at which pH becomes strongly alkaline are used to separate these soils. Soil types 2Dba and 2Ddb have shallow (<0.12 m) A horizons and are strongly alkaline at 0.3 m. Other soil types have varying depths of A horizons from <0.12 m to 0.2-0.35 m and most are strongly alkaline at 0.6 to 0.9 m.

4.4 Soils of landscape unit 4 (Gently undulating rises on acid intrusive rocks, pediments and prior streams)

The pediments of this landscape unit are occupied by solodic-solodized solonetz and soloth soils (4Dya,d,e,g,h and k), a gleyed podzolic soil (4Dga) and a sand with yellow earth affinities (4Gna). All have coarse to medium textured A horizons and grey to yellow-grey or yellow-brown B horizons usually with prominent red or brown mottles. Decomposing rock may be present below 0.75 m. The soloth and podzolic soil types usually have deeper A horizons than the solodic-solodized solonetz soil types.

The low isolated crest and associated simple slope is occupied by a sedentary sand (4Ucf). Decomposing rock is present below 0.3 to 1.1 m.

4.5 Soils of landscape unit 5 (Gently undulating rises on an intrusive rock complex)

All soil types are sedentary with depth to C horizon varying from 0.5 to 1.5 m. A non-calcic brown soil (5Dra) and a yellow equivalent of a non-calcic brown soil (5Dya) occupy the crests, upper and mid slopes. The mid to lower slopes are occupied by a yellow duplex soil (5Dyb) and a cracking clay complex with linear gilgai (5Ugc and d). Solodic-solodized solonetz (5Dyc, 5Dyd) are found on the lower slopes. A black earth (5Uga) and a yellow duplex soil with solodic affinities (5Dye) occur in any slope position. Except for the solodic-solodized solonetz and the cracking clay complex, all have a neutral soil reaction trend.

4.6 Soils of landscape unit 6 (Miscellaneous alluvial landforms)

4.6.1 Landscape Unit 6(A)

A wide range of soil types occurs on the relict levees, flood-outs and fans. These include solodic-solodized solonetz (6Drc, 6Dba, 6Dyf and 6Dyg), a soloth-solodic soil (6Dyb), a red podzoloic soil (6Drb), a yellow smooth-ped earth (6Gnd) and a red-brown earth (6Dbe). Most have medium textured A horizons >0.2 m deep. The depth at which pH becomes strongly alkaline varies amongst the solodic-solodized solonetz. Soil types 6Dba and 6Dyg are usually strongly alkaline by 0.6 m whereas 6Drc and 6Dyf are strongly alkaline at or below 0.9 m.

A solodic-solodized solonetz (6Dbh) is found on the backplain. A small, closed depression is occupied by a yellow podzolic soil (6Dyd).

A small area of a yellow podzolic soil (6Dyc) occurs in the north of the survey area associated with an abandoned course of the Burdekin River identified by Hopley (1970) and Reid and Baker (1984).

4.6.2 Landscape Unit 6(B)

The soils associated with these recent deposits of Scotts-Barratta Creek usually have different morphology than those associated with relict alluvia. Sands (6Uca and c), a uniform loam (6Umb2), a yellow podzolic soil (6Dya5) and solodic-solodized solonetz (6Dyh and j) occupy the levees, flood-outs and fans. Most have deep, coarse textured A horizons. Soil 6Dyj is strongly alkaline at 0.3 m.

A bleached smooth-ped earth (6Gne) and a solodic-solodized solonetz (6Dbb) occupy the channel benches. Cracking clays (6Uga and c) and a solodic-solodized solonetz (6Dda) are found in closed and open depressions.

Table 4.1.1 Landscape units and major distinguishing attributes of the soil types, Mulgrave Section, BRIA.

Landscape unit	Landform element	Soil type	Major distinguishing attributes	Great soil group*	PPF**	Predominant natural vegetation
Local alluvial plains and associated pediments	Low lying flats and drainage depressions	1Uga	0.02m moderate self-mulch over dark to grey medium clay to 0.05 - 0.15 m over alkaline grey to dark medium to heavy clay to 0.90 - 1.50+m over grey to yellow-brown medium to heavy clay to 1.50+m. Normal gilgai, 0.05 - 0.30 m vertical interval.	Grey clay - black earth	Ug5.24 Ug5.16	Low to mid-high open woodland of poplar gum and carbeen with cabbage gum, beefwood and broad leaf tea-tree associated with Tussock grassland of cane grass and blue grasses
		1Ugf	Weakly self-mulching to hard setting surface over bleached, brown-mottled grey to dark light to light medium clay to 0.05 - 0.15 m over grey medium clay to 0.40 - 0.80 m over alkaline grey to yellow-brown medium to heavy clay to 1.50+m. Normal gilgai, 0.05 - 0.15m vertical interval.	(Bleached)+ grey clay	Ug3.2 Ug2	Low to mid-high open woodland of poplar gum and cabbage gum with carbeen, beefwood and broad leaf tea-tree associated with Tussock grassland of blue grasses, black spear grass and brown top
	Pediments and slightly elevated flats	1Dyb	0.10 - 0.15 m dark to brown sandy loam to clay loam A horizon bleached throughout or near base over alkaline grey to yellow-brown light to light medium clay B horizon to 0.40 - 0.60m over strongly alkaline yellow-brown to light grey sandy clay loam to sandy clay D horizon to 1.50+m.	Solodic-solodized solonetz	Dy2.33 Dy2.43	Low to mid-high open woodland to woodland of cabbage gum, poplar gum, carbeen, beefwood and false sandalwood with Tussock grassland of black spear grass and blue grasses
		1Dyc3	0.05 - 0.10m brown-mottled dark to brown light clay A1 horizon over bleached A2 horizon to 0.10 - 0.15m over grey medium to heavy clay B horizon to 0.40 - 0.80m over strongly alkaline grey to yellow-brown medium clay B horizon to 1.50+m.	No suitable group, affinities with solodic soil	Uf3 Uf2	Low to mid-high open woodland of cabbage gum, poplar gum and beefwood with carbeen and false sandalwood associated with Tussock grassland of blue grasses and black spear grass
		1Dda	0.05 - 0.10m brown-mottled dark to grey clay loam A1 horizon over bleached A2 horizon to 0.10 - 0.15m over alkaline dark medium to heavy clay B horizon to 0.60 - 1.20m over grey to yellow-brown light to medium clay B or D horizon to 1.50+m.	Solodic-solodized solonetz	Dd1.33 Dd1.43	Low to mid-high open woodland of poplar gum and carbeen with cabbage gum and beefwood associated with Tussock grassland of black spear grass and blue grasses
Burdekin River alluvial plain	Low lying flats	2Ugc	Weakly self-mulching to hard setting surface over occasionally bleached, brown-mottled dark to grey light to light medium clay to 0.05 - 0.15 m over, grey medium to heavy clay to 1.50+m, neutral throughout or alkaline to strongly alkaline at and below 0.90m. Normal gilgai, 0.05 - 0.25m vertical interval.	Grey clay- (bleached) grey clay	Ug5.24 Ug5.28 Ug3.2	Low to mid-high open woodland to woodland of poplar gum with carbeen, broad leaf tea-tree and beefwood associated with Tussock grassland of cane grass and blue grasses

Table 4.1.1 (Continued)

Landscape unit	Landform element	Soil type	Major distinguishing attributes	Great soil group*	PPF**	Predominant natural vegetation
Burdekin River alluvial plain	Low lying flats	2Ugd	Weakly self-mulching to hard setting surface over bleached, brown-mottled grey light to light medium clay to 0.10 - 0.25m over brown-mottled grey medium clay to 1.00 - 1.20m over grey to brown light to medium clay to 1.50+, strongly alkaline at and below 0.90 - 1.20m. Normal gilgai, 0.10 - 0.25m vertical interval.	(Bleached) grey clay	Ug3.2 Ug2	Low to mid-high open woodland to woodland of poplar gum and carbeen with broad leaf tea-tree associated with Tussock grassland of blue grasses, kangaroo grass and black spear grass
		2Uge	Weakly self-mulching to hard setting surface over occasionally bleached, brown-mottled grey light to light medium clay to 0.05 - 0.25m over brown - mottled grey medium to heavy clay to 0.80 - 1.30m over brown light to medium clay to 1.50+m, strongly alkaline above or at 0.60m. Normal gilgai, 0.05 - 0.25m vertical interval.	Grey clay - (bleached) grey clay	Ug5.29 Ug5.25 Ug3.2 Ug5.2	Low to mid-high open woodland to woodland of poplar gum with carbeen, cabbage gum, and beefwood associated with Tussock grassland of blue grasses, black spear grass and kangaroo grass
		2Ugf	0.01 - 0.02m moderate self-mulch over brown-mottled grey medium to heavy clay to 0.05 - 0.20m over brown-mottled grey medium to heavy clay to 0.90 - 1.50+m over grey to brown medium clay to 1.50+m, neutral throughout or alkaline to strongly alkaline at 1.20 - 1.50m. Normal gilgai, 0.10 - 0.25m vertical interval.	Grey clay	Ug5.2 Ug5.29	Low to mid-high open woodland to open forest of carbeen, poplar gum and broad leaf tea-tree with Open tussock grassland of blue grasses Occasionally para grass is found in the depressions of wetter areas
		2Ugg	0.01 - 0.02m moderate self-mulch over brown-mottled grey medium to heavy clay to 0.10 - 0.20m over grey medium to heavy clay to 1.20 - 1.40m over yellow-brown to grey medium to heavy clay to 1.50+m, strongly alkaline at and below 0.60 - 0.90m. Normal gilgai, 0.10 - 0.25m vertical interval.	Grey clay	Ug5.29 Ug5.24 Ug5.28	Low to mid-high open woodland to woodland of poplar gum with carbeen broad leaf tea-tree associated with Tussock grassland of blue grasses and cane grass
		2Ugh	0.01 - 0.02m moderate to strong self-mulch over brown-mottled grey medium to heavy clay to 0.10 - 0.15m over grey medium to heavy clay to 1.00 - 1.50+m over brown medium to heavy clay to 1.50+m, strongly alkaline at and below 0.30m. Normal gilgai, 0.10 - 0.25m vertical interval.	Grey clay	Ug5.29 Ug5.28 Ug5.24	Tussock grassland of cane grass, blue grasses and Flinders grass Occasionally with low to tall isolated trees to low to mid-high open woodland of carbeen, poplar gum and cabbage gum

Table 4.1.1 (Continued)

Landscape unit	Landform element	Soil type	Major distinguishing attributes	Great soil group*	PPF**	Predominant natural vegetation
Burdekin River alluvial plain	Low lying flats	2Ugk	Normal gilgai, 0.10 - 0.25m vertical interval. Mound: 0.01 - 0.02m weak to strong self-mulch over grey to dark medium to heavy clay to 0.05 - 0.12m over grey medium to heavy clay to 1.00 - 1.50+m over brown light to light medium clay D horizon to 1.50+m, strongly alkaline at and below 0.30 - 0.60m.	Grey clay	Ug5.2 Ug5.28 Ug5.24	Mid-high open woodland of carbeen, poplar gum and cabbage gum with broad leaf tea-tree associated with Tussock grassland of blue grasses, Flinders grass and cane grass
			Depression: Hard setting surface over 0.05 - 0.10m frequently bleached, brown-mottled grey to brown light to light medium clay over brown-mottled grey light medium to medium clay to 0.30 - 0.60m over grey to yellow-brown medium clay to 0.70 - 1.20m over brown light to light medium clay D horizon to 1.50+m, strongly alkaline at and below 0.90 - 1.20m.	(Bleached) grey clay-grey clay - no suitable group	Ug3.2 Ug5.2 Uf6.33	
		2Dyc	0.05 - 0.10m brown-mottled dark to brown clay loam A1 horizon over bleached A2 horizon to 0.12 - 0.25m over alkaline brown-mottled grey to brown medium to heavy clay B horizon to 1.10 - 1.30m over yellow-brown to grey light to medium clay D horizon to 1.50+m. Normal gilgai, 0.10 - 0.25m vertical interval.	Solodic-solodized solonetz	Dy3.33 Dy3.43 Db2.33	Low to mid-high open woodland of poplar gum and cabbage gum with Tussock grassland of blue grasses, black spear grass and kangaroo grass
	Slightly elevated flats	2Dba	0.05 - 0.10m brown clay loam A horizon bleached throughout or near base over brown medium clay B horizon to 1.00 - 1.50+m over brown light to light-medium clay D horizon to 1.50+m, strongly alkaline at and below 0.30m.	Solodic-solodized solonetz	Db1.33 Db1.43	Low to tall shrubland of false sandalwood or Low open woodland of beefwood with cabbage gum, poplar gum and carbeen associated with Sparse to open tussock grassland of blue grasses, black spear grass, purple top Rhodes grass and button grass
		2Dbb	0.05 - 0.15m dark to brown clay loam A1 horizon over bleached A2 horizon to 0.12 - 0.20m over brown medium clay B horizon to 1.20 - 1.50+m over brown to yellow-brown fine sandy clay to light medium clay D horizon to 1.50+m, strongly alkaline at and below 0.60m.	Solodic-solodized solonetz	Db1.43 Db1.33	Low to mid-high open woodland of poplar gum, carbeen and cabbage gum with beefwood associated with Tussock grassland of purple top Rhodes grass, black spear grass and blue grasses

Table 4.1.1 (Continued)

Landscape unit	Landform element	Soil type	Major distinguishing attributes	Great soil group*	PPF**	Predominant natural vegetation
Burdekin River alluvial plain	Slightly elevated flats	2Dbc	0.05 - 0.20m dark to grey loam to clay loam A1 horizon over bleached A2 horizon to 0.20 - 0.35m over brown-mottled grey to brown medium clay B horizon to 1.00 - 1.50+m over dark-mottled brown to yellow-brown fine sandy clay to light medium clay D horizon to 1.50+m, strongly alkaline at and below 0.90 - 1.20m.	Solodic-solodized solonetz	Dy3.33 Dy3.43 Db2.43	Low to mid-high open woodland of poplar gum, carbeen and cabbage gum with Tussock grassland of black spear grass, blue grasses and kangaroo grass
		2Dbd	0.10 - 0.20m brown-mottled dark to brown clay loam A1 horizon over bleached A2 horizon to 0.20 - 0.35m over grey to brown medium clay B horizon to 0.70 - 1.00m over brown to yellow-brown fine sandy clay to light medium clay D horizon to 1.50+m, strongly alkaline at and below 0.60m.	Solodic-solodized solonetz	Dy2.43 Dy2.33 Db1.43	Low to mid-high open woodland of cabbage gum, carbeen and poplar gum with Tussock grassland of black spear grass, blue grasses and kangaroo grass
		2Dbe	0.05 - 0.10m brown-mottled dark to grey clay loam A1 horizon over bleached A2 horizon to 0.12 - 0.20m over brown-mottled grey to brown medium clay B horizon to 1.15 - 1.25m over brown light to medium clay D horizon to 1.50+m, strongly alkaline at and below 0.90 - 1.20.	Solodic-solodized solonetz	Dy3.33 Db2.33 Db2.43	Low to mid-high open woodland of poplar gum, cabbage gum and carbeen with beefwood and associated with Tussock grassland of black spear grasses, blue grasses and kangaroo grass
		2Dya	0.05 - 0.10m brown-mottled grey to brown clay loam A horizon bleached throughout or near base over grey medium to heavy clay B horizon to 0.90 - 1.50+m over brown light to light medium clay D horizon to 1.50+m, strongly alkaline at and below 0.60m. Frequently normal gilgai, less than 0.10m vertical interval.	Solodic-solodized solonetz	Dy2.33 Dy2.43	Low to mid-high open woodland to woodland of poplar gum, cabbage gum and carbeen with beefwood and broad leaf tea-tree associated with Tussock grassland of blue grasses, black spear grass and kangaroo grass
		2Dyb	0.05 - 0.10m brown-mottled grey to brown clay loam A1 horizon over bleached A2 horizon to 0.12 - 0.20m over grey medium to heavy clay B horizon to 0.90 - 1.50+m over brown light to medium clay D horizon to 1.50+m, strongly alkaline above or at 0.60m.	Solodic-solodized solonetz	Dy2.43 Dy2.33	Low to mid-high open woodland of cabbage gum and poplar gum with beefwood and carbeen associated with Tussock grassland of black spear grass, blue grasses and purple top Rhodes grass Where cleared - tall shrubland of beefwood may occur

Table 4.1.1 (Continued)

Landscape unit	Landform element	Soil type	Major distinguishing attributes	Great soil group*	PPF**	Predominant natural vegetation
Burdekin River alluvial plain	Slightly elevated flats	2Dda	0.05 - 0.12m brown-mottled dark to brown clay loam A horizon bleached throughout or near base over dark-brown medium clay B horizon to 0.90 - 1.20 m over dark-mottled brown to yellow-brown light to medium clay D horizon to 1.50+m, strongly alkaline at below 0.60 - 0.90 m.	Solodic-solodized solonetz	Dd1.33 Db1.33	Low to mid-high open woodland of poplar gum, cabbage gum and poplar gum with beefwood and carbeen associated with Tussock grassland of black spear grass, blue grasses and purple top Rhodes grass Where cleared - tall shrubland of beefwood may occur
		2Ddb	0.05 - 0.12m brown-mottled grey to brown clay loam A horizon bleached throughout or near base over grey to dark medium to heavy clay B horizon to 0.65 - 1.00m over brown light to medium clay D horizon to 1.50+m, strongly alkaline at and below 0.30m.	Solodic-solodized solonetz	Dy2.33 Dy2.43 Dd1.33	Low open woodland of beefwood, cabbage gum and poplar gum or Low to tall shrubland of false sandalwood and beefwood with Sparse to open tussock grassland of black spear grass, blue grasses, purple top Rhodes grass and kangaroo grass
		2Ddc-2Ugi	Linear gilgai complex. Vertical interval of gilgai less than 0.05m, 60-70% depression.			Low to mid-high open woodland of cabbage gum and carbeen with beefwood associated with
			Depression(2Ddc): 0.05 - 0.20m brown-mottled dark clay loam A1 horizon over bleached A2 horizon to 0.20 - 0.35m over strongly alkaline dark to grey medium to heavy clay B horizon to 0.80 - 1.20m over grey to brown medium to heavy clay B horizon to 1.00 - 1.40m over yellow-brown light medium to medium clay D horizon to 1.50+m.	Solodic-solodized solonetz	Dd1.33 Dy2.33	Tussock grassland of black spear grass, blue grasses, kangaroo grass and Flinders grass
			Mound(2Ugi): 0.01 - 0.02m moderate to strong self-mulch over grey to brown medium to heavy clay to 0.10 - 0.20m over strongly alkaline grey to brown medium to heavy clay to 1.00 - 1.30 m over yellow-brown medium clay D horizon to 1.50+m.	Grey clay-brown clay	Ug5.2 Ug5.3	
Gently undulating rises on acid intrusive rocks, pediments and prior streams	Crests and simple slopes	4Ucf	0.05 - 0.15m grey to yellow-brown coarse sand to sandy clay loam A horizon over acid to neutral grey to yellow-brown coarse sand to sandy clay loam B horizon to 0.30 - 1.10m over decomposing rock or colluvia.	No suitable group, affinities with siliceous sand	Uc5.11 Um5.21	Low to mid-high open woodland to mid-high to tall open forest of poplar gum, cabbage gum, carbeen and grey bloodwood with broad leaf tea-tree, quinine bush, pandanus and cocky apple associated with Sparse to open tussock grassland of black and giant spear grass with native panic, wire grasses and red natal grass associated

Table 4.1.1 (Continued)

Landscape unit	Landform element	Soil type	Major distinguishing attributes	Great soil group*	PPF**	Predominant natural vegetation
Gently undulating rises on acid intrusive rocks, pediments and prior streams	Pediments	4Gna2	0.05 - 0.10m grey coarse sand to coarse sandy loam A1 horizon over bleached A2 horizon to 0.30 - 0.60m over neutral grey to light yellow-grey sandy clay loam B horizon to 0.65 - 1.00m over brown-mottled grey-brown coarse sandy loam D horizon to 1.50+m.	No suitable group	Gn2.92 Gn2.95	Low to mid-high woodland of poplar gum and grey bloodwood with cocky apple and pandanus associated with Open tussock grassland of black and giant spear grass
		4Dya3	0.05 - 0.15m grey clay loam A1 horizon over bleached A2 horizon to 0.10 - 0.25m over grey light to medium clay B horizon to 1.50+m, strongly alkaline at 1.20 - 1.50 m.	Solodic-solodized solonetz	Dy2.43 Dy2.33	Low to mid-high open woodland to woodland of poplar gum, carbeen and grey ironbark with broad leaf tea-tree and beefwood associated with Open tussock grassland of black and giant spear grass, blue grasses and purple top Rhodes grass
		4Dyd	0.10 - 0.30m grey to brown coarse sand to sandy loam A1 horizon over bleached A2 horizon to 0.40 - 0.95m over acid to neutral brown-mottled grey to yellow-brown light to medium clay B horizon to 0.75 - 1.50+m over brown-mottled grey to yellow-brown sandy clay to light clay B horizon to 1.30 - 1.50+m over red-mottled grey to yellow-brown sandy clay loam to sandy clay D horizon to 1.50+m.	Soloth-solodic soil	Dy3.41 Dy3.31 Dy3.42	Mid-high open woodland to woodland of poplar gum and cocky apple, with grey bloodwood, pandanus and broad leaf tea-tree associated with Sparse to open tussock grassland of black and giant spear grass
		4Dye	0.15 - 0.25m dark to grey light sandy clay loam to clay loam A1 horizon over bleached A2 horizon to 0.35 - 0.40m over alkaline red-mottled grey to yellow-brown light to medium clay B horizon to 0.95 - 1.50+m over decomposing rock or sand.	Solodic-solodized solonetz	Dy3.43 Dy3.33	Mid-high open woodland to woodland of poplar gum with grey bloodwood, cabbage gum and broad leaf tea-tree associated with Tussock grassland of black and giant spear grass, blue grasses and purple top Rhodes grass
		4Dyg	0.10 - 0.20m grey to dark light sandy clay loam to clay loam A1 horizon over bleached A2 horizon to 0.15 - 0.30m over brown-mottled grey medium clay B horizon to 0.80 - 1.50+m over sandy clay to light clay D horizon or decomposing rock, alkaline at and below 0.60 m.	Solodic-solodized solonetz	Dy3.33 Dy3.43	Low to mid-high open woodland to woodland of cabbage gum, grey ironbark, poplar gum and broad leaf tea-tree with beefwood and false sandalwood associated with Open tussock to tussock grassland of black spear grass, kangaroo grass and blue grasses with wire grass and purple top Rhodes grass associated

Table 4.1.1 (Continued)

Landscape unit	Landform element	Soil type	Major distinguishing attributes	Great soil group*	PPF**	Predominant natural vegetation
Gently undulating rises on acid intrusive rocks, pediments and prior streams	Pediments	4Dyh	0.10 - 0.20m dark to grey light sandy clay loam to clay loam A1 horizon over bleached A2 horizon to 0.15 - 0.30m over grey medium clay B horizon to 0.80 - 1.50+m over sandy clay to light clay D horizon or decomposing rock to 1.50+m, alkaline at below 0.60m.	Solodic-solodized solonetz	Dy2.33 Dy2.43	Low open woodland to woodland of carbeen, cabbage gum, grey ironbark, poplar gum and broad leaf tea-tree with beefwood and false sandalwood associated with Open tussock grassland of purple top Rhodes grass, love grass, wire grass and blue grasses
		4Dyk	0.05 - 0.15m grey coarse sand to loam A1 horizon over bleached A2 horizon to 0.35 - 1.00m over acid grey sandy clay loam to light medium clay B horizon to 0.70 - 1.10m over decomposing rock.	Soloth	Dy2.41 Dy2.31	Mid-high open woodland to open forest of poplar gum, grey bloodwood and broad leaf tea-tree with Open tussock grassland of black and giant spear grass
		4Dga	0.10 - 0.20m brown-mottled grey to brown loamy sand to loam fine sandy A1 horizon over bleached A2 horizon to 0.35 - 0.65m over acid red-mottled light grey clay loam to sandy clay B horizon to 0.85 - 1.00m over sandy clay loam D horizon to 1.50+m.	Gleyed podzolic soil	Dg2.41 Dg2.31	Low to mid-high open woodland to open forest of cabbage gum, poplar gum, grey bloodwood and broad leaf tea-tree with Sparse tussock grassland of black and giant spear grass
Gently undulating rises on an intrusive rock complex	No fixed slope position	5Uga	0.02m moderate to strong self-mulch over dark medium to heavy clay to 0.05 - 0.12m over alkaline dark to grey medium to heavy clay to 0.70 - 1.00 m over decomposing rock.	Black earth	Ug5.12 Ug5.14	Low to mid-high isolated trees to open woodland of cabbage gum, grey ironbark and poplar gum with carbeen associated with Tussock grassland of blue grasses, cane grass and Chloris spp.
		5Dye	0.05 - 0.15m dark sandy clay loam to clay loam A1 horizon over frequently bleached brown A2 horizon to 0.15 - 0.30m over neutral to alkaline orange-mottled yellow-brown medium to heavy clay B horizon to 1.05 - 1.50+m over decomposing rock.	Solodic soil - no suitable group	Dy3.33 Dy3.32 Dy3.22	Low to mid-high open woodland of poplar gum and cabbage gum with beefwood associated with Tussock grassland of black spear grass, kangaroo grass and blue grasses
	Crests, upper and mid slopes	5Dra	0.15 - 0.30m dark to brown clay loam A horizon over neutral red to red-brown light medium to medium clay B horizon to 0.70 - 1.20m over decomposing rock.	Non-calcic brown soil	Dr2.12	Low to mid-high open woodland to woodland of grey ironbark and red bloodwood with poplar gum and grey bloodwood associated with Tussock grassland of black and giant spear grass, kangaroo grass and blue grasses

Table 4.1.1 (Continued)

Landscape unit	Landform element	Soil type	Major distinguishing attributes	Great soil group*	PPF**	Predominant natural vegetation
Gently undulating rises on an intrusive rock complex	Upper and mid slopes	5Dya	0.15 - 0.25m dark to brown sandy clay loam to clay loam A horizon over neutral yellow-brown medium clay B horizon to 0.70 - 1.00m over decomposing rock.	No suitable group, yellow equivalent of non-calcic brown soil	Dy2.12	Low to mid-high open woodland to woodland of poplar gum, red bloodwood and grey ironbark with carbeen and grey bloodwood associated with Tussock grassland of black and giant spear grass and kangaroo grass
	Mid to lower slopes	5Ugc-5Ugd	Linear gilgai complex. Vertical interval of gilgai less than 0.10m			Low open woodland to woodland of poplar gum and cabbage gum with red bloodwood associated with Tussock grassland of black and giant spear grass with cane grass, kangaroo grass and blue grasses associated
			Mound(5Ugd): 0.01 - 0.02m weak to moderate self-mulch over grey light to light medium clay to 0.08 - 0.10m over grey medium clay to 0.40 - 0.60m over strongly alkaline grey to brown medium clay to 1.00 - 1.20m over decomposing rock.	Grey clay	Ug5.22 Ug5.26 Ug5.27	
			Depression(5Ugc): Weakly self-mulching to hard setting surface over dark light to light medium clay A1 horizon to 0.10 - 0.15m occasionally over bleached A2 horizon to 0.15 - 0.20m over dark medium clay to 0.50 - 0.90m over strongly alkaline grey to brown medium clay to 0.80 - 1.10m over decomposing rock.	Black earth -(bleached) black earth	Ug5.14 Ug3.1 Ug5.13	
		5Dyb	0.10 - 0.20m dark to brown clay loam A horizon over alkaline yellow to brown light medium to medium clay B horizon to 0.90 - 1.30m over decomposing rock.	No suitable group	Dy2.13	Low to mid-high open woodland to woodland of poplar gum, cabbage gum and grey bloodwood with beefwood, red bloodwood and grey ironbark associated with Tussock grassland of black and giant spear grass, kangaroo grass and blue grasses
	Lower slopes	5Dyc	0.10 - 0.20m dark to brown clay loam A1 horizon over bleached A2 horizon to 0.15 - 0.30m over strongly alkaline grey medium clay B horizon to 0.40 - 1.20m over grey to yellow-brown medium clay B horizon to 0.80 - 1.50+m over decomposing rock.	Solodic-solodized solonetz	Dy2.33 Dy2.43	Low to mid-high open woodland of cabbage gum, poplar gum and beefwood with carbeen associated with Tussock to open tussock grassland of black spear grass, purple top Rhodes grass and blue grasses with wire grass associated

Table 4.1.1 (Continued)

Landscape unit	Landform element	Soil type	Major distinguishing attributes	Great soil group*	PPF**	Predominant natural vegetation
Gently undulating rises on an intrusive rock complex	Lower slopes	5Dyd	0.05 - 0.10m dark to grey sandy clay loam to clay loam A1 horizon over bleached A2 horizon to 0.10 - 0.12m over strongly alkaline grey to yellow-brown medium clay B horizon to 0.70 - 1.20m over decomposing rock or colluvia.	Solodic-solodized solonetz	Dy2.43 Dy2.33	Low open woodland of cabbage gum and poplar gum with false sandalwood and beefwood associated or Tall open shrubland to shrubland of false sandalwood and beefwood with Sparse to open tussock grassland of black spear grass, purple top Rhodes grass and blue grasses
Miscellaneous alluvial landforms (A) Relict alluvial landforms	Levees, flood-outs and fans	6Gnd	0.15 - 0.30m grey to brown sandy loam to clay loam A1 horizon over brown to yellow-brown fine sandy loam to clay loam A2 or A3 horizon to 0.50 - 1.20m over neutral brown to yellow-brown clay loam to light clay B horizon to 1.50+m.	No suitable group, affinities with yellow podzolic soil	Gn3.75 Gn3.72 Gn3.22	Mid-high to tall woodland of carbeen, cabbage gum and poplar gum with red and grey bloodwood and cocky apple associated with Tussock grassland of black and giant spear grass, blue grasses and brown sorghum
		6Drb	0.10 - 0.20m dark to grey loam to clay loam A1 horizon over bleached A2 horizon to 0.20 - 0.45m over neutral red medium clay B horizon to 1.00 - 1.35m over red-brown clay loam D horizon to 1.50+m.	Red podzolic soil	Dr2.32 Dr2.42	Mid-high to tall open woodland to woodland of poplar gum with carbeen, grey bloodwood and cocky apple associated with Open tussock grassland of black and giant spear grass and kangaroo grass
		6Drc	0.10 - 0.20m dark to grey loam to clay loam A1 horizon over bleached A2 horizon to 0.20 - 0.30m over alkaline red-brown to red medium clay B horizon to 1.00 - 1.35m over red-brown to brown fine sandy clay to light clay D horizon to 1.50+m.	Solodic soil	Dr2.43 Dr2.33	Mid-high to tall open woodland of grey bloodwood and poplar gum with carbeen, cabbage gum, cocky apple, beefwood and chinee apple associated with Tussock grassland of black and giant spear grass and blue grasses with kangaroo grass associated
		6Dba	0.10 - 0.20m dark to brown sandy loam to sandy clay loam A1 horizon over bleached A2 horizon to 0.15 - 0.30m over brown medium clay B horizon to 1.50+m, alkaline at and below 0.60m.	Solodic-solodized solonetz	Db1.33 Db1.43	Low to mid-high open woodland to woodland of carbeen, grey bloodwood and cabbage gum with poplar gum and beefwood associated with Tussock grassland of black spear grass, blue grasses and purple top Rhodes grass

Table 4.1.1 (Continued)

Landscape unit	Landform element	Soil type	Major distinguishing attributes	Great soil group*	PPF**	Predominant natural vegetation
Miscellaneous alluvial landforms (A) Relict alluvial landforms	Levees, flood-outs and fans	6Dbe	0.05 - 0.15m brown-mottled dark to brown loam to clay loam A1 horizon over bleached A2 horizon to 0.10 - 0.20m over alkaline red-mottled brown medium clay B horizon to 0.55 - 0.70m over brown to grey loamy sand to light medium clay D horizons to 1.50+m.	Red-brown earth	Db2.33 Db2.43	Mid-high to tall open woodland to open forest of poplar gum, carbeen and red and grey bloodwood with beefwood and cocky apple associated with Tussock grassland of blue grasses, black spear grass and golden beard grass
		6Dyb2	0.15 - 0.30m dark to brown sandy loam A1 horizon over bleached A2 horizon to 0.30 - 0.60m over acid to neutral yellow-mottled yellow-brown sandy clay to light medium clay B horizon to 0.60 - 1.00m over yellow-brown to brown sand to clay loam D horizon to 1.50+m.	Solodic soil-soloth	Dy3.32 Dy3.42 Dy3.41	Mid-high to tall open woodland to open forest of poplar gum and grey bloodwood with carbeen, cocky apple, cabbage gum and broad leaf tea-tree associated with Tussock grassland of black and giant spear grass, blue grasses and blady grass
		6Dyc	0.10 - 0.40m dark to grey loam to clay loam A1 horizon over bleached A2 horizon to 0.45 - 0.80m over acid to neutral red-mottled yellow to brown medium clay B horizon to 1.50+m.	Yellow podzolic soil	Dy3.42 Dy3.41 Db2.32	Mid-high to tall woodland of grey bloodwood and poplar gum with cocky apple associated with Tussock grassland of black and giant spear grass and brown sorghum
		6Dyf	0.10 - 0.25m grey to dark loam to clay loam A1 horizon over bleached A2 horizon to 0.25 - 0.50m over alkaline red-mottled brown to yellow-brown medium clay B horizon to 1.20 - 1.50+m over brown light to light medium clay D horizon to 1.50+m.	Solodic-solodized solonetz	Dy3.43 Dy3.33	Low to tall woodland of poplar gum, carbeen and grey bloodwood with cocky apple associated with Tussock grassland of black and giant spear grass and kangaroo grass
		6Dyg	0.05 - 0.10m grey to dark loam to clay loam A1 horizon over bleached A2 horizon to 0.10 - 0.20m over strongly alkaline brown-mottled grey medium to heavy clay B horizon to 0.70 - 1.20m over brown-mottled yellow-brown to grey clay loam to light medium clay D horizon to 1.50+m.	Solodic-solodized solonetz	Dy3.33 Dy3.43	Low to mid-high open woodland of carbeen, cabbage gum, poplar gum and beefwood with grey bloodwood and cocky apple associated with Open tussock grassland of black spear grass and purple top Rhodes grass
	Backplain	6Dbh	0.05 - 0.15m dark to brown loam to clay loam A1 horizon over bleached A2 horizon to 0.10 - 0.25m over strongly alkaline brown medium clay B horizon to 0.60 - 1.00m over brown clay loam to light medium clay D horizon to 1.50+m.	Solodic-solodized solonetz	Db1.43 Db1.33	Low open woodland to woodland of beefwood, false sandalwood and carbeen with cabbage gum, poplar gum and grey ironbark associated with Open tussock grassland of purple top Rhodes grass and blue grasses

Table 4.1.1 (Continued)

Landscape unit	Landform element	Soil type	Major distinguishing attributes	Great soil group*	PPF**	Predominant natural vegetation
Miscellaneous alluvial landforms (A) Relict alluvial landforms	Closed depressions	6Dyd	0.10 - 0.20m brown-mottled grey to dark loam to clay loam A1 horizon over bleached A2 horizon to 0.20 - 0.40m over acid to neutral red-mottled yellow-brown to brown medium clay B horizon to 1.20 - 1.30m over red-brown sandy clay to light clay D horizon to 1.50+m.	Yellow podzolic soil	Dy3.42 Dy3.41 Dy3.32 Db2.32	Mid-high to tall woodland of grey bloodwood and poplar gum with Tussock grassland of black and giant spear grass
Miscellaneous alluvial landforms (B) Scotts-Barratta Creek alluvial landforms	Levees, flood-outs and fans	6Uca	0.10 - 0.30m dark coarse sand to sandy loam A horizon over acid to neutral brown to yellow-brown coarse sand to sandy loam B horizon to 0.80 - 1.00m over brown-mottled coarse sand D horizon to 1.50+m.	No suitable group, affinities with earthy sand	Uc5.11 Uc5.21 Uc5.23	Low to mid-high open woodland to woodland of pandanus, broad leaf tea-tree and grey bloodwood with cocky apple and poplar gum associated with Tussock grassland of black and giant spear grass
		6Ucc	0.05 - 0.50m dark to brown sand to fine sandy loam A1 horizon over grey, brown or yellow A12 or A2 horizon to 0.50 - 1.10m over acid to neutral brown to yellow sand to light sandy clay loam A2 or B horizon to 1.50+m.	No suitable group, affinities with siliceous sand - earthy sand	Uc5.21 Uc5.11 Uc5.23 Uc4.22	Mid-high to tall open woodland to open forest of poplar gum, carbeen, grey bloodwood and Burdekin plum with broad leaf tea-tree, cocky apple, pandanus, prickly pine and quinine bush associated with Tussock grassland of black and giant spear grass and brown sorghum with golden beard grass and blue grasses associated
		6Umb2	0.20 - 0.30m dark to grey loam to clay loam A horizon over acid to neutral dark to yellow-brown clay loam to light clay B horizon to 0.55 - 0.75m over brown to grey sand to medium clay D horizons to 1.50+m.	No suitable group	Um5.52 Um6.31 Gn3.91	Mid-high to tall woodland of poplar gum, grey bloodwood and carbeen with cocky apple and chinee apple associated with Tussock grassland of brown sorghum, black and giant spear grass and blue grasses
		6Dya5	0.10 - 0.40m dark to brown loamy sand to sandy loam over bleached A2 horizon to 0.60 - 1.20m over acid to neutral brown-mottled grey to yellow-brown sandy clay to light medium clay B horizon to 1.50+m.	Yellow podzolic soil	Dy3.41 Dy3.42	Tall woodland to open forest of poplar gum and grey bloodwood with carbeen and cocky apple associated with Tussock grassland of black and giant spear grass

Table 4.1.1 (Continued)

Landscape unit	Landform element	Soil type	Major distinguishing attributes	Great soil group*	PPF**	Predominant natural vegetation
Miscellaneous alluvial landforms (B) Scotts-Barratta Creek alluvial landforms	Levees, flood-outs and fans	6Dyh	0.15 - 0.30m dark to brown sand to sandy loam A1 horizon over bleached A2 horizon to 0.20 - 0.50m over alkaline yellow-mottled grey light medium to medium clay B horizon to 1.50+m.	Solodic-solodized solonetz	Dy3.43 Dy3.33	Low to mid-high open woodland of poplar gum, cabbage gum, carbeen and beefwood with grey bloodwood, dead finish, chinee apple and cocky apple associated with Tussock grassland of black spear grass and love grass with blue grasses and purple top Rhodes grass associated
		6Dyj	0.02 - 0.15m dark to grey sandy loam to clay loam A1 horizon over bleached A2 horizon to 0.05 - 0.20m over grey medium clay B horizon to 1.00 - 1.50+m over grey-brown to yellow-grey sandy clay loam to medium clay D horizon to 1.50+m, strongly alkaline at and below 0.30m.	Solodic-solodized solonetz	Dy2.43 Dy2.33	Low to mid-high open woodland of poplar gum, cabbage gum and beefwood with false sandalwood, carbeen and grey bloodwood associated with Sparse to open tussock grassland of blue grasses, giant and black spear grass and purple top Rhodes grass
	Channel benches	6Gne	0.15 - 0.35m dark to grey clay loam A1 horizon over bleached A2 horizon to 0.25 - 0.50m over alkaline dark to grey light clay B horizon to 1.50+m.	No suitable group	Gn3.49 Gn3.03 Gn3.06	Low to tall open woodland of poplar gum and cabbage gum with grey bloodwood and cocky apple associated with Tussock grassland of black and giant spear grass with blady grass and brown sorghum associated
		6Dbb	0.10 - 0.25m dark to grey clay loam A1 horizon over bleached A2 horizon to 0.30 - 0.40m over alkaline brown or dark medium clay B horizon to 1.00 - 1.20m over brown to yellow-brown fine sandy loam to light medium clay D horizon to 1.50+m.	Solodic soil	Db1.33 Db1.43 Dd1.43 Dd1.33	Low to mid-high open woodland to woodland of poplar gum, cabbage gum, carbeen and grey bloodwood with cocky apple associated with Tussock grassland of black and giant spear grass and brown sorghum
	Closed and open depressions	6Uga	Weakly self-mulching to hard setting surface over dark to grey light to light-medium clay to 0.05 - 0.20m over alkaline dark to grey light to medium clay to 1.00 - 1.50+m over grey to brown sandy clay to medium clay D horizon to 1.50+m.	Black earth-grey clay	Ug5.17 Ug5.16 Ug5.2	Mid-high open woodland to woodland of poplar gum, cabbage gum and grey bloodwood with carbeen associated with Tussock grassland of black spear grass and blue grasses

Table 4.1.1 (Continued)

Landscape unit	Landform element	Soil type	Major distinguishing attributes	Great soil group*	PPF**	Predominant natural vegetation
Miscellaneous alluvial landforms (B) Scotts-Barratta Creek alluvial landforms	Closed and open depressions	6Ugc	Hard setting surface over brown-mottled dark to grey light clay to 0.10 - 0.20m over bleached brown-mottled dark to grey light clay to 0.15 - 0.30m over alkaline grey medium clay to 0.75 - 1.50+m over grey to brown light clay to 1.50+m.	(Bleached) grey clay	Ug2 Ug3.2	Low to mid-high open woodland to woodland of cabbage gum, poplar gum and carbeen with cocky apple associated with Tussock grassland of blue grasses, kangaroo grass and black spear grass
		6Dda	0.10 - 0.15m dark to brown clay loam A1 horizon over bleached A2 horizon to 0.15 - 0.25m over alkaline dark medium clay B horizon to 0.70 - 1.10m over dark to grey clay loam to light medium clay D horizon to 1.50+m.	Solodic-solodized solonetz	Dd1.43 Dd1.33	Low to tall open woodland of poplar gum, carbeen, cabbage gum and beefwood with grey bloodwood associated with Tussock grassland of black spear grass, blue grasses and purple top Rhodes grasses

* Stace et al (1968)
** Main Principle Profile Forms only (Northcote 1979)
\+ These bracketed qualifiers are not an official part of great soil group names.

5 SOILS - CHEMICAL AND PHYSICAL ATTRIBUTES

5.1 Introduction

Laboratory analyses of representative soil profiles provide quantitative measurements of important soil properties to assist in interpretation of soil and land use data.

Thirteen profiles from nine sites were sampled as representative of the soil types from this survey area. Profiles were usually sampled in 0.1m intervals to 1.5m. However, where an important soil horizon boundary occurred within the 0.1m interval, the depth of sampling was adjusted to avoid sampling across horizons.

At each site a soil pit was excavated. This allowed a close examination of soil morphology and a detailed description to be recorded. Samples were taken from the exposed profile. Where gilgai was present, a separate profile from mound and depression was sampled and analysed. A bulk of nine 0-0.1m samples was collected from around each site for nutrient analyses. A broad suite of analyses were preformed on each sampled profile. The analytical methods utilised are described in Bruce and Rayment (1982).

Ten profiles, representing five soil types, were sampled and analysed within this area during the earlier survey of Reid and Baker (1984). These results were included in the assessment of the physical and chemical properties of the soils.

The sampled profiles were grouped on the basis of similar profile morphology. This facilitated comparision of physical and chemical attributes between similar soil types. For example, group A contains those cracking clays of the Burdekin River alluvial plain which have light to light-medium clay A horizons, whereas those with medium to heavy clay A horizons are contained in group B. However, sampled solodic-solodized solonetz of landscape units 5 and 6 could not be suitably placed in groups.

A brief description of each group or soil type is shown in Table 5.1.1, along with the survey and site number of each sampled profile.

One site sampled during this survey was not considered in the groupings. This site represents an important variant, 2Ugd2, which was sampled to determine the effect of the variant on soil chemical and physical properties. Comparisons between selected chemical and physical properties of site 3 and soil type 2Ugd are included in section 5.13.

Ratings for salinity, sodicity and nutrients in the sampled soil types appear in Table 5.1.2. Detailed morphological and analytical data for the profiles sampled in this survey are presented in Appendix V.

Table 5.1.1 Brief description of soil groups or soil types with the survey and site number of each sampled profile, Mulgrave Section, BRIA.

Soil group or soil type designation	Brief description of morphology	Soil type*	Sampled profiles Survey**	Site no.	Series Affiliation***
A	Cracking clays of the Burdekin River alluvial plain with light to light-medium clay A horizons.	2Uge 2Ugc	MLG MLG	S1A S2A	Barratta
B	Cracking clays of the Burdekin River alluvial plain with medium to heavy clay A horizons.	2Ugk 2Ugh 2Ugk 2Ugh	BRLB BRLB BRLB BRLB	S29++ S38 S40++ S42	Barratta
C	Solodic-solodized solonetz of the Burdekin River alluvial plain, not usually strongly alkaline at 0.3 m.	2Dya 2Dya 2Dyb	MLG MLG BRLB	S4 S11 S31	Oakey
D	Solodic-solodized solonetz of the Burdekin River alluvial plain, strongly alkaline at 0.3 m.	2Dba 2Ddb	BRLB MLG	S27+ S7	Dowie
5Dyc	Solodic-solodized solonetz of the gently undulating rises on an intrusive rock complex.	5Dyc	MLG	S9	Ranly
6Drc	Solodic-solodized solonetz of the miscellaneous alluvial landforms, strongly alkaline at 0.9-1.5 m.	6Drc	BRLB	S38	Lanona
6Dbh	Solodic-solodized solonetz of the miscellaneous alluvial landforms, strongly alkaline at 0.3-0.6 m.	6Dbh	MLG	S10	-

* Mounds only included. Mounds and depressions compared separately in Section 5.12.
** MLG - Mulgrave survey
BRLB - Reid and Baker (1984)
*** Hubble and Thompson (1953)
\+ Soil profile name changed from 2Ddb
++ Soil profile name changed from 2Ugh

Table 5.1.2 Ratings* for salinity, sodicity and nutrients in the sampled soil types, Mulgrave Section, BRIA.

				Profile 0-0.1 m						Bulked 0-0.1 m DTPA		
Soil type	Salinity	Sodicity[b] 0.2-0.3 m	0.8-0.9 m	Extractable potassium	Total sulphur	Extr. Acid	Phosphorus Bicarb	Total nitrogen	Organic carbon	Manganese	Copper	Zinc
2Ugc	low	sodic	s. sodic	medium	low	v. low	v. low	low	low	high	medium	medium
2Ugd2	low	non-sodic	sodic	high	low	v. low	v. low	low	low	high	medium	medium
2Uge	low	sodic	s. sodic	medium	low	v. low	v. low	low	low	high	medium	medium
2Ugh	low	non-sodic	s. sodic	medium	low	v. low	v. low	low	low	medium	medium	low
2Ugk	v. low **	non-sodic	sodic	high	low	v. low	v. low	low	low	high	medium	medium
2Dba	high	s. sodic***	s. sodic	medium	low	v. low	v. low	low	low	high	medium	medium
2Dya	high	s. sodic	s. sodic	medium	low	v. low	v. low	low	low	high	medium	medium
2Dyb	high	s. sodic	s. sodic	medium	low	v. low	v. low	low	low	medium	medium	medium
2Ddb	high	s. sodic	s. sodic	low	low	v. low	v. low	low	low	high	medium	low
5Dyc	medium	sodic	s. sodic	medium	low	low	v. low	low	low	high	medium	medium
6Drc	v. low	non-sodic	sodic	medium	low	v. low	v. low	low	low	high	medium	medium
6Dbh	medium	s. sodic	s. sodic	medium	low	v. low	v. low	low	low	high	medium	low

* Soil salinity rating as weighed average root-zone salinity to 0.9 m from predicted EC_{se} values after Shaw *et al* (1986).
Sodicity ratings after Northcote and Skene (1972). Other ratings after Bruce and Rayment (1982).

** Very low

*** Strongly sodic

5.2 pH

Soil pH is an easily determined measurement of the intensity of soil acidity or alkalinity. The base status of the soil, the availability of nutrients and the presence or absence of toxic elements can be inferred from soil pH.

pH profiles for the seven soil groups or soil types are shown in Figures 5.2.1 and 5.2.2. All soil types or groups except 6Dbh and group B have surface pH in the range 6.0 to 7.0 which is suggested by Blair (1979) as optimum for most plant growth. The surface pH of 6Dbh was 5.7 and group B was 7.8. The pH thoughout the profile of group A soil types was lower than that for group B soil types. Of the solodic-solodized solonetz, the pH at 0.3 m is lowest for 6Drc and highest for group D soil types.

Field pH, determined by the method of Raupach and Tucker (1959), was strongly correlated to the 1:5 pH determined in the laboratory, $r^2 = 0.99$ (n=77).

5.3 Salinity

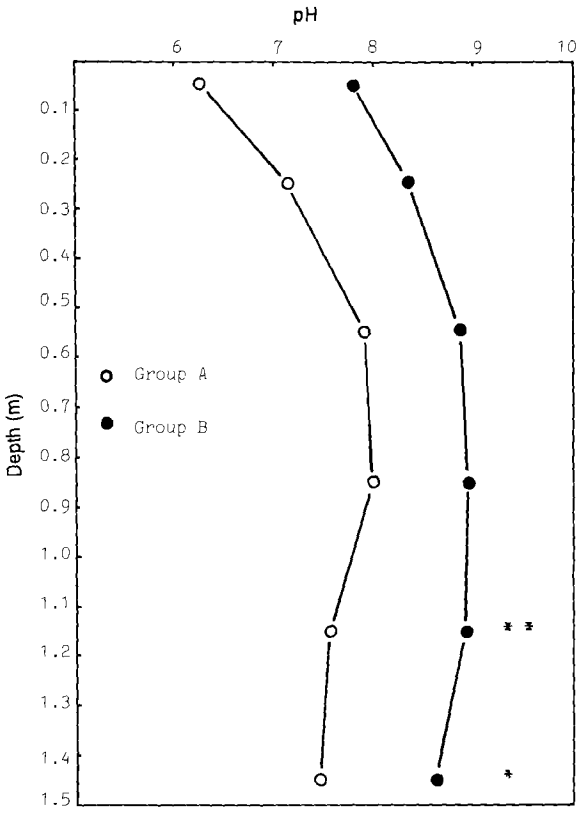
Excessive levels of total soluble salts affect crop growth by reducing water availability through osmotic pressure effects and by toxic effects on plant metabolism. Total soluble salt content was determined by electrical conductivity on 1:5 soil to water mixture (EC1:5). Although EC1:5 is a convenient laboratory measurement, the electrical conductivity of a saturation extract (ECse) is a more useful determination to relate to plant response (Shaw *et al.* 1986). The EC1:5 measurements were therefore converted to ECse values using the mathematical model developed by Shaw *et al.* (1986).

Figures 5.3.1 and 5.3.2 show the ECse profiles for the sampled cracking clays and solodic-solodized solonetz.

The cracking clays have very low ECse levels at the surface increasing to high values at 1.1-1.2 m. Group B soil types have lower ECse values at 0.5-0.6 m and 0.8-0.9 m than group A soil types, but the differences are not significant. No pronounced salt bulge occurs in either group.

The ECse values at the surface (0-0.1 m) of the solodic-solodized solonetz are low to very low and all except 6Drc increase to high to very high at depth. Group D soil types have the highest ECse values, with very high levels at 0.5-0.6 m (9.6 dSm^{-1}). The ECse values for soil type 6Drc are low to 0.8-0.9 m and increase slightly to medium levels at 1.1-1.2 m.

A concentration of salts in the profile indicates the depth to which wetting under rainfall occurs (McCown *et al.* 1976; Mullins 1981). Group D soil types have a pronounced salt bulge at 0.8-0.9 m. Soil types 5Dyc and 6Dbh have a less pronounced salt bulge also at 0.8-0.9 m.



Significance of difference (**p=.01, *p=.05).

Figure 5.2.1 pH profiles for the sampled cracking clays, Mulgrave Section, BRIA.

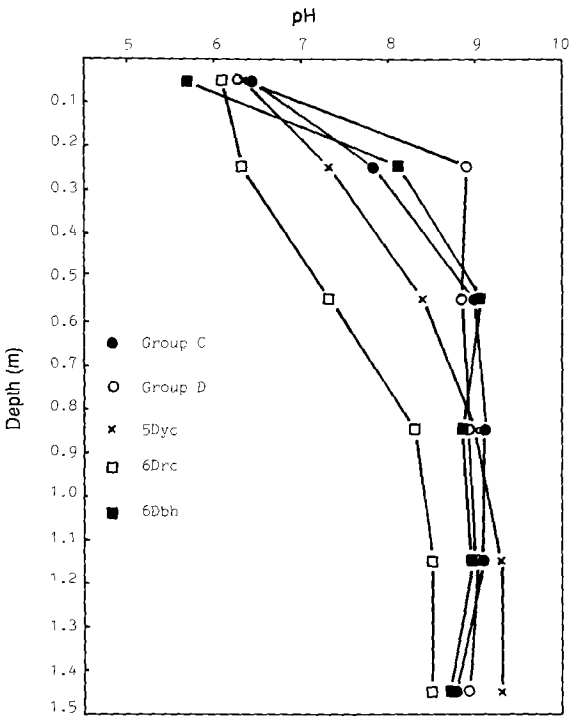
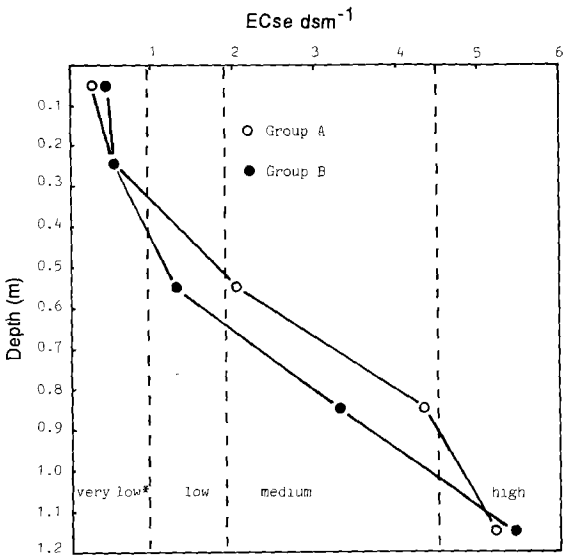
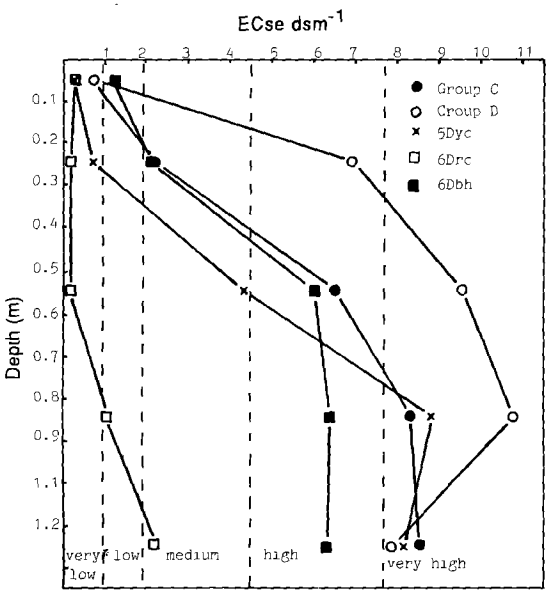


Figure 5.2.2 pH profiles for the sampled solodic-solodized solonetz, Mulgrave Section, BRIA.



* Ratings of Shaw et al 1986.

Figure 5.3.1 ECse profiles for the sampled cracking clays, Mulgrave Section, BRIA.



* Ratings of Shaw et al 1986.

Figure 5.3.2 ECse profiles for the sampled solodic-solodized solonetz, Mulgrave Section, BRIA.

Group A Soil types 2 Ugc and e
Group B Soil types 2 Ugh and k

Group C Soil types 2Dya and b
Group D Soil types 2Dba and 2Ddb

The proportion of the total soluble salts due to chloride (EC cl) has been estimated using the formula of Shaw *et al.* (1986). The estimated values are given in Table 5.3.1. The contribution of the chloride ion is lower at all depths for group B than for group A of the cracking clays, although the values are similar at 1.1-1.2 m. As chloride is a mobile ion, the lower value for the soil types of group B indicates a better leaching environment in the cracked state than those of group A. Field observations show that soil types of group B have larger and more frequent surface cracks than those of group A.

The chloride ion makes a major contribution to the total soluble salts in the B horizon of all solodic-solodized solonetz, except 5Dyc. The lower EC cl value for soil type 5Dyc indicates the presence of salts other than chloride, probably sodium carbonates.

Table 5.3.1. Estimated percentage of total soluble salts due to chloride (EC cl) for seven soil groups or soil types, Mulgrave Section, BRIA.

Soil group or soil type*	EC cl$^+$				
	0-0.1 m	0.2-0.3 m	0.5-0.6 m	0.8-0.9 m	1.1-1.2 m
A	65	66	81	89	85
B	21	17	34	63	72
C	55	83	70	73	75
D	60	75	82	81	76
5Dyc	33	60	54	69	59
6Drc	33	33	66	91	81
6Dbh	51	76	62	73	72

$^+$ estimated as EC cl = (Cl% * 6.64)/EC1:5 * 100 (after Shaw *et al.* 1986)

* Group A soil types 2Ugc and e
Group B soil types 2Ugh and k
Group C soil types 2Dya and b
Group D soil types 2Dba and 2Ddb

5.4 Cation exchange capacity and exchangable cations

Measurements of cation exchange capacity (CEC) and exchangeable cations can be used to indicate potential soil fertility.

Figures 5.4.1 to 5.4.7 illustrate mean profile trends for CEC and the exchangeable cations sodium, magnesium and calcium of the seven soil groups or soil types. Because of low values of potassium it was not feasible to present these on the same graph.

Using the ratings of Landon (1984), the A horizons of all cracking clays have high CEC. Magnesium is the major cation in group A soil types, while calcium is the dominant cation in the upper profile (to 0.6 m) of group B soil types.

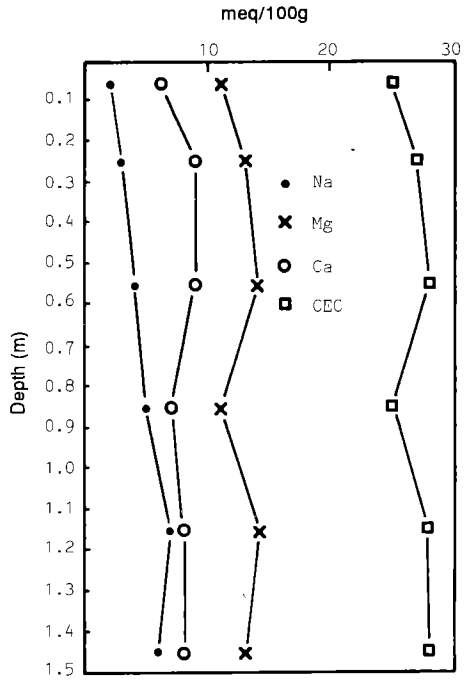


Figure 5.4.1 Exchangeable sodium, magnesium, calcium and cation exchange capacity (CEC) for group A soil types, Mulgrave Section, BRIA.

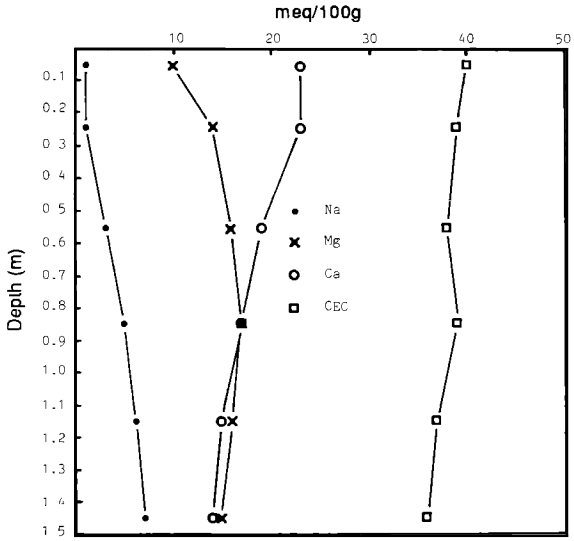


Figure 5.4.2 Exchangeable sodium, magnesium, calcium and cation exchange capacity (CEC) for group B soil types, Mulgrave Section, BRIA.

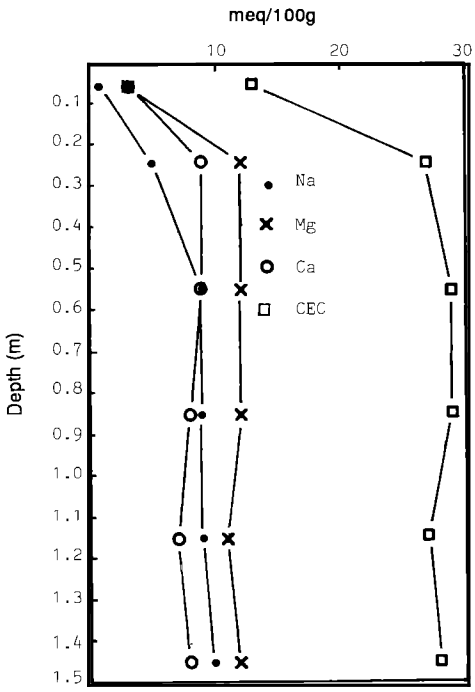


Figure 5.4.3 Exchangeable sodium, magnesium, calcium and cation exchange capacity (CEC) for group C soil types, Mulgrave Section, BRIA.

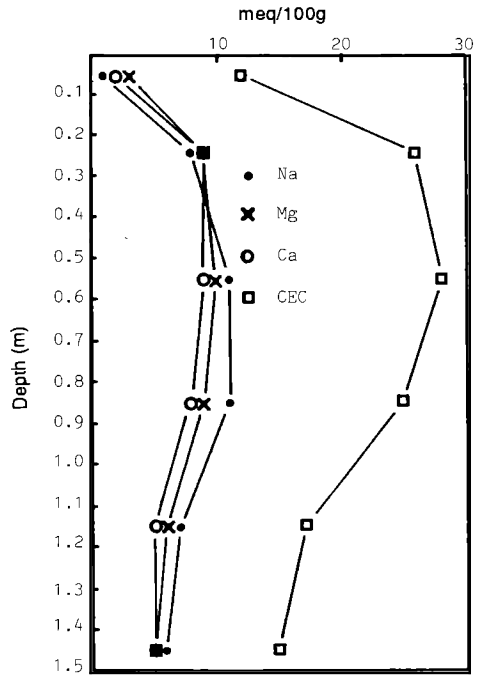


Figure 5.4.4 Exchangeable sodium, magnesium, calcium and cation exchange capacity (CEC) for group D soil types, Mulgrave Section, BRIA.

Group A Soil types 2 Ugc and e
Group B Soil types 2 Ugh and k

Group C Soil types 2Dya and b
Group D Soil types 2Dba and 2Ddb

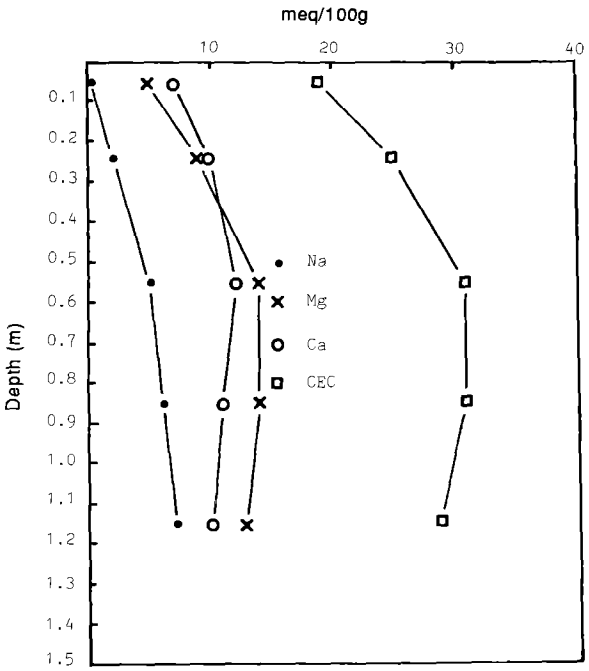


Figure 5.4.5 Exchangeable sodium, magnesium, calcium and cation exchange capacity (CEC) for 5Dyc, Mulgrave Section, BRIA.

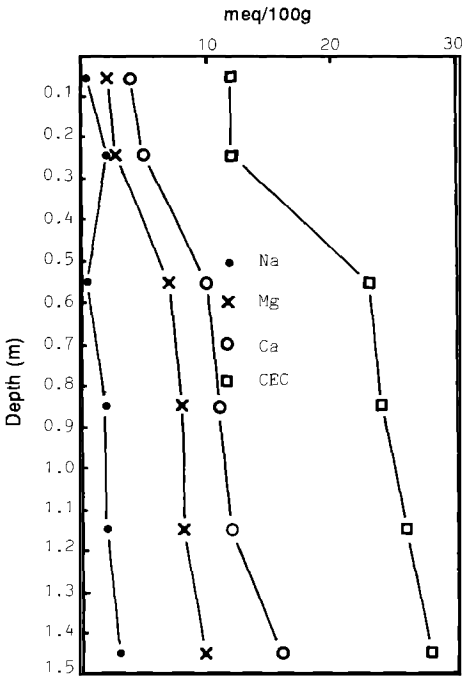


Figure 5.4.6 Exchangeable sodium, magnesium, calcium and cation exchange capacity (CEC) for 6Drc, Mulgrave Section, BRIA.

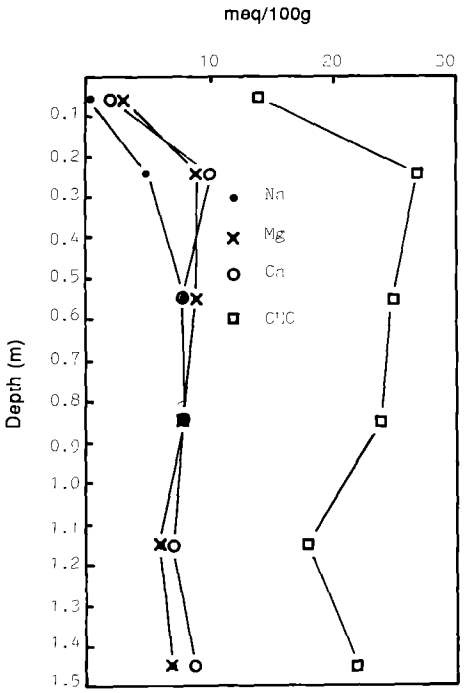


Figure 5.4.7. Exchangeable sodium, magnesium, calcium and caution exchange capacity (CEC) for 6Dbh, Mulgrave Section, BRIA.

The A horizons of all solodic-solodized solonetz except soil type 5Dyc have low CEC. Soil type 5Dyc has medium CEC. Magnesium is the major cation in group C soil types and soil type 5Dyc, while calcium is the major cation in soil type 6Drc. Calcium, magnesium and sodium have similar levels throughout the profile for group D soil types and soil type 6Dbh.

In most soils, exchangable calcium is regarded as the most important cation. In addition to being a plant nutrient, it promotes flocculation and inhibits soil dispersion. The levels of calcium required for optimum soil conditions and plant growth are difficult to assess as the requirements vary with a number of factors such as pH and the levels of other cations on the exchange complex (Landon 1984). However, soils with a calcium level of less than 5 m. eq. 100^{-1}g should be regarded as deficient. Using this criteria, all solodic-solodized solonetz except 5Dyc should be regarded as deficient.

The effects of exchangeable magnesium on the exchange complex are often considered equivalent to the effects of calcium. Darab (1980), however, shows that magnesium may adversely affect soil conditions. McNeal *et al.* (1986) and Bakker and Emerson (1973) have shown that sodium-magnesium soils have more clay dispersion and lower hydraulic conductivity than sodium-calcium soils. It is not clear when the level of magnesium is harmful. Rengasamy *et al.* (1984) suggest that when sufficient sodium is present, a 15% reduction in hydraulic conductivity of red-brown earths could occur if the exchangeable Ca/Mg ratio is less than 1.0.

Table 5.4.1 shows the mean calcium to magnesium ratio at two depths for the seven soil groups or soil types. The 0-0.1 m depth represents the surface and 0.5-0.6 m the subsoil.

The Ca/Mg ratio is much higher at the surface for group B of the cracking clays than for group A. This higher ratio may lead to increased clay flocculation and finer soil structure. Field observations show that group B soil types have moderately to strongly self mulching surfaces whereas group A soil types have hard setting to weakly self mulching surfaces.

All solodic-solodized solonetz except 6Drc have a Ca/Mg ratio less than 1.0 in the subsoil. When the Ca/Mg ratio is low, most of the calcium applied as gypsum is absorbed by the exchange complex and exchanged with magnesium (Loveday 1981). The amelioration effect of gypsum in reducing the sodium on the exchange complex of these soil types may therefore be reduced.

Table 5.4.2 shows the mean exchangeable potassium levels at three depths for the seven soil groups or soil types.

A level of 0.2 m. eq. 100^{-1}g is the critical level for exchangable potassium below which deficiencies occur (Williams and Lipsett 1960 and Piper and DeVries 1960). Based on this figure, soil type 5Dyc will require potassium fertiliser if cropping is attemped on this soil type. A similar low potassium level has been found in soil type 5Dyc in the Leichhardt Downs Section (Donnollan *et al.*, 1990). Levels of potassium below the surface depth

(0-0.1 m) are very low for group A and D soil types and 6Dbh. These soil types may require potassium fertilisers if the subsoil is exposed following levelling or this surface reserve is depleted by cropping.

Table 5.4.1 Mean calcium to magnesium ratio at two depths for seven soil groups or soil types, Mulgrave Section, BRIA.

Soil group or soil type*	Ca/Mg ratio	
	0-0.1 m	0.5-0.6 m
A	0.53	0.65
B	14.25	1.21
C	0.71	0.96
D	0.67	0.77
5Dyc	1.45	0.85
6Drc	1.90	1.51
6Dbh	0.89	0.95

Table 5.4.2 Mean exchangeable potassium levels at three depths for seven soil groups or soil types, Mulgrave Section, BRIA.

Soil group or soil type	Exchangeable potassium (meq/100)		
	0-0.1 m	0.2-0.3 m	0.5-0.6 m
A	0.27	0.09	0.11
B	0.64	0.34	0.34
C	0.45	0.20	0.19
D	0.35	0.11	0.14
5Dyc	0.17	0.08	0.16
6Drc	0.50	0.32	0.52
6Dbh	0.62	0.12	0.20

* Group A soil types 2Ugc and e
Group B soil types 2Ugh and k
Group C soil types 2Dya and b
Group D soil types 2Dba and 2Ddb

5.5 Sodicity and dispersion

5.5.1 Sodicity

High levels of sodium ions can affect plant growth by direct toxicity, development of poor soil physical conditions or by causing imbalances between calcium and magnesium.

Northcote and Skene (1972) developed three sodicity classes based on exchangeable sodium percentage or ESP[1]. Soils with an ESP less than 6.0 are termed non-sodic soils, soils with an ESP 6.0 to 14.0 sodic soils and soils with an ESP of greater than 15.0 strongly sodic soils. In this survey, a value of 14.0 was used to separate sodic and strongly sodic soils.

Profile trends of ESP for the seven soil groups or soil types are presented in Figures 5.5.1 and 5.5.2.

ESP is higher throughout the profile for group A of the cracking clays than for group B, although the difference is significant only at 0-0.1m and 0.2-0.3m (Students T test). Both groups become strongly sodic at depth.

All solodic-solodized solonetz, except 5Dyc and 6Drc, are strongly sodic by 0.2-0.3 m. Soil types of group D have the highest ESP, increasing to over 40 lower in the profile. Soil type 5Dyc becomes strongly sodic by 0.5-0.6 m. These high ESP levels combined with the low Ca/Mg ratios suggest clay dispersion would be high and hydraulic conductivity very low. Soil type 6Drc has the lowest ESP and the highest Ca/Mg ratio of all the sampled solodic-solodized solonetz.

5.5.2 Dispersion

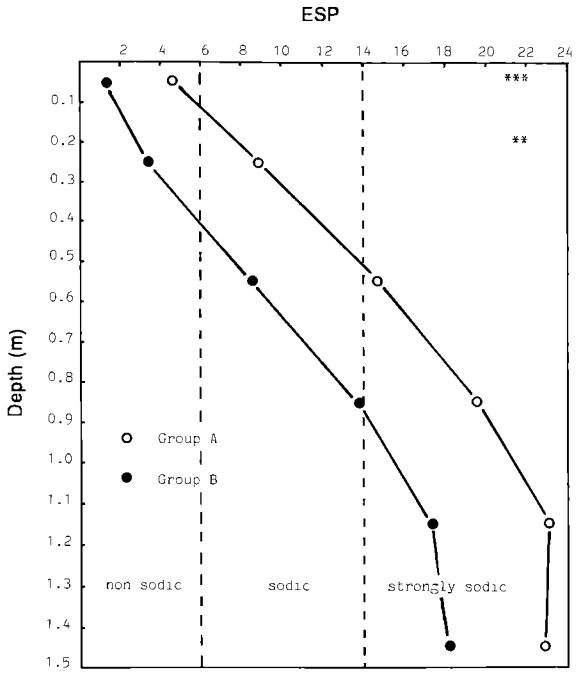
The tendency for soils to disperse in water has been quantified in terms of a dispersion ratio index, R1. High dispersion ratios suggest low permeability. Mean values for R1 for the seven soil groups or soil types are presented in Table 5.5.1.

Baker (1977) has used the following rating for the R1 value:

. R1 > 0.8 as a high tendency to disperse (undesirable);
. R1 0.6-0.8 moderate tendency to disperse;
. R1 < 0.6 low to moderate tendency to disperse (desirable).

Using these criteria, group A, C and D soil types and 6Dbh have a high tendency to disperse at and below 0.2 to 0.3 m. The surfaces of all sampled soil types have a low to moderate tendency to disperse.

[1] ESP = Na/CEC * 100 where Na = Exchangeable sodium
CEC = Cation exchangeable capacity



Significance of difference (***p=.01, **p=.01).

Figure 5.5.1 ESP profiles for the sampled cracking clays, Mulgrave Section, BRIA.

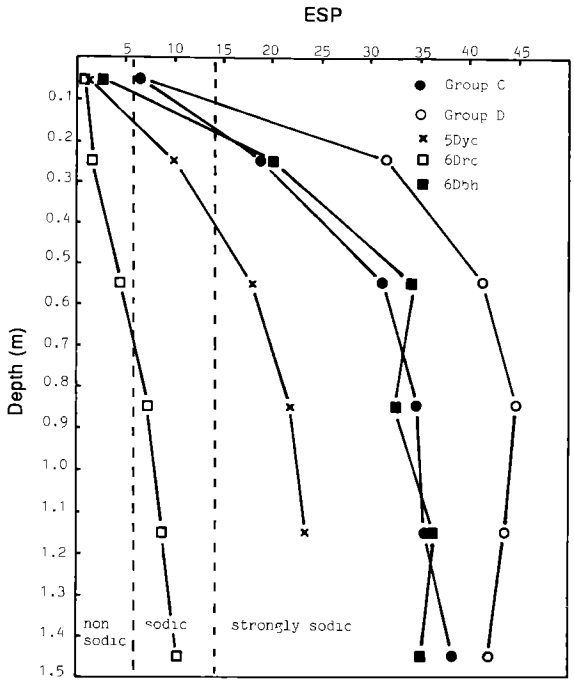


Figure 5.5.2 ESP profiles for the sampled solodic-solodized solonetz, Mulgrave Section, BRIA.

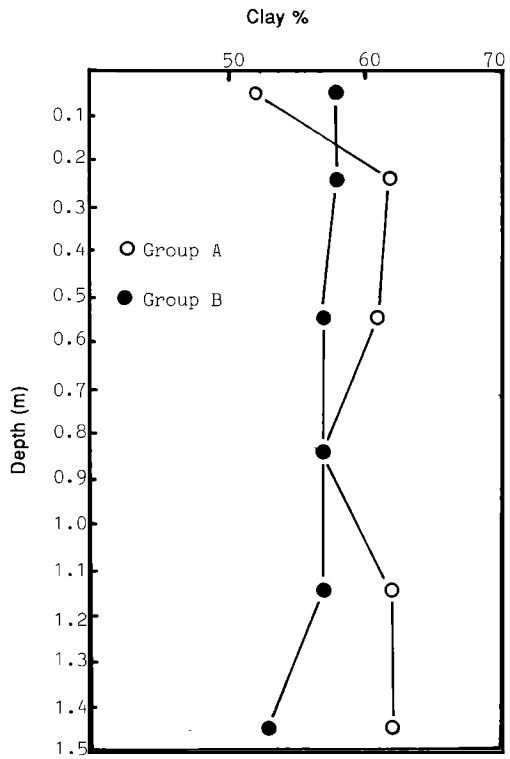


Figure 5.6.1 Clay percentage profiles for the sampled cracking clays, Mulgrave Section, BRIA.

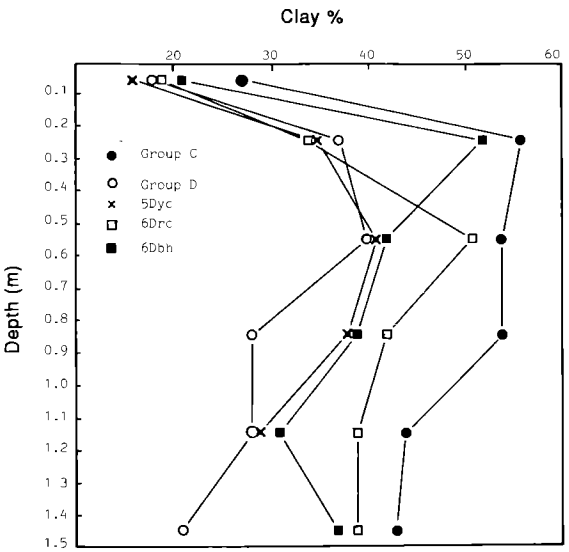


Figure 5.6.2 Clay percentage profiles for the sampled solodic-solodized solonetz, Mulgrave Section, BRIA.

Group A Soil types 2 Ugc and e
Group B Soil types 2 Ugh and k

Group C Soil types 2Dya and b
Group D Soil types 2Dba and 2Ddb

Table 5.5.1 Mean R1 value at four depths for seven soil groups or soil types Mulgrave Section, BRIA.

Soil group or soil type*	R1			
	0-0.1 m	0.2-0.3 m	0.8-0.9 m	1.1-1.2 m
A	0.54	0.86	0.96	0.99
B	0.45	0.55	0.77	-
C	0.64	0.88	0.96	0.94
D	0.70	0.92	0.92	0.98
5Dyc	0.63	0.71	0.72	0.63
6Drc	0.60	0.54	0.67	-
6Dbh	0.65	0.87	0.94	0.98

* Group A soil types 2Ugc and e
Group B soil types 2Ugh and k
Group C soil types 2Dya and b
Group D soil types 2Dba and 2Ddb

5.6 Clay content, clay activity ratio and clay mineralogy

5.6.1 Clay content

Clay percentage profiles for the seven groups or soil types are given in figures 5.6.1 and 5.6.2. Generally, the clay content agrees with the field texture.

The clay content at the surface of group A of the cracking clays is lower than that for group B. The field texture of group A soils is light to light-medium clay whereas for group B it is medium to medium-heavy clay.

Group C of the solodic-solodized solonetz has the highest clay content of the B horizon and group D the lowest. The decrease in clay content at depth in group D and soil type 6Dbh is due to the presence of lighter textured D horizons, whereas the decrease at depth of 5Dyc is due to the precence of the C horizon.

5.6.2 Clay activity ratio (CCR) and clay mineralogy

The clay activity ratio (CCR) can be used as an indication of clay mineralogy (Landon 1984), and is defined as cation exchange capacity over clay content.

Mean CCR at three depths for the seven soil groups or soil types is given in Table 5.6.1. The 0-0.1 m depth has not been included as the contribution to CEC from organic matter is expected to be highest at this depth. Using the criteria of Shaw *et al.* (1986), the CCR of all solodic-solodized solonetz soil types indicates they are a mixture of kaolinite and montmorillonite, except 6Drc and which has a low CCR indicating a high proportion of kaolinite clay. Soil types of group A of the cracking clays have lower CCR, which indicates

lower proportions of montmorillonite, and therefore less cracking, than those of group B. Field observations show that soil types of group A have less frequent, smaller cracks than those of group B.

Coughlan (1979) using x-ray diffraction of A horizon material of a Barratta clay site with a CCR of 0.62 found it contained interstratified expanding layer silicate (or poorly crystalline montmorillonite), kaolinite, quartz, illite and interstratified kaolin-montmorillonite in the <2um fraction.

Table 5.6.1 Mean clay activity ratio at three depths for seven soil groups or soil types, Mulgrave Section, BRIA.

Soil group or soil type*	Clay activity ratio (CEC g^{-1} of clay)		
	0.2-0.3 m	0.5-0.6 m	0.8-0.9 m
A	0.44	0.47	0.45
B	0.68	0.68	0.68
C	0.75	0.75	0.87
D	0.51	0.56	0.55
5Dyc	0.71	0.77	0.81
6Drc	0.36	0.45	0.57
6Dbh	0.53	0.59	0.62

* Group A soil types 2Ugc and e
Group B soil types 2Ugh and k
Group C soil types 2Dya and b
Group D soil types 2Dba and 2Ddb

5.7 Plant available water capacity

The plant available water capacity (PAWC) of a soil is important in irrigation scheduling. PAWC is obtained by measuring the difference between the upper soil water storage (field capacity) and the lower storage limit (wilting point). However, because direct field measurements of PAWC are difficult and costly, PAWC is usually estimated by the use of predictive mathematical relationships.

Gardner and Coughlan (1982) and Ahern (1988) showed that for cracking clays and solodic-solodized solonetz the equations of Shaw and Yule (1978), based on CEC and water held in the soil at -1500 KPa water potential, give better estimates of PAWC than the difference between water held in the soil at -33 and -1500 KPa.

The depth of wetting for soils with restricted subsoil permeability has to be considered when using these equations. McCown *et al.* (1976) and Mullins (1981) showed for such soils, the depth of wetting can be estimated from the depth to the maximum concentration of soluble salts. Ahern (1988) also showed the maximum rate of increase in chloride was in good agreement with measured depths of wetting in soils of the BRIA.

Table 5.7.1 shows predicted PAWC using two different mathematical relationships and predicted root depth for the seven soil groups or soil types. Both groups of cracking clays have similar predicted PAWC of 12.3 to 13.6 cm. All solodic-solodized solonetz also had similar predicted PAWC of 9.4 to 9.8 cm. The predicted rooting depth was 0.9 m for both cracking clay groups and soil type 6Drc. All other solodic-solodized solonetz soil types or groups had a predicted rooting depth of 0.6 m.

The -1500 KPa and CEC equation give show similar results for all soils or groups except 6Drc. For 6Drc, which is essentially a freely drained soil to at least 0.9 m, the prediction based on CEC was much lower than that based on -1500 KPa. This trend agrees with data reported in Ahern (1988) who suggested the CEC based equations underestimate PAWC for freely drained soils.

Gardner and Coughlan (1982) reported a measured PAWC of 8.0 cm and rooting depth of 0.6m for a 2Dyb site (2Dyb is within group C). This is lower than the predicted PAWC of 9.4 to 9.6 cm.

Table 5.7.1 Mean predicted PAWC and rooting depth for seven soil groups or soil types, Mulgrave Section, BRIA.

Soil group or soil type*	PAWC[1] (cm)	PAWC[2] (cm)	Predicted rooting depth[3] (m)
A	12.9	12.3	0.9
B	13.1	13.6	0.9
C	9.6	9.4	0.6
D	9.7	9.6	0.6
5Dyc	9.6	9.7	0.6
6Drc	12.6	9.8	0.9
6Dbh	9.6	9.4	0.6

* Group A soil types 2Ugc and e
Group B soil types 2Ugh and k
Group C soil types 2Dya and b
Group D soil types 2Dba and 2Dbh

[1] equation of Shaw and Yule (1978) based on -1500 KPa value and depth
[2] equation of Shaw and Yule (1978) based on CEC and depth
[3] based on max. rate of Cl increase

5.8 Total phosphorus and potassium

Measurements of total phosphorus and total potassium can give an indication of the reserves of these elements in the soil. Total phosphorus and potassium profiles for the seven groups or soil types appear in Figures 5.8.1 to 5.8.4.

5.8.1 Total phosphorus

Using the criteria of Bruce and Rayment (1982), the total phosphorus levels are low to medium throughout for all soil types or groups except 5Dyc. Soil type 5Dyc has high to very high levels at depth which may reflect the total phosphorus content of the decomposing rock.

All soil types or groups, expect group A, have higher phosphorus levels at the surface (0-0.1 m) than at 0.2-0.3 m. This probably reflects the contributions to the total phosphorus pool from soil organic material. The levels for group A are very consistent with depth. The levels at depth for all other soil types or groups are higher than at 0.2-0.3 m. This profile trend is reported for similar soil types in Reid (1978) and Reid and Baker (1984). Reid (1978) reported this deep subsoil phosphorus from a Barratta clay site (similar to soil types of groups A and B) was extractable by acid but not bicarbonate solution and suggested it was mainly apatite minerals which have low plant availability.

5.8.2 Total potassium

There are large differences between levels of some soil types or groups. Soil types of group A of the cracking clays have levels that are approximately one-third of those of group B. This low value for group A contrasts sharply with values for similar soil types reported elsewhere in the BRIA (Thompson 1977; Reid and Baker 1984; Donnollan *et al.* 1990) which have values of 1.0-1.5%.

Soil type 5Dyc has similar total potassium levels to those of group A of the cracking clays. All other solodic-solodized solonetz groups or soil types have levels around 1.5 to 2.0%, with 6Drc having values greater than 2.0%.

Little and Ward (1981) suggest total potassium levels in soils developed on alluvium decrease with increasing age of the soil. However, the alluvium of this study area may have come from a diverse range of sources (because of the size of the catchment of the Burdekin River) and therefore it is difficult to correlate total potassium content of the soil types of this area with their age. The total potassium levels of the relict alluvium (6Dbh and 6Drc) are higher than the younger alluvial plain deposits (group C and D soil types). The comparatively low potassium levels of soil types of group A of the cracking clays may, however, suggest that they are older than the soil types of group B.

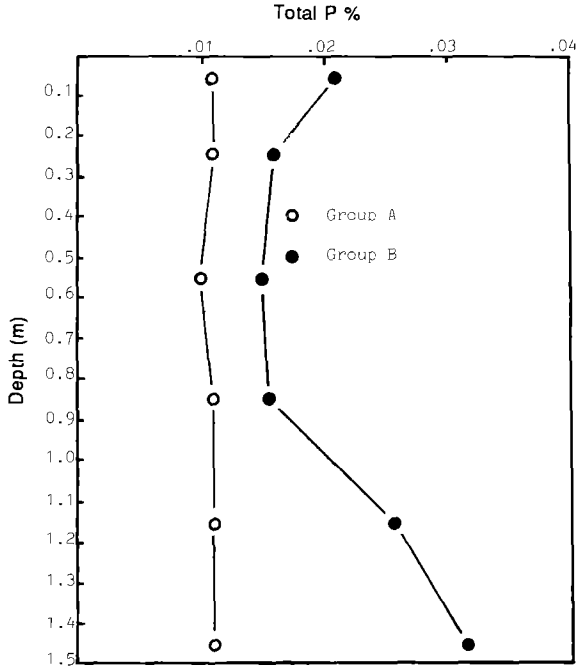


Figure 5.8.1 Total phosphorus profiles for the sampled cracking clays, Mulgrave Section, BRIA.

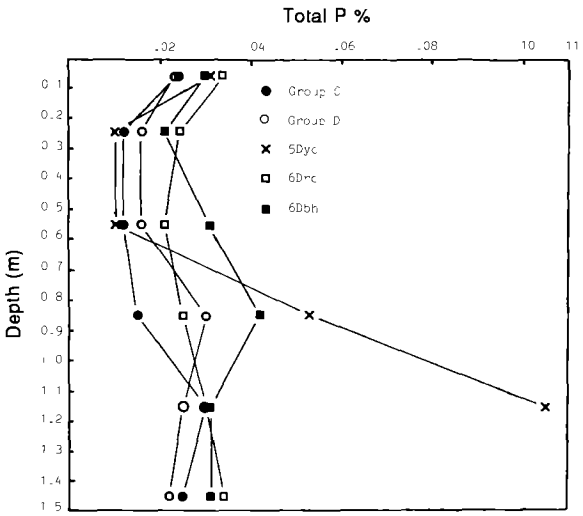


Figure 5.8.2 Total phosphorus profiles for the sampled solodic-solodized solonetz, Mulgrave Section, BRIA.

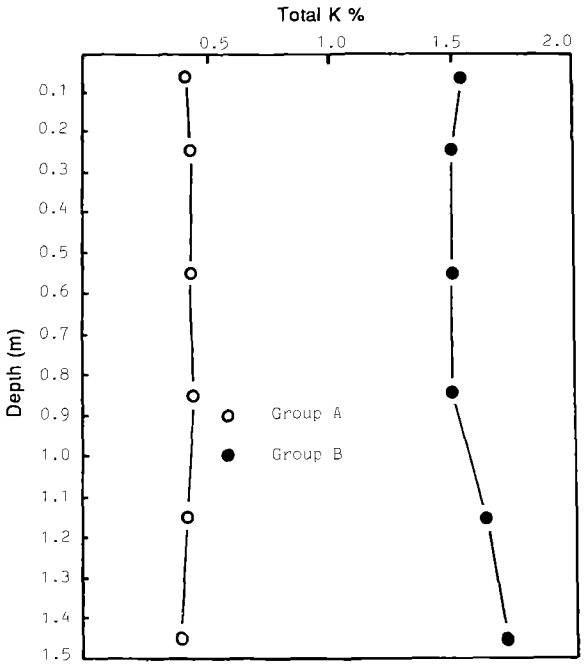


Figure 5.8.3 Total potassium profiles for the sampled cracking clays, Mulgrave Section, BRIA.

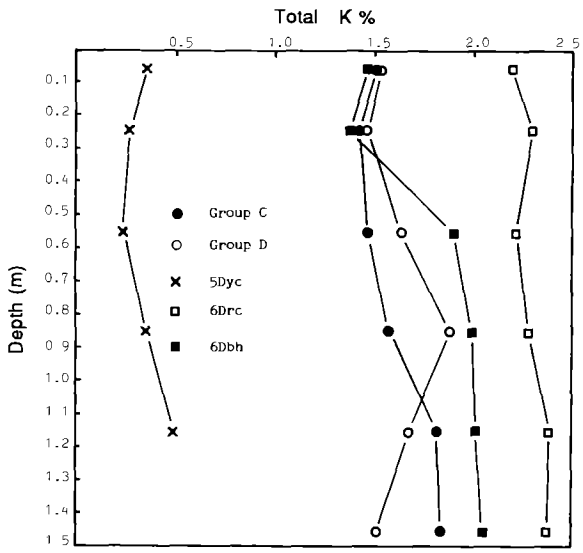


Figure 5.8.4 Total potassium profiles for the sampled solodic-solodized solonetz, Mulgrave Section, BRIA.

Group A Soil types 2 Ugc and e
Group B Soil types 2 Ugh and k

Group C Soil types 2Dya and b
Group D Soil types 2Dba and 2Ddb

5.9 Extractable phosphorus

Acid and bicarbonate extractable phosphorus levels for the seven soil groups or soil types appear in Table 5.9.1. Except for soil type 5Dyc, all have very low levels of both acid and bicarbonate extractable phosphorus, based on the ratings of Bruce and Rayment (1982). This trend has been observed in other BRIA surveys (Thompson 1977; Reid and Baker 1984; Donnollan *et al.*, 1990). Soil 5Dyc has low values for acid extractable phosphorus. Plant response to the addition of phosphorus fertiliser is expected to be marked on all soil types in this survey area.

In a pot experiment using lucerne as the test plant, Maltby and McShane (1988) showed significant yield increases with the addition of phosphorus on soil types 2Ugh (group B), 2Uge (group A), and 2Dyb (group C) which were sampled from the Burdekin Agricultural College just to the north of this survey area. The amount of phosphorus required to achieve 90% maximum yield of lucerne was estimated at 95 kg/ha for 2Dyb and 75-85 kg/ha for 2Ugh and 2Uge. Rice responded to phosphorus fertilisation on soils 2Uge and 2Ugh, with the estimated amount of phosphorus required to achieve 90% maximum yield as 5 kg/ha on 2Uge and 25 kg/ha on 2Ugh. This higher estimated value for 2Ugh accounted for the reduced availability of phosphorus from exposed mounds with high pH (greater than 7.5).

Table 5.9.1 Acid and bicarbonate - extractable phosphorus levels for surface (0-0.1 m) bulk samples of seven soil groups or soil types, Mulgrave Section, BRIA.

Soil group or soil type*	Acid-P (ppm)	Bicarb-P (ppm)
A	2	4
B	4	4
C	2	5
D	6	7
5Dyc	17	9
6Drc	5	9
6Dbh	5	5

* Group A soil types 2Ugc and e
Group B soil types 2Ugh and k
Group C soil types 2Dya and b
Group D soil types 2Dba and 2Ddb

5.10 Organic carbon, nitrogen and total sulphur

Measurements of total nitrogen and total sulphur determined on the bulk 0-0.1 m sample indicate likely plant response to nitrogen or sulphur. Organic carbon measurements and carbon to nitrogen (C:N) ratio indicate the likely importance of nitrogen mineralisation and immobilisation of nitrogen by soil micro-organisms.

Table 5.10.1 gives organic carbon (unadjusted Walkley and Black), total nitrogen, total sulphur and C:N ratio for the surface of the seven soil groups or soil types. Using the criteria of Bruce and Rayment (1982) all soil types or soil groups have low organic carbon and total nitrogen, which is similar to results reported in Reid and Baker (1984). These results suggest plant response to the addition of nitrogen will be marked on all soil types of this area. C:N ratios are narrow (< 15) which suggests little nitrogen immobilisation loss will occur.

In a pot experiment, Maltby and McShane (1988) showed addition of sulphur increased lucerne dry matter yields on soils 2Ugh (group B), 2Uge (group A) and 2Dyb (group C) and sulphur deficiency was a distinct possibility on these soil types. Rice dry matter yields were increased on soil types 2Uge and 2Ugh by the addition of sulphur.

Andrew *et al* (1974) indicates responses to sulphur could occur on soils with less than 0.013% total sulphur. Using this criteria, five of the seven soil types or groups are either deficient or marginally deficient in sulphur. This low sulphur status will be further compounded with the use of concentration phosphatic fertilisers, as added phosphate can be expected both to displace absorbed sulphate and reduce the capacity of surface horizons to absorb additional sulphate ions (Blair 1979). Sulphur deficiency is expected to increase as the area is developed.

Table 5.10.1 Mean organic carbon, total nitrogen, total sulphur and carbon to nitrogen ratio for surface (0-0.1 m) bulk samples of seven soil groups or soil types, Mulgrave Section, BRIA.

Soil group or soil type*	Organic carbon %	Total nitrogen %	Total sulphur %	C:N ratio
A	0.79	0.06	0.010	13
B	1.03	0.07	0.015	14.7
C	0.99	0.08	0.014	12.4
D	0.73	0.07	0.010	11.1
5Dyc	1.12	0.08	0.020	14.0
6Drc	1.00	0.07	0.012	14.3
6Dbh	1.10	0.08	0.020	13.8

* Group A soil types 2Ugc and e
Group B soil types 2Ugh and k
Group C soil types 2Dya and b
Group D soil types 2Dba and 2Ddb

5.11 Trace Elements

Measurements of DTPA extractable trace elements manganese (Mn), copper (Cu) and zinc (Zn) for the bulk 0-0.1 m sample give indications of deficiencies of these elements. Values for DTPA extractable trace elements for the surface (0-0.1 m) of the seven soil groups or soil types are given in Table 5.11.1.

Using the ratings of Bruce and Rayment (1982), manganese levels are high for all soil types or soil groups except group B which have medium values. Copper and zinc levels are medium for all soil types or groups except 6Dbh which has a low zinc level.

In a pot experiment using the surface 0-0.1m and lucerne as the test plant Maltby and McShane (1988) recorded copper deficiency in soil 2Dyb (group C) and suggest zinc levels should be adequate on soils 2Uge (group A), 2Ugh (group B) and 2Dyb. However, these experiments were on the surface 0-0.1 m of a number of soils, with the highest pH being 7.1. Mikkelsen and Kuo (1976) have shown that zinc deficiencies are common in soils with pH of 7.4 or higher. The exposure of subsoils with high pH (>7.5) results in sorption of phosphorus and reduced availability of zinc. Most solodic-solodized solonetz and some cracking clays after levelling will therefore require additional phosphorus and zinc applications due to exposure of alkaline subsoils.

Table 5.11.1 Mean levels of DTPA extractable trace elements for surface (0-0.1m) bulk samples of seven soil groups or soil types, Mulgrave Section, BRIA.

Soil group or soil type*	DTPA extractable (ppm)		
	Mn	Cu	Zn
A	78	2.1	0.7
B	46	2.7	0.6
C	56	1.8	0.7
D	71	1.6	0.7
5Dyc	79	1.0	0.9
6Drc	61	1.2	2.8
6Dbh	55	1.4	0.3

* Group A soil types 2Ugc and e
Group B soil types 2Ugh and k
Group C soil types 2Dya and b
Group D soil types 2Dba and 2Ddb

5.12 Comparisons of mounds and depressions of gilgai

Comparisons of mound and associated depression profiles can give indications of the likely effects of levelling.

A separate mound and depression profile was sampled and analysed from five of the cracking clay sample sites. Comparisons were made between pH, ESP, ECse and Clay% of the mound and corresponding depression. Profile trends appear in Figures 5.12.1 to 5.12.4.

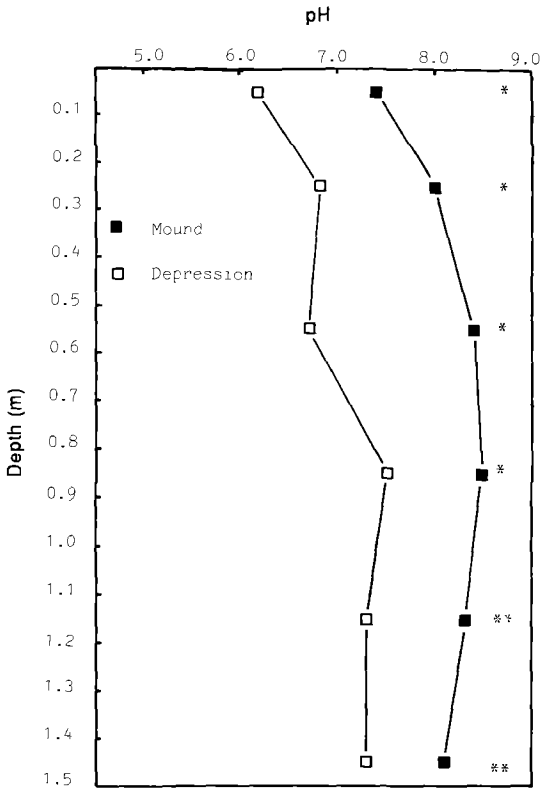
The pH at all sampled depths of the mounds was significantly higher than the pH of the depressions. However, ESP was similar at all depths except 1.1-1.2 m. Calculated ECse was similar to 0.8-0.9 m for both mounds and depressions. The ECse was slightly lower for depressions than the mounds at 1.1-1.2 m. The surface (0-0.1 m) clay content of the mounds was significantly higher than the depressions.

Hallsworth *et al.* (1955), Beckman and Thompson (1960) and Thompson and Beckman (1982), have shown differences between pH, clay percentage, clay type and nutrient status of mounds and depression of gilgai soils. Beckman and Thompson (1960) indicated that uneven crop growth due to differences between mounds and depressions of a black earth in the Kurrawa area of the Darling Downs could be expected in the first few years of cultivation. These differences were attributed to different soil chemical conditions of the mound and the depression. Such differences are expected in the cracking clays of this area because of the differences in pH and to lesser extent ECse in the mounds and depressions. Smith and McShane (1981) report a stronger leaching environment currently exists in the mounds than the corresponding depressions of Barratta clays. The depth of wetting of the mounds was 1.15 m whereas for the corresponding depression it was 0.85 m. To reduce variability in crop stands, exposed subsoils of the mounds, which will be mostly alkaline, will require additional fertilisers, particularly phosphorus and zinc.

5.13 Comparisons between 2Ugd2 and 2Ugd

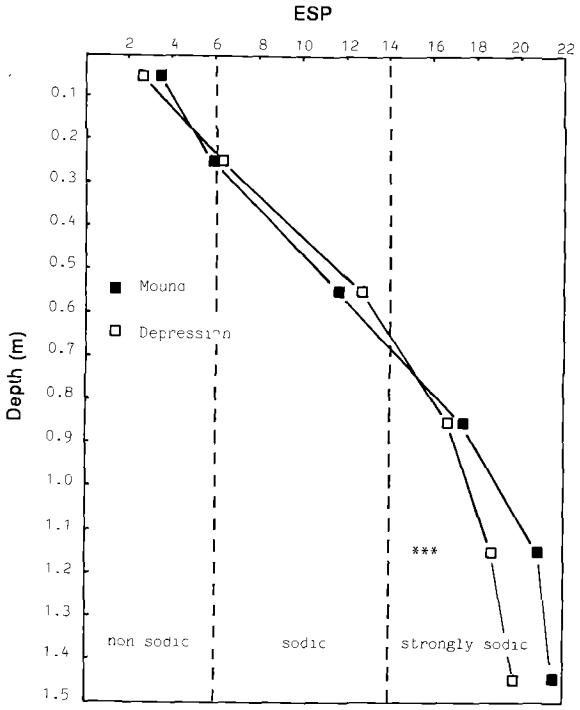
An important variant of the soil type 2Ugd was sampled and analysed (2Ugd2, site 3). This variant has sand to loamy sand D horizons from 1.3 to 1.6 m which are not normally associated with soil type 2Ugd. The size and location of UMAs of this variant may be of concern for rice production, as deep drainage losses are expected to be greater than on soil type 2Ugd because of the presence of these D horizons. Comparisons between the pH, ESP and ECse of site 3 and the average values for the same parameters for other profiles of soil type 2Ugd at the same depths are shown in Figures 5.13.1 to 5.13.3. pH is similar for site 3 and the average of 2Ugd. The ESP of site 3 is slightly higher than the average of 2Ugd at 0.5-0.6 m but becomes lower in the sandy D horizons. However, except for 0.5-0.6 m, the ECse of site 3 is much lower throughout the profile than the average of 2Ugd. This suggests a more favourable leaching environment.

An experiment was conducted using 3 ponded rice bays each 5 m square on a 2Ugd2 site from within this survey area to measure deep drainage losses (McShane, personal communication). The average deep drainage loss for each bay was 1mm/day although one value was 6mm/day. This compares with 1 to 3 mm/day for most cracking clays of the BRIA (Gardner and Coughlan 1982). This ponded mini-bay work proved inconclusive due to the uncleared state of the site and the likely influence of adjacent trees. However, the one value of 6mm/day does indicate some preferential deep drainage path or excessive water use. Ahern and Rosenthal (1988) calculated no difference in mean predicated deep drainage loss under irrigation between 2Ugd and 2Ugd2.



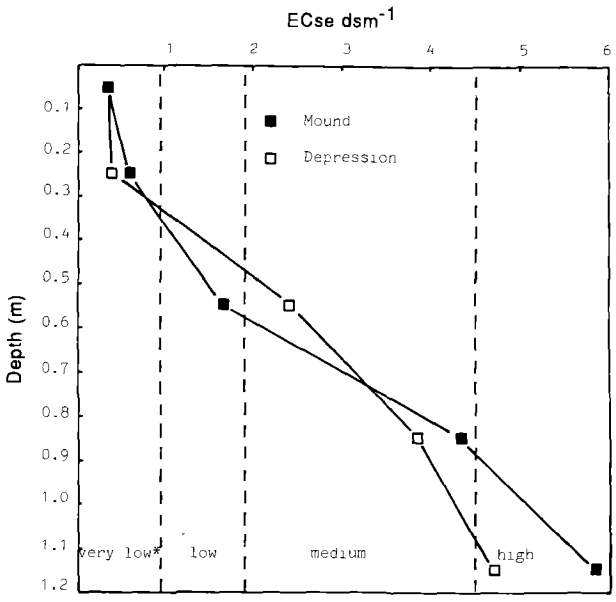
Significance of difference (*p=.05, **p=.01).

Figure 5.12.1 pH profiles for mounds and depressions of the sampled cracking clays, Mulgrave Section, BRIA.



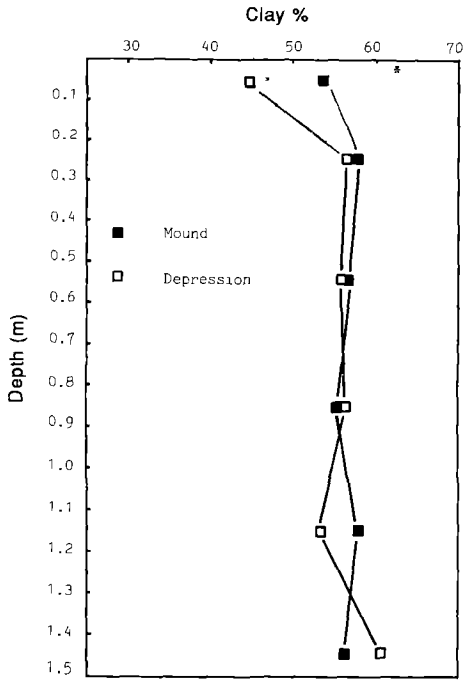
Significance of difference (***p=.001)

Figure 5.12.2 ESP profiles for mounds and depressions of the sampled cracking clays, Mulgrave Section, BRIA



* Ratings of Shaw et al 1986.

Figure 5.12.3 ECse profiles for mounds and depressions of the sampled cracking clays, Mulgrave Section, BRIA.



Significance of difference (*p=.05)

Figure 5.12.4 Clay percentage profiles for mounds and depressions of the sampled cracking clays, Mulgrave Section, BRIA.

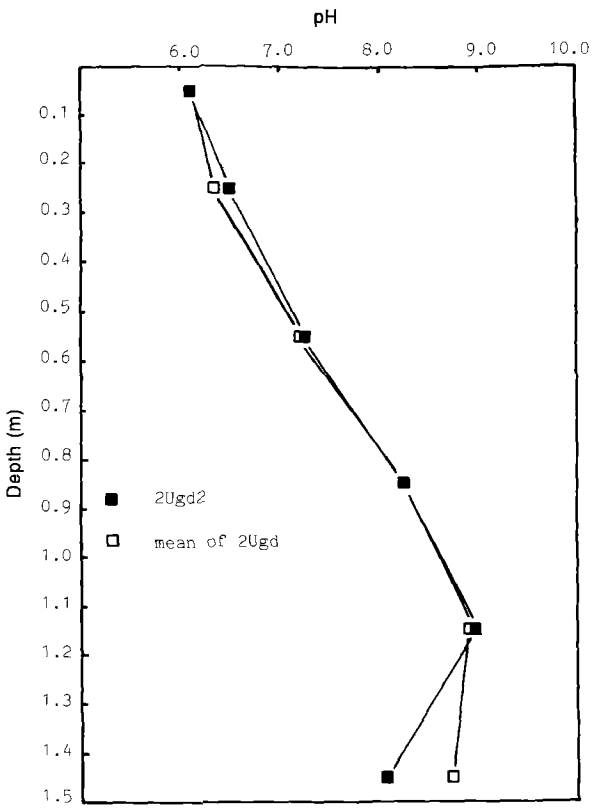


Figure 5.13.1 pH profiles for 2Ugd2 and mean of 2Ugd from Reid and Baker (1984).

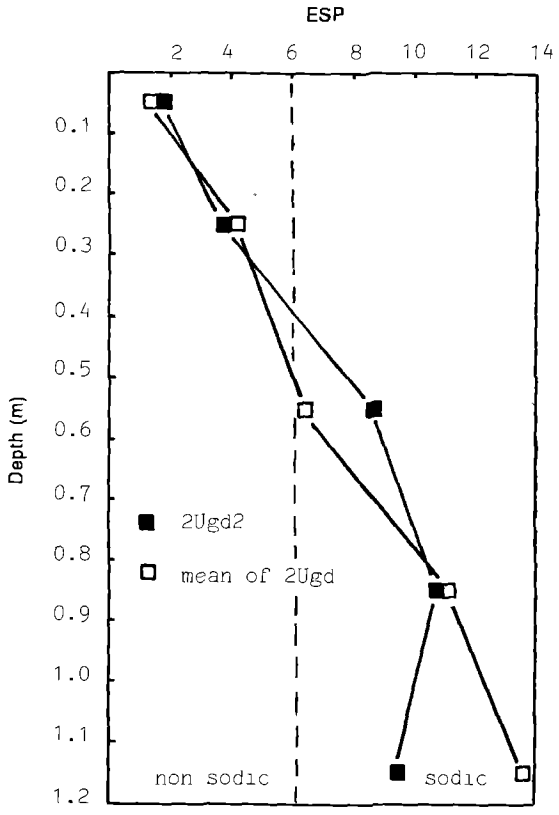
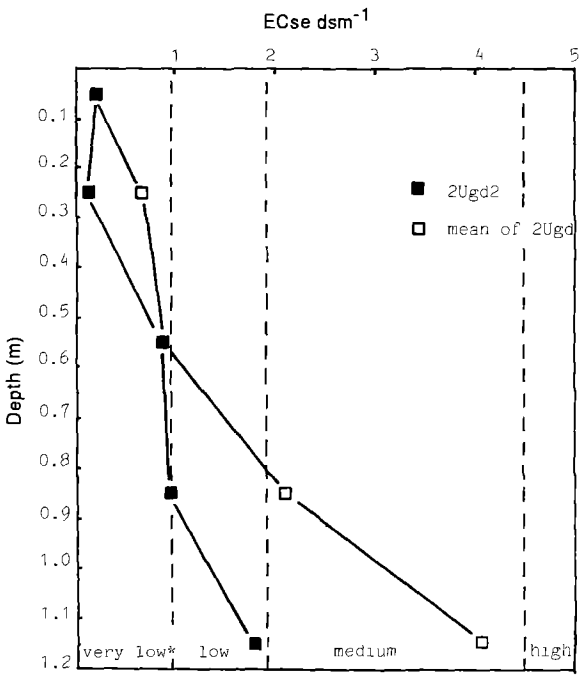


Figure 5.13.2 ESP profiles for 2Ugd2 and mean of 2Ugd from Reid and Baker (1984).



* Ratings of Shaw et al 1986.

Figure 5.13.3 ECse profiles for 2Ugd2 and mean of 2Ugd from Reid and Baker (1984).

6 LAND USE

6.1 Current land use

The majority of the area at the time of survey was leased by "Woodhouse Holdings" and used for beef cattle grazing on native pastures. Limited clearing had been undertaken. Approximately 200 ha was under crops. A small area in the south-east had been cleared and used for grazing and irrigated sorghum. Further small areas have been cropped under irrigation in the north-east. Crops grown included maize, sugar-cane, sunflower, legume seeds, rockmelons and rice. A gravel air-strip had been established in the north-east.

Since the time of survey, channels and associated drains have been constructed by WRC as part of the the development of the Burdekin River Irrigation Area. A total of 25 new irrigation blocks have been offered for sale by WRC within the Mulgrave Section to the end of 1990. Rice, sugar-cane and rockmelons have been successfully grown.

6.2 Land suitability

The suitability of each UMA was assessed for furrow irrigation of sugar-cane, grain crops and small crops and low volume irrigation of mangoes. Flood irrigation of rice was assessed using a separate classification. The classifications used for this assessment contain five classes with the suitability decreasing from class 1 to 5 and agree with the definitions of Land Resource Branch staff (1990).

A short definition of the classes is given below:

. Class 1 Suitable land with negligible limitations;
. Class 2 Suitable land with minor limitations;
. Class 3 Suitable land with moderate limitations;
. Class 4 Marginal land - presently unsuitable; and
. Class 5 Unsuitable land.

The classes are defined in detail in Appendix VI.

The method of determining land suitability was consistent with that described in Land Resource Branch staff (1990). Limitations of both the soil and the land considered important for irrigated crop performance were assessed. Sixteen limitations were used in the classification for crop or crop groups other than rice, while seven were used in the rice classification.

Subclasses were determined for each limitation to rank its effects in terms of increasing degree of severity for irrigated crop performance. A number, usually from two to five, was allocated to each subclass depending on its severity. A subclass of one was not recorded as this denotes a neglible limitation. The diagnostic attributes used to determine each subclass are discussed in section 6.3 and presented in detail in Appendix VII(a) and VII(b).

The naming and definition of the limitations is not consistent with that of Land Resources Branch staff (1990). However, the limitations and subclass definitions are consistent with the previous survey in this series, Donnollan *et al* (1990), except that one additional limitation, fertility, has been added to the rice classification.

When assessing the suitability of a UMA, the attribute subclass for each limitation were determined. The highest number of any subclass then determined the land suitability class. For UMAs which had two or more limitations with this highest number, consideration was given to downgrading the land suitability class to account for the effect of any interactions between these limitations.

The classification for crops or crop groups other than rice was developed primarily for assessing the suitability of land for grain crops. To assess the suitability for sugar-cane, small crops and low volume irrigation of mangoes, the effects of the limitations on the growth and management of each of those crops or crop groups was considered. The rice classification is modified from the classification of Reid and Baker (1984). The subclasses of each limitation and land suitability classes of each UMA for the five crops or crop groups were added to the UMA data file.

The classifications are based on the irrigation method specified for each crop or crop group or for soil types 5Dra and 5Dya and do not take into account other irrigation techniques.

The subclass of each limitation and land suitability classes for the soil types of the Mulgrave section are listed in Table 6.2.1. The area and land suitability classes for each UMA of the Mulgrave section are listed in Table 6.2.2. Maps showing the land suitability classes for the five crops or crop groups accompany this report.

Areas of land rated as suitable for the five crops or crop groups in the Mulgrave Section of the BRIA are listed in Table 6.2.3. Land suitable for all three of the crops or crop groups, sugar-cane, grain crops and rice, totals 4 578 ha. A total of 1 893 ha is not suitable for any of the crops or crop groups considered because of extreme sodicity at shallow depths in the profile, excessive wetness, unacceptable risk of flooding, severe erosion, complex soil distribution or excessive rock outcrop.

Table 6.2.1. Subclasses of the limitations and land suitability classes for each soil type, Mulgrave Section, BRIA[1].

Soil type	Subclasses of limitations for crops other than rice															Land suitability classes				Subclasses of limitations for rice							Land suitability class
	d	pb	ps	pd	pt	sa	so	t	n	r	g	w	e	f	i	o	Sugar-cane	Grain crops	Small crops	Mangoes	t	g	f	n	p	sa	pd	Rice
1Uga			3					2	2		2	3		2			2	3	4	4	3	2			2			3
1Ugf			3					2	2		2	3		2			2	3	4	4	3	2			2			3
1Dyb		4	3	4		3	4		2								4	4	4	4					5			5
1Dyc3		3	3	3		3	4	2	2				2				3	4	4	5	4						4	5
1Dda		4	4			3	3-4	2	2				2				3	4	4	5	4						4	5
2Ugc			3						2		2	3		2-3			2	3	4	4		2	2		2			2
2Ugd			3						2		2	3		2			2	3	4	4		2			2			2
2Uge			3						2		2	3		2			2	3	4	4		2			2			2
2Ugf			3						2		2	3		3			3	3	4	4		2	2		2			2
2Ugg			3						2		2	3		2-3			2	3	4	4		2	2		2			2
2Ugh			3				3		2		2	3		2			2	3	4	4		2			2			2
2Ugk			3				3		2		2	3		2			2	3	4	4		2			2			2
2Dba		4	4				4	2	2				2				4	5	5	5	3			3				4**
2Dbb		3	3			3	3		2					3			2-3	3	4	4							2-3	2-3
2Dbc		2	3	3				2	2								2	3	3	3	3				3		2-3	3
2Dbd		2	3						2								2	3	3	3					3		3	3
2Dbe		3	3						2					2			2	3	4	4	3							3
2Dya		4	3-4			3	3-4		2					2			3	4	4	4							2-3	2-3
2Dyb		3	3			3	3-4		2								2-3	3-4	4	4							2*	1-2
2Dyc		3	3						2		2	3		3			2	3	4	4		2	2		5*		4*	2-5
2Dda		4	3				3		2								3	4	5	4							2-3	2-3
2Ddb		4	4			3	4		2								4	5	5	5				3			2-3	4**
2Ddc-2Ugi		3	3	3		3	3	3					2	2-3			3	3	4	4	5				2			5
4Ucf	2				4			4	3	3			4		4		5	5	5	3	5				5			5
4Gna2				4	4				3			2	2		3		4	4	3	3	4				5			5

Table 6.2.1. (Continued)

Soil type	Subclasses of limitations for crops other than rice																Land suitability classes				Subclasses of limitations for rice							Land suitability class
	d	pb	ps	pd	pt	sa	so	t	n	r	g	w	e	f	i	o	Sugar-cane	Grain crops	Small crops	Mangoes	t	g	f	n	p	sa	pd	Rice
4Dya3		2	3	4					3								3	4	4	4					5			5
4Dyd		2	3					2-3	3				3				3	4	4	3	4-5				5			5
4Dye	2		4	4				2	3			3	3				4	5	5	3					5			5
4Dyg	2	3	4				3	2-3	3				3			4	4	4	4	4	4-5				5			5
4Dyh		4	4				4	2	3				3			4	4	5	5	5	4				5			5
4Dyk	2	3	4					3	3			4	3				4	4	4	4	5				5			5
4Dga			3						3			4					4	4	4	4					5			5
5Uga	2		3	3-4				2					2				3	3	4	4	4-5				5			5
5Ugc-5Ugd			3					2					3				3	3	4	4	4				5			5
5Dra	2		3	2-4				2	2	3			2-3		3		3-4	3-4	3-4	2-4	5				5			5
5Dya	2		3					4	2	3			3		3		4	4	3	2	5				5			5
5Dyb	2		3					4	2				3				4	4	4	2	5				5			5
5Dyc	2	2-3	3	2-4			3	3	3				3			4	4	4	4	4	5				5			5
5Dyd	2	4	4				4	3	3				2-3			4	4	4	4	4	5				5			5
5Dye			3	3-4				2-3	2				2-3				3-4	3-4	3	3	5				5			5
6Uca			3	4	4			3	3					4	4		4	5	4	3	5		3		5			5
6Ucc			3	4	4			3	3					4	4		5	5	5	5	5		4		5			5
6Umb2				4				3	2								4	4	3	3	5				5			5
6Uga			3	4					2			5		4			5	5	5	5			4		5			5
6Ugc			3									4		3-4			4	4	5	5			2-3		2			2-3
6Gnd			2	4													3	4	3	2					5			5
6Gne			3	4					2					3-4			4	4	4	4	3		2		5			5
6Drb		2	3	4				2-3	2								4	4	3	3	3-5				5			5
6Drc		2	3					2	3								2	3	3	2	3				5			5
6Dba		3	3				3	2	2								2	3	3	3	3				4-5			4-5
6Dbb		2	3	3				2					2	4			4	4	4	4	3		3		5			5

Table 6.2.1. (Continued)

Soil type	Subclasses of limitations for crops other than rice																Land suitability classes				Subclasses of limitations for rice							Land suitability class
	d	pb	ps	pd	pt	sa	so	t	n	r	g	w	e	f	i	o	Sugar-cane	Grain crops	Small crops	Mangoes	t	g	f	n	p	sa	pd	Rice
6Dbe		3	2						2								2	3	3	2					5			5
6Dbh		3	4				4	2	2				2				4	4	4	5	3				5			5
6Dya5			3	4	3			2	2					4			4	4	3	3	4		3		5			5
6Dyb2		2	3	4					2			4					4	4	5	4					5			5
6Dyc			3	4					2								3	4	3	3					5			5
6Dyd		2	2	4				2	2			3	2				3	4	3	3	3				5			5
6Dyf		2	3	3				2	2								2	3	3	2	3				5			5
6Dyg		3	3	4			3		2								3	4	4	4					5			5
6Dyh		2	3	4				3	3					3-4			4	4	4	4	4				5			5
6Dyj		3-4	3-4	4			4		3					3-4			4	4	5	5					5			5
6Dda		3	3				3-4	2	2					3			3	4	4	4	4-5		2		5			5

[1] This table is a general guide to the suitability of each soil type. For the suitability of individual areas, refer to the UMA data file.

* Some UMAs do not have this subclass.

** The combination of sub-classes for the limitations indicate that this soil type should be class 3. However, crop performances indicate that class 4 is more appropriate.

Table 6.2.2 The area (ha) and land suitability classes of each unique map area (UMA), Mulgrave Section, BRIA.

UMA No.	UMA name	Area ha	Land suit. [1] [2] C	G	S	M	R
1	5Dra1 5 R	19.8	5	5	5	5	5
2	5Dya	17.2	4	4	3	2	5
3	5Dyc	146.8	4	4	4	4	5
4	5Dya1	6.2	3	3	3	2	5
5	1Uga	27.7	2	3	4	5	3
6	2Uge	321.3	2	3	4	4	2
7	2Dyb	16.6	2	3	4	4	1
8	2Dya	21.3	3	4	4	4	1
9	2Dya 2Uge	5.5	3	4	4	4	2
10	2P	9.6	5	5	5	5	5
11	2Uge	3.0	4	4	4	5	4
12	2Ddb	6.1	4	5	5	5	4
13	2Dbb	8.6	2	3	4	4	2
14	2Ugd	17.2	2	3	4	4	3
15	2Ugd 2Ddb	16.8	4	4	5	5	4
16	2Ddb	0.9	4	5	5	5	4
17	2Dya 2Uge	3.0	3	4	4	4	2
18	2Ddb	2.7	4	5	5	5	4
19	5Dra1	35.7	4	4	3	2	5
20	5Dyb	10.3	4	4	4	2	5
21	5Uga	4.4	3	3	4	4	5
22	2Ddb	7.9	4	5	5	5	4
23	5Dyb	1.8	4	4	4	4	5
24	1Dyc3	4.6	3	4	4	5	5
25	5Dra	12.1	3	3	3	2	5
26	5Uga	1.0	4	4	4	4	5
27	5Dyc	36.5	4	4	4	4	5
29	1Ugf	17.1	2	3	4	4	3
30	5Dra	0.8	2	4	4	4	5
31	2Ugf	24.3	2	3	4	4	2
32	2Ugg	6.3	2	3	4	4	2
33	2Ugd	38.2	2	3	4	4	2
34	1Dyc3	5.2	3	4	4	4	5
35	5Dyd	2.1	4	4	4	4	5
36	5Ugc 5Ugd	11.6	3	3	4	4	5
37	5Dra	0.5	4	4	4	4	5
38	5Dra	1.0	4	4	4	4	5
39	5Ugc 5Ugd	7.1	3	3	4	4	5
40	1Dda	11.8	3	4	4	5	5
41	5Dyc	47.0	4	4	4	4	5
42	5Dra	0.7	4	4	4	4	5
43	5Dra	1.7	4	4	4	4	5
44	5Dra	0.3	4	4	4	4	5
45	5Dra	1.8	4	4	4	4	5
46	5Dye	5.8	3	3	3	3	5
47	5Dra	0.7	4	4	4	4	5
48	1Ugf	14.0	2	3	4	4	3
49	1Uga	15.6	2	3	4	4	3
50	1Ugf	4.3	2	3	4	4	3
51	1Uga1	18.9	2	3	4	4	5
52	1Ugf	2.7	2	3	4	4	2
53	2Uge	80.9	3	3	4	4	2
54	2Ugc	106.2	2	3	4	4	2
55	5Dyd	3.1	4	4	4	4	5
56	5Dye	3.2	4	4	3	3	5
57	2UgcW	7.8	5	5	5	5	4
58	2Ugc	5.6	4	4	5	5	4
59	2Ugd	34.4	3	4	5	5	2
60	2Dyb	39.4	2	3	4	4	1
61	2Dyb	9.3	2	3	4	4	2
62	2Uge 2Dbc	15.3	3	3	4	4	3
63	2Dya	5.8	3	4	4	4	3
64	2Dbd	4.9	2	3	3	3	3
65	6Gne	2.2	3	4	3	3	5
66	2Ugc	15.3	3	4	5	5	3
67	2Ugd 2Dbc	4.3	3	4	4	4	3
68	2Dyb	46.5	2	3	4	4	1
69	2Dbd	13.2	2	3	3	3	3
70	6Dyf	13.1	2	3	3	2	5
71	6DyfE	2.6	5	5	5	5	5
72	6Dyf	54.4	2	3	3	2	5
73	6Dbh	12.1	4	4	4	5	5
74	2Dba	11.8	4	5	5	5	4
75	2Dba	6.5	4	5	5	5	4
76	2Dbd	4.3	2	3	3	3	3
77	2UgcW	4.3	5	5	5	5	4
78	2Ugd	3.5	3	4	4	4	3
79	2Dya	2.4	3	4	4	4	3
80	2Dya 2Uge	52.3	3	4	4	4	3
81	2Dba	46.1	4	5	5	5	4
82	6Dyg	4.9	3	3	4	4	4
83	6Dyg	5.8	3	4	4	4	5
84	6Dyf	51.4	2	3	3	2	5
85	6Dba	7.6	4	4	5	5	4
86	2Ddb	22.2	4	5	5	5	4
87	2Dba	0.7	4	5	5	5	4
88	2Dya	6.4	3	4	5	4	2
89	2Ugg	21.1	2	3	4	4	2
90	2Ugd	7.8	2	3	4	4	2
91	2Dbe	2.0	3	4	4	4	4
92	6Gne	3.1	4	4	5	5	5
93	6Uga	6.2	4	4	5	5	5
94	2Dyb	2.9	3	4	5	5	4
95	2Dbe	6.6	3	4	5	5	5
96	2Dya	1.1	3	4	5	5	2
97	2Uge	18.4	3	4	5	5	3
98	2Dya	2.7	3	4	5	5	2
99	1Ugf	10.7	3	3	4	4	2
100	2Ddb	3.3	4	5	5	5	4
101	2Dya	8.5	4	4	5	5	3
102	2Dyb	7.7	2	3	4	4	2
103	2Dba	36.1	4	5	5	5	4
104	6Dyg	3.2	3	4	4	4	4
105	2Dyb2	2.3	3	4	4	4	5
106	2Ddb	6.4	4	5	5	5	4
107	6Dyd	0.4	3	4	3	3	5
108	6Dbh 6Dda	5.0	4	4	4	5	5
109	2Dbc	1.1	2	3	3	3	3

[1] Land Suitability Classes

[2] C - Sugar-cane; G- Grain crops; S - Small crops; M - Mangoes; R - Rice

Table 6.2.2 (continued)

UMA No.	UMA name	Area ha	Land suit. C	G	S	M	R
110	2Dbd	1.3	3	4	3	3	3
111	2Dya	5.6	3	4	5	5	3
112	2Uge2	9.4	2	3	4	4	5
113	2Ugg	6.1	2	3	4	4	2
114	2Uge	17.1	2	3	4	4	2
115	2Ugd1	15.6	2	3	4	4	5
116	2Ugc	41.1	2	3	4	4	2
117	2Uge 2Dya	59.2	3	3	5	5	3
118	6Dyg	1.5	3	4	4	4	4
119	2Uge2	13.4	2	3	4	4	5
120	2Dba	28.0	4	5	5	5	4
121	2Dyb	2.4	3	4	4	4	3
122	6Drc	29.4	3	4	3	2	5
123	2Dyb	11.1	2	3	4	4	4
124	2Ugd2	6.3	2	3	4	4	5
125	2Dba	12.6	4	5	5	5	5
126	6Dbh	5.1	4	4	5	5	5
127	6Dbh 6Dda	2.7	4	4	4	4	5
128	6Dbh	4.9	4	4	4	5	5
129	2Uge 2Dya	27.1	3	3	4	4	5
130	2Uge	7.4	2	3	4	4	2
131	2Uge2	17.1	2	3	4	4	5
132	2Dya	2.2	3	4	5	4	4
133	6Dbh	85.7	4	4	5	5	5
134	6Dbh	37.6	4	4	5	5	5
135	2Dya	50.4	4	4	5	5	2
136	2Uge	5.7	2	3	4	4	3
138	2Ugk	150.9	2	3	4	4	2
139	2Dya 2Uge	0.9	3	4	4	4	2
140	2Dya	12.5	3	4	4	4	4
141	2Dya	9.2	3	4	4	4	2
142	4DygE	29.0	5	5	5	5	5
143	2Ddb	7.8	4	5	5	5	4
145	6Dbh	9.9	4	4	4	4	5
146	6Dyf	3.5	2	3	3	2	5
147	2Uge	31.2	2	3	4	4	2
148	2Dyb	12.7	2	3	4	4	5
149	2Dya	9.5	4	4	4	4	4
150	2Dyc	7.8	2	3	4	4	3
151	2Ddb	74.4	4	5	5	5	5
152	2Ugg	23.0	2	3	4	4	2
153	2Dya	12.4	4	4	5	4	4
154	2Uge	5.4	3	4	4	4	4
155	2Dba	10.3	4	5	5	5	5
156	6UgaC	4.4	5	5	5	5	5
157	2Dyb	82.8	3	4	4	4	5
158	2P	5.8	5	5	5	5	5
159	2Dbe	4.2	4	4	4	4	2
160	2Uge	10.5	2	3	4	4	2
161	2Dbe	2.3	4	4	4	4	4
162	2Ugd	1.7	4	4	4	4	4
163	2Ddb	1.3	4	5	5	5	4
164	2Dyb	1.9	4	5	5	5	4
165	6Drb	3.6	4	4	4	4	5
166	2Dbc	1.2	2	3	3	3	4
167	2Dyb	154.7	2	3	4	4	1
168	2Ddb	1.8	4	5	5	5	4
169	2Dbd	3.1	2	3	3	3	3
170	2Uge	0.8	3	3	5	5	3
171	2Dbd	1.6	3	3	5	5	3
172	2Ddb	2.1	4	5	5	5	4
173	2Ugg	6.5	2	3	4	4	3
174	2Ugh	2.7	2	3	4	4	2
175	2Ddb	4.5	4	5	5	5	4
176	2Uge	39.8	2	3	4	4	2
177	6Drc	2.6	3	4	3	2	5
178	2Ugk	8.5	2	3	4	4	2
179	2Dya3	17.8	3	4	5	4	2
180	2Uge	7.1	2	3	4	4	2
181	2Ugh	30.5	2	3	4	4	2
182	2Ugg	3.1	2	3	4	4	2
183	2Dyb	35.2	2	3	4	4	2
184	2Ugg	10.5	2	3	4	4	2
185	2Ugd	10.3	2	3	4	4	2
186	2Ugd 2Dya	3.3	2	3	4	4	2
187	2Uge	16.8	3	4	5	4	2
188	2Ugd	62.7	4	4	5	4	3
189	2Dyc	5.5	2	3	4	4	2
190	2Dya	2.9	3	4	5	4	2
191	2Ugd	19.8	3	3	4	4	2
192	2Ugg	8.4	3	3	4	4	2
193	2Ugc	10.2	2	3	4	4	2
194	2Ugg	36.4	3	3	4	4	2
195	2Uge	5.8	2	3	4	4	2
196	2Ugd	5.1	3	3	4	4	2
197	2Uge	50.3	3	3	4	4	2
198	2Ugg	8.6	2	3	4	4	2
199	2Ugh	232.3	2	3	4	4	2
200	2Ugg	27.3	2	3	4	4	2
201	2Uge 2Ddb	2.3	4	5	5	5	4
202	2Dyb	12.3	2	3	4	4	2
203	2Ddb	13.2	4	5	5	5	4
204	2Uge	35.9	2	3	4	4	2
205	2Ddb	26.2	4	5	5	5	4
206	2Dbe	13.8	2	3	4	4	2
207	2Dyb	22.8	2	3	4	4	2
208	2Dya	16.5	3	4	5	4	2
209	2Ugg	40.0	2	3	4	4	2
210	2Dyb	1.9	2	3	4	4	2
211	2Dya	11.0	3	4	5	4	2
212	2Uge 2Ddb	28.9	4	5	5	5	4
213	2Dyb	21.6	2	3	4	4	1
214	2Ddb2	9.4	4	5	5	5	5
215	2Ugd2	57.3	2	3	4	4	5
216	2Dyc	14.5	2	3	4	4	2
217	2Dbb	14.8	2	3	4	4	2
218	2Ugg	4.2	2	3	4	4	4
219	6Dbe	4.2	2	3	3	2	5
220	6Dba	9.1	2	3	3	3	5
221	2Dya	37.1	3	4	5	4	2
222	2Ddb	30.0	4	5	5	5	4
223	2Uge	210.2	2	3	4	4	2
224	2Ugk	290.2	2	3	4	4	2
225	2Ugk	19.5	2	3	4	4	2

Table 6.2.2 (continued)

UMA No.	UMA name		Area ha	Land suit. C	G	S	M	R
226	6Gnd		5.7	3	4	3	2	5
227	6Dbe		12.9	2	3	3	2	5
228	2Ugh7		3.0	2	3	4	4	3
229	2Dbb		2.2	2	3	4	4	3
230	2Dda		8.8	3	4	5	4	3
231	2Dya		11.3	3	4	5	4	2
232	2Ugh		18.6	2	3	4	4	2
233	2Uge2		1.9	2	3	4	4	5
234	2Dya	2Uge	5.4	3	4	5	4	3
235	2Dba		7.2	4	5	5	5	4
236	6Dbh		15.1	4	4	4	5	5
237	6Drc		4.6	3	4	5	3	5
238	2Dba		2.3	4	5	5	5	4
239	2Ugg		4.1	3	3	4	4	4
240	6Dyg2		19.2	3	3	4	4	5
241	2Ugh7		4.9	3	3	4	4	4
242	2Dyb		19.0	2	3	4	4	2
243	2Ugh7		2.6	3	3	4	4	4
244	2Ugk		2.2	3	3	4	4	4
245	2Ugk		6.1	2	3	4	4	2
246	4Dyg		100.2	4	4	4	4	5
247	4Dyd		4.7	4	4	4	3	5
248	4Dyd		8.8	4	4	4	3	5
249	4Ucf		15.0	5	5	5	3	5
250	4R		0.1	5	5	5	5	5
251	4Dyg		6.3	4	4	4	4	5
252	4Dyk		22.5	4	4	4	3	5
253	4Dyh		16.8	4	5	5	5	5
254	4Dga		6.8	4	5	5	5	5
255	5Dra		2.9	4	4	4	4	5
256	4Dye		1.2	4	5	5	3	5
257	5Dra		6.4	4	5	5	2	5
258	2Ddb		3.9	4	5	5	5	4
259	2Ugg		6.9	2	3	4	4	3
260	2Dyb		1.2	2	3	4	4	4
261	5DycE		0.4	5	5	5	5	5
262	5DycE		0.3	5	5	5	5	5
263	5DraR		32.4	5	5	5	3	5
264	5R		3.6	5	5	5	4	5
265	5Dyb		3.6	4	4	4	2	5
266	5Dyb		6.8	4	4	4	2	5
267	2Ugc		9.7	2	3	4	4	2
268	2Ddb		2.9	4	5	5	5	4
269	2Dyb		28.7	2	3	4	4	2
270	2Uge		149.1	2	3	4	4	2
271	2Dyb		22.1	2	3	4	4	1
272	2Ugd		109.9	2	3	4	4	2
273	2Dya		19.8	3	4	5	4	1
274	2Ugk		133.7	2	3	4	4	2
275	2UgfW		160.7	5	5	5	5	4
276	2Dyb	2Ugh	28.7	3	3	4	4	2
277	2Dyb		78.6	3	4	4	4	3
279	2Ugg		45.6	2	3	4	4	3
280	2Ugh		36.0	2	3	4	4	2
281	2Ugh	2Ddb	9.9	4	4	5	5	4
282	2Dya		3.5	3	4	5	4	2
283	2Ugh		27.4	2	3	4	4	2
284	2Ddc	2Ugi	28.9	3	4	5	5	5
285	2UggW		25.8	5	5	5	5	4
286	2Dyb	2Uge	11.1	3	4	4	4	2
287	2Ugh		278.2	2	3	4	4	2
288	2Ugc	2Dyb	6.0	3	4	4	4	2
289	2Uge		13.6	2	3	4	4	2
290	2Ugk		93.0	2	3	4	4	2
291	2Uge		15.0	2	3	4	4	2
292	2Ugf2		3.1	2	3	4	4	5
293	2Ugg		112.3	2	3	4	4	3
294	2Dya	2Ugd	9.5	3	4	4	4	2
295	2Dya	2Ugg	21.0	3	3	4	4	2
296	2Ddb		13.2	4	5	5	5	4
297	2Uge		2.1	2	3	4	4	2
298	2Ddb3	2Uge	5.1	4	5	5	5	4
299	6Dyf2		13.1	3	3	3	3	5
300	2Uge	2Dya	18.0	3	4	5	4	2
301	2Ugh		151.5	2	3	4	4	2
302	2Ddb		9.7	4	5	5	5	4
303	6Dyf2		6.3	3	3	3	3	5
304	2UghE		2.8	5	5	5	5	5
305	2Ugk		11.9	2	3	4	4	3
306	2Ddb		25.3	4	5	5	5	4
307	6Dbb		21.9	4	4	4	4	5
308	2Ddc	2Ugi	1.7	4	4	4	4	5
309	2Dbe	2Uge	19.5	2	3	4	4	3
310	2Dyb		9.3	2	3	4	4	4
311	2Ugg		7.1	2	3	4	4	2
312	6Dyb2	6Dyf	6.5	4	4	5	4	5
313	2Ugk		17.3	2	3	4	4	3
314	6Dyb2		3.3	4	4	5	4	5
315	2Dba		11.7	4	5	5	5	4
316	2Dya	2Uge	22.9	3	4	4	4	2
317	2Ugk		8.4	2	3	4	4	2
318	2Dya		17.0	3	4	5	4	5
319	2Uge2		8.2	2	3	4	4	5
320	2Dyb		19.1	3	4	4	4	3
321	6Dbh	6Dda	4.8	4	4	5	5	5
322	6Drc		5.6	3	4	5	4	5
323	6Drc	6Dda	2.1	3	4	5	4	5
324	6Uga		1.0	4	5	5	5	4
325	6Drb		7.2	4	4	4	4	5
326	6Drc		79.0	2	3	3	2	5
327	2Ugg		5.3	3	4	4	4	3
328	2Dya		61.0	3	4	4	4	3
329	2Ugk		206.3	2	3	4	4	3
330	2Dya	2Ugg	26.2	3	4	4	4	3
331	6Drc	6Dyf	8.5	2	3	3	2	5
332	2Dba		2.4	4	5	5	5	4
333	2Dyc		4.7	3	4	4	4	4
334	6Dyj		4.0	4	4	4	4	5
335	2DycE		0.8	5	5	5	5	5
336	6DyjE		3.0	5	5	5	5	5
337	2Ugk		35.7	3	3	4	4	3
338	6Dyg		4.0	4	4	4	4	5
339	2Dyc	2Dyb	12.5	4	4	4	4	5
340	6DygE		2.7	5	5	5	5	5

Table 6.2.2 (continued)

UMA No.	UMA name	Area ha	Land suit. C	G	S	M	R
341	6Dbh	2.6	4	4	5	5	5
342	2Ugg 2Ddb	4.0	4	4	4	4	4
343	1Dyb	1.9	4	4	4	4	5
344	4Gna2	1.0	4	4	3	3	5
345	6Uca	3.8	4	5	4	3	5
346	4Dyd3	2.6	3	4	3	3	5
347	4Dga	15.9	4	4	4	4	5
348	4Dyd3	10.8	3	4	4	4	5
349	4Dya3	2.7	3	4	4	4	5
350	6Dya5	3.5	4	4	3	3	5
351	6UccC	2.9	5	5	5	5	5
352	6Dda	2.7	4	4	4	4	5
353	6Dba2	3.3	3	4	4	4	5
354	4Dyd3	34.7	3	4	4	4	5
355	6Dda	0.9	3	4	4	3	5
356	6Dda	4.4	3	4	4	3	5
357	6Umb2 6Uca	15.3	4	4	3	3	5
358	4DydE	0.7	5	5	5	5	5
359	6Dda 6Umb2	30.5	4	4	3	3	5
360	6Dyh 6Uca	58.0	4	4	4	4	5
361	6Dda	22.8	3	4	4	4	5
362	6Dda 6Dyj	3.1	4	4	4	4	5
363	6Uga	1.4	5	5	5	5	5
364	6Dda	4.8	4	4	4	4	5
365	6Dyj2	1.7	4	4	4	4	5
366	6Ugc	6.3	4	4	5	5	5
367	6Dyh	3.2	4	4	4	4	5
368	6Uga2	2.1	5	5	5	5	5
370	2Dya2	31.7	3	4	4	4	5
371	2Dyb	4.5	3	4	4	4	4
372	6Umb2	24.0	5	5	5	5	5
373	6Uga	2.8	5	5	5	5	5
374	6Ugc	9.8	4	4	5	5	3
375	6Dyj	14.9	4	4	5	5	5
376	6Dyg3	3.2	3	4	4	4	5
377	6Dyg	4.6	3	4	4	4	5
378	2Ddb	6.0	4	5	5	5	5
379	2Dya	3.1	4	4	4	4	5
380	2DyaE	7.4	5	5	5	5	5
381	6Uga	0.6	5	5	5	5	5
382	6Uga	4.0	5	5	5	5	4
383	2Ugh	6.0	2	3	4	4	4
384	2Ddb	16.0	4	5	5	5	4
385	2Dyb2	3.8	4	4	4	4	5
386	2DybE	3.4	5	5	5	5	5
387	2Dya	8.4	4	4	4	4	3
388	2Dbb	8.0	3	4	4	4	4
389	2DbbE	0.7	5	5	5	5	5
390	2DyaE	1.2	5	5	5	5	5
391	6Dyg	2.9	5	5	5	5	5
392	2Dbb	22.6	3	4	4	4	5
393	2Ddb	17.4	4	5	5	5	5
394	6Dda	2.8	3	4	4	4	4
395	6Dbh7	1.7	4	4	4	4	5
396	2Dyb	8.7	3	4	4	4	5
397	2Dyb	7.7	3	4	4	4	3
398	2DyaE	5.0	5	5	5	5	5
399	2Dyb	4.2	3	4	4	4	4
400	2Ugg	2.7	4	4	5	5	4
401	6Gne3	1.2	4	4	4	4	5
402	6Gne	3.0	4	4	4	4	4
403	2Uge	7.6	4	4	5	5	3
404	2Dba	52.1	4	5	5	5	4
405	2Dya2 2Ugf	16.9	5	5	5	5	5
406	2Dbb2	1.8	4	4	4	4	5
407	2Dyc 2Ugg	10.7	4	4	5	5	5
408	2Dbb	8.0	3	4	4	4	4
409	6Dyf	0.6	4	4	5	5	5
410	2Dba2	9.6	4	5	5	5	5
411	2Dba	16.9	4	5	5	5	4
412	2Dyb	52.1	3	3	4	4	2
413	2Ugh	13.8	3	3	4	4	2
414	6Dyf	3.0	4	4	5	5	5
415	2Dyc	1.9	4	4	5	5	5
416	2Ugg	5.3	4	4	5	5	4
417	2Ugg 2Dya	6.4	2	3	4	4	3
420	2Ugg	1.4	5	5	5	5	5
421	2Dbd2	8.1	3	3	3	3	5
422	2Dbb2 2Dya2	16.9	3	4	4	4	5
423	2DbaE	2.0	5	5	5	5	5
424	6Uca	0.7	4	5	4	3	5
425	2Ugf 2Dya	2.6	5	5	5	5	5
426	6Drb	2.9	4	4	3	3	5
427	2Dbd	3.1	2	3	3	3	5
429	2Dya	15.2	3	4	4	4	3
430	2Dya	1.9	3	4	4	4	5
431	2Dyc2 2Ugd2	13.4	4	4	5	5	5
432	2Ugg	29.5	2	2	4	4	2
433	2Ugh	17.4	2	3	4	4	2
434	2Ugg	58.1	2	3	4	4	2
435	2Dya 2Uge	32.8	3	4	4	4	3
436	2Uge2	5.0	4	4	5	5	5
437	2Dyc2	14.5	4	4	5	5	5
438	2Ugh 2Uge	14.7	2	3	4	4	2
439	2Dba	10.3	4	5	5	5	4
440	2Dya 2Uge	6.2	3	4	4	4	4
441	2UgfW	3.4	5	5	5	5	4
442	2Ugf	33.0	4	4	5	5	3
443	2Dbc	1.6	2	3	3	3	3
444	2Dyb	27.8	2	3	4	4	2
445	2Ugk	2.2	2	3	4	4	2
446	2Dda	0.9	3	3	5	4	2
447	2Ugg	46.8	2	2	4	4	2
448	2Dyb	2.7	3	4	4	4	2
449	6Dyc	2.4	3	4	3	3	5
450	2Ddb	9.4	4	5	5	5	4
451	2Ddb	1.8	4	5	5	5	4

Table 6.2.3. Areas (ha) of land suitability classes for the five crops or crop groups, Mulgrave Section, BRIA.

Land suitability class	Sugar-cane	Grain crops	Rice	Small crops	Mangoes
1			342		
2	4 574	76	3 894		363
3	1 703	5 078	1 190	476	239
1,2 or 3 (suitable)	6 277	5 154	5 426	476	602
4	1 887	2 344	900	6 184	6 325
5	416	1 082	2 254	1 920	1 653

Total area = 8 580 ha

Most of the soil types of the Burdekin River alluvial plain (LU*2) which occupy 80% of the survey area are generally suitable for sugar-cane, a range of grain crops and rice. These soil types are not suitable for small crops using furrow irrigation because of their gentle slope and resultant waterlogging and reduced trafficability. They are not suitable for mangoes mainly because of restricted internal drainage and excessive subsoil sodicity. The exceptions are soil type 2Ddb and 2Dba which are assessed as not suitable for all crops because of the extreme sodicity levels at 0.2-0.3 m in the profile which has adverse affects on fertility, PAWC and seedbed preparation. These soil types (which together occupy 597 ha) mainly occur in very broad areas adjoining the area of relict levees in the south of the survey area (LU6A).

Soil types of the gently undulating rises (LU4 and 5) in the south of the survey area are mostly not suitable for all crops because of complex soil distribution, extreme sodicity at shallow depth in the soil profile or excessive rock outcrop. Only minor areas are suitable for small crops or mangoes. The combined area of LU 4 and 5 is 715.4 ha.

All areas of the gently undulating rises (LU4 and 5) and miscellaneous alluvial deposits (LU6) are not suitable for rice because of excessive profile permeability. Some areas of the local alluvial plains and associated pediments (LU1) and minor areas of the Burdekin River alluvial plain (LU2) are also not suitable for rice for the same reason. The area unsuitable for rice because of excessive profile permeability totals 2 128 ha. Most of the this area also has excessive slope for rice production.

Generally, the area of recent alluvia of Scotts/Barratta Creek (LU6B) is not suitable for all crops because of unacceptable flooding risk and complex soil distribution.

* Landscape Unit

6.3 Limitations to irrigated agriculture

Climate, although not included in the land suitability classification, is discussed in terms of its effect on irrigated agriculture in this area. The limitations affecting furrow irrigated crops are discussed separately to those affecting flood irrigation of rice because of the different land use requirements associated with such different irrigation methods.

6.3.1 Climate

The Lower Burdekin Valley is the highest yielding sugar district in Queensland (Ham 1985) because of suitable soils, availability of irrigation water and favourable climate. The warm winters with plenty of sunlight allows production of a wide range of irrigated crops when other parts of Australia are not producing. This has a distinct market advantage. This favourable climate does, however, impose some limitations on irrigated crops.

Soybeans and maize have been successfully grown over the wet season. Generally, however, grain cropping is not widely practiced over the wet season due to lack of suitable crops or varieties, high disease incidence and unpredictability of heavy rainfall.

Rice has been successfully double cropped in the Burdekin. However, summer planted rice yields are generally lower than winter planted rice. Cloud cover from January to March may reduce light intensity sufficiently to decrease crop growth potential in some years (Thompson 1977). Barnes and Reid (1978) showed a 30% decrease in yield between a summer and winter planted rice crop. This difference was attributed to lower hours of sunshine because of wet season cloud cover from panicle initiation to grain filling. Murata (1975) showed that solar radiation or hours of sunshine between booting, after panicle initiation, and grain filling was an important climatic factor limiting rice growth. Lodging during the wet season may also contribute to lower yields in summer planted rice crops.

Rice yields can be reduced by low temperatures at anthesis. Minimum temperatures below 15 to 17°C for three consecutive nights can cause cold induced sterility in rice (Norman, personal communication). Therefore, crops flowering in May to September, will have some risk of cold induced sterility.

Strong winds and flooding or waterlogging from cyclonic disturbances may damage crops grown over the wet season in some years. Tree crops are especially at risk as strong winds can damage trees and cause fruit loss.

During the dry season, a wide range of grain and horticulture crops and planting dates are suitable. Climatic effects, however, must be taken into account. Low temperatures may cause problems with sorghum establishment in July. Frosts can damage sensitive crops in some years and oil content of sunflowers can be reduced by high night temperatures at flowering and seed set.

6.3.2 Limitations affecting furrow irrigated crops

d - Soil depth. This limitation assesses the effect of soil depth on root development or plant available water. The presence of rock or other physical restriction at a shallow depth in the soil profile will act as a barrier to root development and hence reduce the volume of soil from which water and nutrients can be extracted. Within this survey area, only some soils types found on the gently undulating rises (landscape units 4 and 5) have a subclass of two or more. Effective rooting depth as suggested by salinity, sodicity or bulk density, is not considered.

Soil types 4Ucf, 4Dyg, 4Dyk, 4Dga, 5Dra and 5Dya have a subclass of two. Some mapping units of 5Dra and 5Dya have been mapped as shallow variants and been given a subclass of two or three, while UMA 250 (4R) is a small outcrop of rock and has a subclass of five.

pb - Depth to hard, slowly permeable subsoil. Hard subsoils reduce water entry and restrict root development and plant available water capacity. These subsoils are characterised by coarse macro-structure, high sodicity and high bulk density. Where such hard subsoils occur at shallow depths, crop growth is severely restricted.

Irrigated crop yields on solodic-solodized solonetz of the Lower Burdekin Valley with shallow (<0.12 m) A horizons have been poor. Many farmers have ceased irrigating these soils because of low yields. The shallow depth to the hard, slowly permeable B horizon has been considered the main reason for the poor crop yields. Such soils have therefore been given a subclass of four for grain crops and include soil types 1Dda, 1Dyb, 2Dda, 2Dba, 2Ddb, 2Dya and 5Dyd.

Solodic-solodized solonetz with slightly deeper A horizons (0.12-0.2 m) usually have better physical properties and lower ESP and have been given a subclass of three. Such soil types include 2Dbb, 2Dbe, 2Dyb, 2Dyc, 2Ddc, 4Dyh, 4Dyk, 4Dyg, 6Dba, 6Dbb, 6Dbe and 6Dyg.

Those solodic-solodized solonetz with A horizons between 0.2 m and 0.4 m in depth have been given a subclass of two and include soil types 2Dbc and 2Dbd.

The subclass varies for UMAs of soil types 1Dyc3, 5Dyc, 6Dda, 6Dbh and 6Dyj because of the range of depths of the A horizon of these soil types. However, these soil types usually have a subclass of three.

ps - Nature of surface soils. Germination, seedling emergence and crop establishment may be affected by adverse physical conditions of the soil surface. This limitation assesses seedbed characteristics particularly soil-seed contact, hard setting, crusting, coarse self mulch and ability to wet-up. Seedling emergence and crop establishment problems have been demonstrated by commercial experience and agronomic studies on soil types of landscape units 1,2 and 5 (Smith and McShane 1981, Gardner and Coughlan 1982, Elliot and McDonald 1987). Sugar-cane is less affected by this limitation as billets are planted which have large reserves of plant nutrients enabling the young plant to emerge through hard setting or crusting surfaces.

Seedling emergence problems can be expected to be more frequent on those cracking clays with a large fraction of dry aggregates >5 mm (Yule *et al.*, 1976). Direct measurements of proportions of dry aggregates have not been made on BRIA soils. Instead, a formula developed by Coughlan and Lock (1984) calculates the proportion of dry aggregates >5 mm using cation exchange capacity (CEC), exchangeable sodium percentage (ESP) and clay content for the 0.1 m depth. Data from 26 different cracking clays from Central Queensland and the Darling Downs was used.

The equation is:

% dry aggregates >5 mm = 14.2 + 6.86 ESP + 1.15 clay % - 1.39 CEC
(R^2 = 0.76, N=26, P<0.01).

Gardner and Coughlan (1982) have used the % dry aggregates >5 mm calculated by this equation to compare BRIA soils with two cracking clays of the Darling Downs with and without emergence problems. The results suggest all cracking clays of the Mulgrave section will present some problems with crop establishment. All cracking clays of the Mulgrave section have therefore been given a subclass of three.

For soil types with rigid surfaces a qualitative assessment has been made based on the degree of hard setting, surface crusting, surface texture, grade of pedality of the A horizon and depth at which the profile becomes strongly sodic.

Awadhwal and Thieistein (1985) have defined a soil crust as a thin, hard layer formed on drying of the soil surface due to the dispersive forces of rain drops or irrigation water. The mechanical impedance of these crusts can impede seedling emergence. Crusting problems will occur on soils with surface textures of sandy loams, loams, silty loams and sandy clay loams (Gardner 1979). Sodicity in the surface also favours crust formation.

A horizons are considered by Northcote (1979) to be hard setting when a compact, hard and apparently apedal condition prevails on the drying out of the soil. This condition can also impede seedling emergence. The development of a hard setting surface or a surface crust has been observed on many soil types of the BRIA, especially the solodic-solodized solonetz which mostly have loam to clay loam texture of the A horizon.

Seedling emergence and water infiltration can be adversely affected by high proportions of fine sand or significant silt levels combined with low organic matter content of surface soils (Loveday 1981). Many duplex soil types of the BRIA have high proportions of fine sand in the A horizon and are expected to present emergence problems.

Most soil types of the Mulgrave section with rigid surfaces have been given a subclass of three for this limitiation. However, solodic-solodized solonetz with a shallow surface (less than 0.12 m) and high sodicity at 0.2-0.3 m, have been given a subclass of four. Such soil types include 1Dda, 2Dba, 2Ddb, 5Dyd and 6Dbh and some UMAs of 2Dya, 2Dyb and 6Dyj. Most duplex soil types of landscape unit 4 also have a subclass of four because of the extremely hard setting nature of these soil types. The sandy soil types, 4Ucc, 4Ucf, 4Gna2 and 6Uca, and the uniform loam 6Umb2 have no subclass as seedling emergence is not expected to be a problem on these soil types.

pd - Distribution of soils. This limitation assesses the effect on irrigation management of soil complexity both within a UMA and between adjacent UMAs. To maximise crop productivity soil types within irrigation blocks should have similar soil water stores and infiltration attributes. If these soil properties are markedly different between soils in a manageable production unit, productivity over the whole unit will be reduced because of ineffective irrigation scheduling and difficulty in timing for planting, cultural and harvesting operations.

A combination of depth and texture of the A horizon and permeability of the upper B horizon of the soil types are the diagnostic attributes used to determine the subclasses. These attributes are assessed over a 300 m length as this furrow length is regarded as the minimum for a manageable irrigation unit. Areas with soil types that have widely contrasting attributes within a 300 m transect will be extremely difficult to manage and have a subclass of four. Most of the areas of landscape units 4 and 6 and soil types 1Dyb, 1Dyc, and 5Dra have this subclass. Areas of the compound UMA 2Ddc-2Ugi have a subclass of three.

pt - Texture of surface soils. The most cost effective means of irrigation is to minimise the number of water applications per crop without causing an economic yield reduction. The costs of irrigation and management inputs will be highest on soil types with deep, coarse-textured layers. Hence, the depth of sandy texture is used as the diagnostic attribute to determine the subclasses. Soil types with greater than 0.9 m of sand to sandy loam have therefore been given a subclass of four and include 4Ucc, 4Ucf, 4Gna2, 6Uca and 6Ucc. Trickle or other micro-irrigation methods would be more suitable on these soil types. Soil types with 0.45 to 0.9 m of sand to sandy loam have been given a subclass of two or three. UMAs of soil type 6Dya have a subclass of three or four depending on the depth of the sandy A horizon.

sa - Salinity. The presence of salinity in the soil solution can affect crop growth by reducing the water available to the crop (osmotic effect) and by increasing the concentration of certain ions that have a toxic effect on plant metabolism (specific effect) (F.A.O. 1985).

Electrical conductivity on a 1:5 soil to water mixture, EC1:5, has been measured on a number of sampled profiles representing most soil types in the BRIA. The average value for EC1:5 of a soil type is used as the diagnostic attribute to determine the subclasses. If this value was 1.0 dSm^{-1} or greater at 0.3-0.9 m a subclass of three was given. The only soil types within this survey area that have this subclass are some solodic-solodized solonetz of landscape units 1 and 2, such as 1Dda, 1Dyb, 1Dyc3, 2Dbb, 2Dda, 2Ddc, 2Dya and 2Dyb.

A wide range of salt tolerances exist for various agricultural crops (Maas and Hoffman 1977). This has not been accounted for. The limitation assesses the salt levels of the virgin profile. Leaching of salts from the profile has not been considered nor has secondary salinisation.

so - Sodicity. High levels of sodium on the exchange complex can affect plant growth by the direct toxicity effect, by development of poor soil physical conditions and by reducing the availability of, and causing imbalances between calcium and magnesium.

As a large proportion of the rooting system of most crops is developed in the upper 0.2 to 0.3m of the soil, the level of ESP at this depth is used as the diagnostic attribute to determine the subclasses. In the BRIA, productivity of soil types that are strongly sodic at this depth is low. These soils therefore have a subclass of four.

Baker, Rayment and Reid (1983) developed a power function between ESP and laboratory pH using soils analysed in the survey by Reid and Baker (1984). The function is $Y = a.X^b$ where Y = ESP and X = laboratory pH. For solodic-solodized solonetz the relationship was good ($r^2 = 0.85$, n = 60, a = 5.229×10^{-4} and b = 5.016). However, for the cracking clays the relationship had a lower correlation co-efficient of 0.50 (n = 72, a = 5.111×10^{-4}, b = 4.583). These relationships have been used to predict the ESP in soils where little ESP information is available or where the ESP at 0.2-0.3 m has a wide range. Field pH has been used instead of laboratory pH as a strong relationship exists between field and laboratory pH.

A total area of 1 321 hectares has a subclass of four for this limitation and includes all areas of soil types 2Dba, 2Ddb, 4Dyh, 5Dyd, 6Dbh, and 6Dyj and some areas of 2Dya, 2Dyb, 2Ddc-2Ugi and 6Dda. The area with a subclass of three totals 3 164 hectares, and includes all areas of soil types 1Dda, 1Dyb, 1Dyc3, 2Dbb, 2Dbd, 4Dyg, 5Dyc, 6Dba, 6Dbe, 6Dda and 6Dyg and the cracking clays 1Uga, 1Ugf, 2Ugh and 2Ugk and some areas of 2Dya, 2Dyb, 2Ddc-2Ugi and 6Dda.

t - Topography. Gradients and lengths of furrows should be designed to meet the water application rate, the infiltration characteristics of the soil and sensitivity of the crop to waterlogging (Loveday 1981). The potential for soil erosion in the furrow must also be considered (Shaw and Yule 1978).

The optimum furrow gradients for soils of the BRIA have been regarded as 0.03 to 0.25 percent. Elliot and McDonald (1987), however, have found that <0.1 percent furrow gradient on a solodic-solodized solonetz (1Dyc) is too low for effective furrow irrigation of maize and soybeans due to slaking and dispersion of the clods on the hills into the furrows. Irrigation on about 0.5 percent slope was regarded as too steep due to poor infiltration.

Even slopes have been considered in this limitation. Slope phases have not been mapped. Consequently, complexity of slope within a UMA is not considered unless the slopes are so complex that they may be considered in microrelief.

Sloping lands are found mainly on the gently undulating rises (landscape units 4 and 5). Flat areas occur in the Burdekin River alluvial plain (landscape unit 2). In many cases these approach 0.03%.

n - Fertility. This limitation assesses the initial fertiliser requirements as part of land development for irrigation. Some soil types will require larger initial amounts of fertiliser than others to compensate for fixation into unavailable forms. Those soils deficient in a number of plant nutrients will also require greater fertiliser inputs than those with fewer deficiences. The ratings of Bruce and Rayment (1982) for the level of the major nutrients in the analysed soil profiles are used as the diagnostic attributes to determine subclasses limits. Those soil types with very low levels, for one or two major nutrients have a subclass

of two while those with more than two nutrients with very low levels have a subclass of three. Most of the Mulgrave Section has a subclass of two. The soil types of landscape unit 4 whose analysed profiles show they are deficient in most nutrients, have a subclass of three.

r - Rockiness or stoniness. 'Rockiness' refers to rock outcrop which has been defined by McDonald *et al.*, (1984) as any exposed area of rock that is inferred to be continuous with underlying bedrock. 'Stoniness' refers to coarse fragments of rocks, usually cobble, stone or boulder, with large gravels being considered if sufficient are present to cause harvesting problems with low-lying crops. The terms cobble, stone, boulder and large gravel are consistent with the definitions of McDonald *et al.* (1984).

Insufficient observations have been made to critically determine the subclasses limits. Instead, the likely effect of rockiness or stoniness on cultural operations is considered. The amount of stone on the surface will determine the cost of stone picking and therefore the requirement for stone picking is used to determine the subclass limits. Some UMAs of the gently undulating rises (landscape units 4 and 5) have a subclass of three. All UMAs delineating a rocky phase have a subclass of four or five.

g - Microrelief. Areas with gilgai or other microrelief must be levelled to ensure even slopes for efficient water use under furrow irrigation. The vertical interval of the microrelief, which affects the amount of levelling required and therefore the cost, is used as the diagnostic attribute to determine the subclass limits.

Most cracking clays have a subclass of two or occasionally three. Soil type 2Dyc also has a subclass of two. Areas with long, narrow, smooth-sided open depressions or creek channels with less than 3.0 m vertical interval occur in the south-west of the survey area. Such areas have been indicated by the phase C and have been given a subclass of four.

Areas with vertical interval of gilgai different to what is normally associated with the soil type are indicated by the variant 7. Such areas will therefore not have the normal subclass for this limitation.

w - Wetness. Wetness refers to excessive water on the soil surface and in the profile as a result of rainfall or local run-on water. The excess water is caused by inadequate surface drainage and poor soil permeability. This limitation assesses the additional engineering works that may be required on some lands before normal preparation procedures for furrow irrigation can be undertaken. Levelling involving both cut and fill and surface drainage may be necessary.

Most areas of cracking clays of the Burdekin River alluvial plain have a subclass of three, although some have a subclass of four, particularly along the broad natural drainage depressions. Areas that are subject to permanent or seasonal inundation and which require substantial drainage and reclamation works before any production is possible have been indicated by the phase W. Such UMAs have a subclass of five, and include such UMAs as 77, 275 and 441. Other UMAs with the most severe subclass include 358, 363, 373, 381, 382, 368 and 156 and UMAs 10 and 158. UMAs 431, 436 and 437 occur as slight depressions at the end of a flood-out from Gladys Lagoon and have been given a subclass of four because of expected waterlogging problems from subsurface drainage.

With the development of the irrigation scheme, construction of area works including drains may alleviate the problem of wetness of the affected UMAs.

e - Water erosion. This limitation assesses the susceptibility to erosion and control measures required to minimise soil erosion in this environment. Erosion within the Mulgrave Section can best be described in two categories:

. Sheet and rill erosion of the gently undulating rises (landscape units 4 and 5), the pediments of landscape unit 1 and some solodic-solodized solonetz of the Burdekin River alluvial plain (landscape unit 2); and

. Stream bank erosion of Scotts/Barratta Creek and Gladys Lagoon.

. Sheet and rill erosion. The erodibility of a soil or its susceptibility to erosion depends on a complex interaction of a number of its physical and chemical factors. Particle size, percent organic matter, the structure of the A horizon and permeability of the profile are used in the Universal Soil Loss equation to determine erodibility (Wischmeier and Smith 1978). Those soils with shallow, massively structured A horizons of medium texture together with an impermeable B horizon are the most erodible. The length and degree of slope also substantially affects the rate of soil erosion by water. The amount, frequency and intensity of rainfall are important parameters influencing the erosive energy of rain. The potential erosion during the summer months is high.

The subclasses have been defined in general terms, and indicate the relative management practices required to keep soil erosion within acceptable limits. Most of the soils of landscape units 1, 4 and 5 have a subclass of two or three with minor areas of steeper slopes having been given a subclass of four. Some of the solodic-solodized solonetz of landscape unit 2 have a subclass of two or three.

. Stream bank erosion. A small UMA, number 71, at the end of Gladys Lagoon is severely eroded and has a subclass of five. Scotts/Barratta Creek along the western boundary of the Mulgrave Section usually has clearly, well defined and severely eroded banks. Some existing gullies are actively eroding from the present creek line where water run-off is concentrated, for example UMAs 389, 386, 380, 142, 335 and 304. *Such areas must be stabilised as part of development of the area to prevent further progression of gullies.*

f - Flooding. The area subjected to flooding at a frequency of one in ten years has been discussed in section 2.3.1. This limitation assesses the likelihood of serious flooding at frequencies of one in ten years or greater. However, most of the survey area, with the exception of the gently undulating rises (landscape units 4 and 5), will be subject to overbank flooding from the Burdekin River which is not considered. The areas likely to be inundated will change after development.

i - Intake or recharge attributes. Recharge or intake areas have been defined as that portion of the landscape where the net saturated flow of groundwater is directed away from the water table (Shaw *et al.* 1986). There is a significant downward component to groundwater flow near the soil surface in recharge areas. Subclasses of this limitation indicate whether alternative forms of irrigation are recommended to minimise contributions to groundwater.

The processes of secondary salinisation in the Leichhardt Downs Section is described in Donnollan *et al.* (1990). The recharge areas usually occur on upper slopes and convex topgraphy of landscape unit 5. Often prior streams in landscape unit 6 act as recharge areas or distributory channels. Soil types involved are 5Dra, 5Dya and 6Ucc. Similar soils of landscape unit 4 (4Ucf, 4Gna) may also act as intake areas.

UMAs of 5Dra and 5Dya have been given a subclass of three while sands of landscape units 4 and 6 have been given a subclass of four. *Sprinkler irrigation or other low volume irrigation methods are recommended on these soil types to minimise contribution to groundwater and off-site seepage and salinisation problems.*

o - Outflow or discharge attributes. Outflow or discharge areas are those portions of the landscape where the net saturated flow of groundwater is directed towards the water table (Shaw *et al.*, 1986). In a discharge area there is an upward component to groundwater flow near the soil surface which may result in salinisation.

The likely position of some potential discharge areas in the BRIA can now be identified. This knowledge is used in the classification to identify those areas which may become salinised. Such areas include the lower slopes of the gently undulating rises (landscape units 4 and 5) and the margins of the relict levees associated with Gladys Lagoon.

6.3.3 Limitations affecting flood irrigation of rice

Of the seven limiting factors in this suitability classification, six are also in the furrow irrigated suitability classification. All, except the gilgai limiting factor, have different diagnostic attributes or subclass limits because of the different irrigation method employed. Each is discussed below as it effects the rice classification.

t - Topography. Flood irrigation of rice requires ponding of water between 0.05 m and 0.2 m depth (Borrell, personel communication). Using this criteria, a rice bay on 0.5 percent slope will have a bay width of 30 m which is the minimum acceptable. At slopes above 0.5% bay walls occupy an unacceptably high proportion of the area (Reid and Baker 1984). Slopes less than 0.03% present problems with water distribution at flushing.

Complexity of slope is also considered as more levelling is required to produce the even bay slope necessary for rice production.

Slopes greater than 0.75% are considered impractical for rice bay development. All the areas of the gently undulating rises (landscape units 4 and 5), most of the area of landscape unit 6 and some areas of landscape unit 1 have slopes in this category and have been given a subclass of five.

f - Flooding. Areas subject to erosive flooding are unsuitable. The limits for subclasses two and three have included greater frequencies of flooding than for furrow irrigated crops as rice is grown under flooded conditions.

p - Profile permeability. This limitation assesses the likely losses to deep drainage from ponded rice bays. To maintain an adequate ponded depth of water in bays without excessive losses to deep drainage, soils with very low hydraulic conductivities in the B horizon are the most suitable. As hydraulic conductivities have not been measured on many soils of the BRIA, morphological characteristics of the soil types that are known to relate to hydraulic conductivity were used as the diagnostic attributes to determine the subclasses. These characteristics are texture throughout the profile, consistence of the B horizon, depth of the A horizon and pH trends (or ESP). Duplex soils with A horizons <0.2 m deep, moderately strong, very strong or rigid upper B horizons, textures of clay from the base of the A horizon to >1.5 m and pH >8.5 by 0.6 m are considered the least permeable. Uniform sands, loams, gradational soils or duplex soils with acid or neutral pH trends are considered unsuitable and have a subclass of five.

The criteria need to be quantified to increase their precision. Gardner and Coughlan (1982) used criteria for water use of 2 mm/day as their cut-off for suitable soils, and showed that the soils desired for rice had the properties mentioned above. Most cracking clays and solodic-solodized solonetz of landscape units 1 and 2 have these morphological properties.

A total of 2 128 hectares of the Mulgrave Section has a subclass of four or five for this limitation. All areas of landscape units 4, 5 and 6, some areas of landscape unit 1 and those areas of landscape unit 2 that have some soil profiles overlying material coarser than sandy clay before 1.5 m are included.

n - Fertility. This limitation assesses both the initial fertilier requirements as part of land development and fertiliser requirements to achieve good growth in subsequent crops. Some soil types will require larger initial fertiliser applications than others to compensate for fixation into unavailable forms. The costs of cropping will increase if large fertiliser inputs are required during the crop cycle. Crop performance has been poor on solodic-solodized solonetz with shallow A horizons and high ESP close to the surface. Large fertiliser inputs are required to overcome this poor growth. Such soil types have been given a subclass of three and include 2Dba and 2Ddb.

sa - Salinity. This limitation assesses the effects of high soil salinity on the growth of rice, particularly young seedlings. No areas in the Mulgrave Section have a subclass greater than one.

pd - Distribution of soil types. This limitation assesses the effect of soil complexity on management of rice bays. Distribution of soil types is considered last and is only assessed on UMAs that have a subclass of one, two or three for all other limitations (suitable UMAs). Any suitable UMA less than 300 m wide has been given a subclass of four if the adjacent UMA (or UMAs) has a subclass of four or five for any limitation. The subclass of minor soils within a compound UMA are also considered.

6.4 Guidelines for development

Land resource information is an important input to farm planning to ensure sustained economic production and long-term stability of the land resource.

In the Mulgrave section of the BRIA particular concerns for farm design and resubdivision of land are:

. Land degradation hazards - flooding, erosion and secondary salinisation; and
. Land management problems - complex soil distribution, distribution of unsuitable soils and the presence of needle nematodes in certain soil types.

6.4.1 Land degradation hazards

Flooding. Significant flooding in much of the area will ocur when the Burdekin River overflows and Gladys Lagoon becomes a major distributory channel. This is estimated to have a recurrence interval of 12 years (Burdekin Project Assessment Committee 1977). Broad drainage depressions are likely to be inundated almost annually by local run-off.

Construction of an extensive system of drains is essential during any development of the area and must be designed to minimise depth and length of inundation to reduce crop or infrastructure damage or loss.

Infrastructure must be designed and located so that natural drainage is not impeded, particularly in broad drainage depressions such as UMAs 275, 441 and 442.

Erosion. Any existing gullies, delineated on the accompanying soils map as an eroded phase, must be fully rehabilitated as part of design of the area. The banks of Scotts-Barratta Creek must be protected by adequate buffer zones maintained to prevent erosion.

Secondary salinisation. Leakage from channels and deep drainage losses from irrigation must be kept within acceptable limits to minimise subsequent rises in groundwater. Particular attention must be given to irrigation development of most of the area of landscape units 4, 5 and 6 and those UMAs identified as variant 1 or 2 of a soil type because of the presence of weathered rock or coarse textured porous layers before 1.5 m. Groundwaters must be monitored and modelling undertaken to determine the likely extent of land subject to rising groundwater.

6.4.2 Land management problems

Complex soil distribution. A complex pattern of soil types with widely different management requirements may cause management problems with a subsequent reduction in crop yield. Such complex patterns occur over much of landscape units 4, 5 and 6.

Distribution of unsuitable soil types. Two soils types, 2Dba and 2Ddb are unsuitable for all the crops or crop groups considered because of their adverse physical and chemical attributes. As far as practicable, any areas of these two soil types should be excluded from irrigation development.

Discrete areas of 2Dba or 2Ddb distributed within a larger area which is suitable for irrigation development will be difficult to exclude from resubdivision. As far as practicable, farm boundaries should be located so that these soil types are away from the centre of a farm. Location of farm boundaries in this way will provide opportunity for management of these soil types as a separate unit.

A number of UMAs (for example 215, 318, 319, 421 and 422) are unsuitable for rice because of the presence of coarse textured porous layers before 1.5m which will allow excessive deep drainage. The distribution of these UMAs within areas suitable for rice will create problems for bay design.

Nematodes. Needle nematodes can seriously damage rice crops in the Lower Burdekin (Stirling and Shannon 1986). The cost-benefit analysis of applying suitable nematicides (Stirling *et al.* 1989) indicate costs are prohibitive and the only immediate answer is deemed to be the breeding of resistant cultivars. Rice production may be at risk from some nematode damage on all cracking clay soil types of landscape unit 2 within this survey area, particularly where they occur in broad drainage depressions.

Research is urgently needed to identify more precisely those soil types and/or landscape positions that favour the development of large populations of the nematode. Monitoring of all rice production on cracking clays of landscape unit 2 is desirable to determine those areas where excessive nematode populations may cause economic damage or crop failure.

6.4.3 Management of Cracking Clays and Solodic-Solodized Solonetz.

The management problems of both cracking clays and solodic-solodized solonetz have been discussed in detail in Donnollan *et al.*, (1990). A summary of the important points is outlined below.

Management problems of cracking clays. Cracking clays are favourable soils for irrigation but suitable management strategies are needed to ensure that irrigation of these soils is successful. The more important problems associated with the irrigation of cracking clays include:

a) Reduced permeability in the swollen state as both infiltration and internal drainage are very slow;
b) Narrow optimum moisture range for tillage and seeding operations;
c) Germination and emergence difficulties associated with rapid drying of granular surfaces and sealing or crusting of some types; and
d) An uneven land surface requiring levelling (especially where gilgaied), and gradients requiring adjustment for efficient irrigation.

Management problems of solodic-solodized solonetz. As the B horizons of these soils have very low permeabilities, rice is the most suitable crop. Soils of landscape unit 1 with slopes greater than 0.5 percent and soils of landscape unit 2 with D horizons coarser than sandy clay are exceptions.

The major problems associated with irrigation of solodic-solodized solonetz for crops other than rice are:

a) Low PAWC and high ESP;
b) Seedling emergence; and
c) Soil salinity.

6.4.4 Guidelines for farm management

Management considerations for each agricultural management unit* are given in Table 6.4.1. Some guidelines for management are discussed below.

Precision levelling will be required during land preparation to ensure even furrow gradients and adequate surface drainage to minimise waterlogging problems. This will be critical on areas of very low slopes and/or gilgai microrelief such as most areas of landscape unit 2.

Large cuts must not be made in soil types with strongly sodic or strongly alkaline subsoils close to the surface, particularly 2Dya, 2Dyb, 2Dbb and 2Dda. Exposure of such subsoil will increase fertility problems and make preparation of an adequate seedbed difficult and generally produce a very unsuitable medium for plant growth.

Application of water for more than 18 to 24 hours can induce waterlogging problems in cracking clay soil types (Norman, personal communication). In areas of cracking clays with very low slopes, irrigation runs should be shorter than those on higher slopes to reduce the time of water application. These shorter run lengths will also reduce waterlogging from large rainfall events.

Channels and drains should be appropriately designed and constructed so that losses to groundwater and impedance to surface flow are kept to a minimum.

All waterways should be grassed and adequately maintained so that the risk of erosion is minimised.

* See glossary

Table 6.4.1 Land suitability classes, soil or land limitations and management considerations for each agricultural management unit, Mulgrave Section, BRIA.

Agricultural management unit	Land suitability classes					Soil or land properties		Management considerations
	Sugar-cane	Grain crops	Small crops	Mangoes	Rice	Physical	Chemical*	
1Uga, f	2	3	4	4	3	Gilgai to 0.3 m Waterlogging Flooding	Low general fertility with very low phosphorus levels Usually strongly alkaline at 0 3 m Sodic to strongly sodic below 0.6 m Medium to high salt levels at 0 6-0.9m	Seedling emergence Wet season trafficability Precision levelling required for adequate surface drainge Uneven crop stand due to soil variability after levelling Narrow range of optimum moisture for tillage operations
1Dyb	4	4	4	4	5	Shallow A horizon Surface crusting B horizon of very low permeability Low PAWC** Soil distribution D horizons coarser than light clay below 0.4-0.6m	Low general fertility with very low phosphorus levels Often strongly alkaline at 0.3 m Strongly sodic at and below 0.3 m Very high salt levels at 0.9 m	Unsuitable for all crops or crop groups considered except rice because of high sodicity, shallow A horizon and close association with soil types that have different management requirements Unsuitable for rice because of excessive permeability below 0.4-0.6 m
1Dyc3, 1Dda	3	4	4	5	5	Shallow A horizon Surface crusting B horizon of very low permeability Low PAWC Slope >0.5% Susceptible to erosion	Low general fertility with very low phosphorus levels Often strongly alkaline by 0.3 m Strongly sodic at and below 0.3 m High to very high salt levels at 0.6 m (Note, 1Dda may have medium to high salt levels by 0.9m)	Unsuitable for rice because of excessive slope Seedling emergence Restricted rooting depth Soil profile amendment required to increase PAWC Fertility problems if strongly sodic B horizon exposed after levelling or cultivation Dispersive B horizons Erosion control practices required
2Ugc, 2Ugd, 2Uge	2	3	4	4	2	Low lying areas with low gradients Waterlogging Gilgai to 0.25 m Flooding Surface crusting	Low general fertility with very low phosphorus levels Sodic by 0.6 m and usually strongly sodic at 0.9 m Medium salt levels at 0.9 m	Seedling emergence Wet season trafficability Precision levelling required for adequate surface drainage Uneven crop stand due to soil variability after levelling Narrow range of optimum moisture for tillage operations
2Ugf, 2Ugg, 2Ugk	2	3	4	4	2	Low lying areas with low gradients Waterlogging Gilgai to 0.25 m Flooding	Low general fertility with very low phosphorus levels Sodic at 0.6 m (2Ugk maybe strongly sodic at and below 0.9 m) Medium salt levels at 0.9-1.2 m	Seedling emergence Wet season trafficability Precision levelling required for adequate surface drainage Narrow range of optimum moisture for tillage operations
2Ugh	2	3	4	4	2	Low lying areas with low gradients Waterlogging Gilgai to 0.25 m Flooding	Low general fertility with very low phosphorus levels Strongly alkaline by 0.3 m Sodic by 0.6 m and strongly sodic sodic at and below 0.9 m High salt levels at 1.2 m	Seedling emergence Wet season trafficability Precision levelling required for adequate surface drainage Uneven crop stand due to soil variability after levelling and exposure of strongly alkaline B horizon of mound Narrow range of optimum moisture for tillage operations
2Dyc	2	3	4	4	2-5	Low lying areas with low gradients Waterlogging Gilgai to 0.25 m Flooding Surface crusting Soil distribution	Low general fertility with very low phosphorus levels Sodic by 0.6 m and strongly sodic by 1.2 m Medium salt levels at 0.9 m	Some UMAs are unsuitable for rice because of excessive permeability or close association with unsuitable UMAs Seedling emergence Wet season trafficability Precision levelling required for adequate surface drainage Uneven crop stand due to soil variability after levelling

Table 6.4.1 (Continued)

Agricultural management unit	Land suitability classes					Soil or land properties		Management considerations
	Sugar-cane	Grain crops	Small crops	Mangoes	Rice	Physical	Chemical*	
2Dba, 2Ddb	4	5	5	5	4	Shallow A horizon Surface crusting B horizon of very low permeability Very low PAWC	Low general fertility with very low phosphorus levels Strongly alkaline by 0.3 m Strongly sodic at and below 0.3 m Very high salt levels at 0.6 m	Unsuitable for all crops or crop groups considered because of extreme sodicity at and below 0.3 m which has adverse effects on fertility, PAWC and seedbed preparation
2Dbc, 2Dbd	2	3	3	3	3	Surface crusting	Low general fertility with very low phosphorus levels Strongly sodic at and below 0.6 m Usually moderate to high salt levels at 0.9 m	Seedling emergence Dispersive B horizon
2Dya, 2Dda	3	4	4-5	4	2-3	Shallow A horizon Surface crusting B horizon of very low permeability Low PAWC	Low general fertility with very low phosphorus levels Strongly sodic at and below 0.3 m High salt levels at 0.6-0.9 m	Seedling emergence Restricted rooting depth Soil profile amendment required to increase PAWC for crops or crop groups other than rice Fertility problems if strongly alkaline B horizon exposed after levelling or cultivation Dispersive B horizon
2Dyb, 2Dbb, 2Dbe	2-3	3-4	4	4	1-3	Surface crusting B horizon of very low permeability Low PAWC	Low general fertility with very low phosphorus levels Strongly sodic by 0.6 m Medium to very high salt levels at 0.6 m	Seedling emergence Restricted rooting depth Soil profile amendment required to increase PAWC for crops or crop groups other than rice Fertility problems if strongly alkaline B horizon exposed after levelling or cultivation Dispersive B horizon
2Ddc-2Ugi	3	3	4	4	5	Soil variability Slopes >1% Surface crusting B horizon of ZDdc has very low permeability Low PAWC of 2Ddc	Low general fertility with very low phosphorus levels Sodic at 0.3 m and strongly sodic at and below 0.6 m Medium to high salt levels at 0.6 m	Unsuitable for rice because of excessive slope Seedling emergence Uneven crop stands due to soil variability Restricted rooting depth of 2Ddc Profile amendment required to increase PAWC of 2Ddc Erosion control practices required
4Ucf	5	5	5	3	5	High infiltration rate Medium to large pebbles throughout profile Slope >2% Susceptible to erosion Soil Depth <0.9 m	Low general fertility with very low phosphorus	Unsuitable for all but low volume methods of irrigation because of high infiltration rate Stone picking required in most areas Very low PAWC
4Gna2	4	4	3	3	5	Surface crusting Very low PAWC Soil variability Soil distribution	Low general fertility with very low phosphorus levels	Unsuitable for rice because of excessive permeability Seedling emergence and establishment Closely associated with soil types that have different management requirements Frequent irrigations required
4Dya3	3	4	4	4	5	Surface crusting Low PAWC Soil distribution	Low general fertility with very low phosphorus levels	Unsuitable for rice because of excessive permeability Seedling emergence and establishment Profile amendment required to increase PAWC Closely associated with soil types that have different management requirements Frequent irrigations required
4Dyd	3	4	4	3	5	Surface crusting Low PAWC in A horizon Slopes usually >1% Soil variability Susceptible to erosion	Low general fertility with very low phosphorus levels Strongly sodic at 0.9 m	Unsuitable for rice because of excessive permeability Seedling emergence and establishment Uneven crop stand because of soil variability Erosion control practices required
4Dye	4	5	5	3	5	Soil distribution Surface crusting Slope >1% Susceptible to erosion	#	Unsuitable for all crops or crop groups considered except mangoes because of soil distribution Sodicity and salinity levels in the B horizon may reduce the yield of mangoes

Table 6.4.1 (Continued)

Agricultural management unit	Land suitability classes					Soil or land properties		Management considerations
	Sugar-cane	Grain crops	Small crops	Mangoes	Rice	Physical	Chemical*	
4Dyg, h	4	4-5	4-5	4-5	5	Susceptible to secondary salinisation Surface crusting B horizon of very low permeability Low PAWC Slopes >1% Susceptible to erosion	Low general fertility with very low phosphorus levels Strongly sodic at and below 0 3 - 0 6 m Medium to high salt levels at 0.6 m	Unsuitable for irrigation development because of susceptibility to secondary salinisation
4Dyk	4	4	4	3	5	High infiltration rate Surface crusting Slope 1-2% Susceptible to erosion Low PAWC	Low general fertility with very low phosphorus levels Strongly sodic at and below 0.6 m	Unsuitable for all but low volume irrigation methods of irrigation because of high infiltration rate Sodicity and salinity levels in the B horizon may reduce the yield of mangoes
4Dga	4	4	4	4	5	Waterlogging Surface crusting Very low PAWC of A horizon Soil variability	#	Unsuitable for all crops or crop groups considered because of development of perched water table
5Uga	3	3	4	4	5	Soil distribution Soil depth <0.9 m Slope 0.5 - 0.75% Susceptible to erosion	Low general fertility with low phosphorus levels	Unsuitable for rice because of excessive permeability below 0 7 - 0.9 m Closely associated with soil types that have different management requirements Erosion control practices required
5Ugc-5Ugd	3	3	4	4	5	Slope >0.75% Susceptible to erosion	Low general fertility with low phosphorus levels Strongly sodic at and below 0 6 m Medium to high salt levels at 0.6 m	Unsuitable for rice because of excessive slope and permeability Seedling emergence Erosion control practices required
5Dra, 5Dya	3-4	3-4	3-4	2-4	5	Surface crusting Soil distribution of 5Dra Slopes >1% Susceptible to erosion Soil depth <0.8 m Surface stone and rock outcrops in some areas	Low general fertility with low to very low phosphorus levels	Spray or trickle irrigation recommended to decrease deep drainage losses and prevent secondary salinisation down slope 5Dra often closely associated with soil types that have different management requirements Erosion control practices required Stone picking required
5Dyb	4	4	4	2	5	Surface crusting Slopes >2% Susceptible to erosion	Low general fertility with low to very low phosphorus levels Sodic at and below 0.9 m	Unsuitable for all but low volume methods of irrigation because of slope Non-saline seeps may develop if deep drainage losses are not prevented upslope
5Dyc, 5Dyd	4	4	4	4	5	Susceptible to secondary salinisation Surface crusting Susceptible to erosion B horizon very low permeability Low PAWC	Low general fertility with low to very low phosphorus levels Strongly sodic at and below 0.3-0.6 m High to very high salt levels at 0.6 m	Unsuitable for irrigation development because of susceptibility to secondary salinisation
5Dye	3-4	3-4	3	3	5	Soil distribution Slopes >1% Susceptible to erosion B horizon of low permeability	Medium salt levels below 1.2 m	Unsuitable for rice because of excessive slope and permeability Closely associated with soil types of different management requirements Seedling emergence Erosion control practices required
6Uca, 6Ucc	4-5	5	4-5	3-5	5	Flooding Soil distribution Very low PAWC High infiltration rates Uneven slopes in some areas	Low general fertility with very low phosphorus levels	Most UMAs unsuitable for irrigation development because of unacceptable risk of flooding

Table 6.4.1 (Continued)

Agricultural management unit	Land suitability classes					Soil or land properties		Management considerations
	Sugar-cane	Grain crops	Small crops	Mangoes	Rice	Physical	Chemical*	
6Umb2	4	4	3	3	5	Soil distribution Slope >1% Flooding in some areas		Unsuitable for rice because of excessive slope and permeability Closely associated with soil types that have very different management requirements
6Uga, 6Ugc	4-5	4-5	5	5	3-5	Flooding Waterlogging Irregular slopes Soil distribution	#	Most UMAs unsuitable for irrigation development because of unacceptable risk of flooding
6Gnd	3	4	3	2	5	Surface crusting Soil distribution Low PAWC	Low nitrogen levels	Unsuitable for rice because of excessive permeability Seedling emergence Frequent irrigations required Closely associated with soil types that have different management requirements
6Gne	4	4	4	4	5	Soil distribution Surface crusting Low PAWC Flooding	#	Unsuitable for all crop or crop groups considered because of complex soil distribution
6Drb, 6Dyc	3-4	4	3	3	5	Surface crusting Soil distribution Slopes often >1%	Low general fertility with very low phosphorus levels	Unsuitable for rice because of excessive permeability and often excess slope Seedling emergence Closely associated with soil types that have different management requirements
6Drc, 6Dyf	2	3	3	2	5	Surface crusting Soil distribution in some areas	Low general fertility with very low phosphorus levels Sodic at and below 0.9-1.5 m	Unsuitable for rice because of excessive permeability Seedling emergence Some UMAs closely associated with soil types that have different management requirements
6Dba	2	3	3	3	4-5	Surface crusting Slopes >0.5% in some areas Dispersive B horizon	Sodic at and below 0.6 m Medium salt levels at 0.9 m	Unsuitable for rice because of excessive slope Seedling emergence
6Dbb	4	4	4	4	5	Flooding Surface crusting Soil distribution	Sodic at and below 0.6 m	Unsuitable for irrigation development because of unacceptable risk of flooding
6Dbe	2	3	3	2	5	Surface crusting	Sodic at 1.5 m	Unsuitable for rice because of excessive permeability Seedling emergence
6Dbh, 6Dyj	4	4	4	5	5	Surface crusting B horizon of very low permeability Very low PAWC (6Dyj - Soil variability and distribution and frequent wet season flooding)	Low general fertility with low phosphorus levels Strongly sodic at and below 0.3 m High salt levels at 0.6 m	Unsuitable for all crops or crop groups considered because of extreme sodicity at and below 0.3 m which has adverse effects on fertility, PAWC and seedbed preparation
6DyaS, 6Dyd	3-4	4	3	3	5	Surface crusting Soil distribution Low PAWC of A horizon of 6DyaS Frequent wet season inundation	Low general fertility	Unsuitable for rice because of excessive permeability Seedling emergence and establishment Closely associated with soil types that have different management requirements Wet season flooding
6Dyb2	4	4	5	4	5	Soil variability Low PAWC in A horizon Soil distribution	Low general fertility Medium salt levels at 0.9-1.2 m	Unsuitable for all crops or crop groups considered because of wetness and complex soil distribution

Table 6.4.1 (Continued)

Agricultural management unit	Land suitability classes					Soil or land properties		Management considerations
	Sugar-cane	Grain crops	Small crops	Mangoes	Rice	Physical	Chemical*	
6Dyg, h	3-4	4	4	4	5	Soil variability Surface crusting B horizon of low permeability Low PAWC Soil distribution	Low general fertility Maybe strongly sodic at 0.3 m	Unsuitable for rice because of excessive permeability Seedling emergence Closely associated with soil types that have different management requirements Fertility problems associated if strongly sodic B horizon exposed Uneven crop stand due to soil variability Profile amendment required to increase PAWC
6Dda	3	4	4	4	5	Soil variability Surface crusting Frequent wet season inundation	Low general fertility with very low phosphorus levels Maybe strongly sodic at and below 0.6 m High salt levels at 0.9 m	Unsuitable for rice because of excessive permeability Seedling emergence Uneven crop stand due to soil variability Wet season flooding

\# No chemical data available for these soils types
* Soil salinity rating from predicted ECSE values after Shaw et al (1986). Sodicity rating after Northcote and Skene (1972). Other ratings after Bruce and Rayment (1982)
** Plant Available Water Capacity

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8 GLOSSARY

Landscape unit	A natural unit of land in which a particular soil or association of soils is developed from a single rock type (consolidated or unconsolidated) or complex of rock types. The soils bear a constant relationship with a limited range of landform elements or native vegetation communities and there is a similar drainage net throughout the landscape unit. These relationships have developed as a result of interactions between climate, rock types and geomorphic history (adapted from Thompson and Moore 1984).
Soil type	A three-dimensional soil body such that any profile within the body has a similar number and arrangement of major horizons whose attributes, primarily morphological, are within a defined range. All profiles within the soil type have similar parent materials (R.C. McDonald, personal communication).
Agricultural Management unit	A mapping unit or group of mapping units with similar land suitability classes, soil and land limitations and management requirements.

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APPENDIX I VEGETATION - COMMON AND SCIENTIFIC NAMES

Trees:	
Beefwood	*Grevillea striata*
Cabbage gum	*Eucalyptus papuana*
Carbeen	*E. tessellaris*
Grey bloodwood	*E. polycarpa*
Grey ironbark	*E. drepanophylla*
Poplar gum	*E. alba*
Red bloodwood	*E. dichromophloia*
Pandanus	*Pandanus spp.*
Shrubs:	
Broad leaf tea-tree	*Melaleuca viridiflora*
False sandalwood	*Eremophila mitchellii*
Quinine bush	*Petalostigma pubescens*
Narrow leaf tea-tree	*Melaleuca nervosa*
Cocky apple	*Planchonia careya*
Grasses:	
Black spear grass	*Heteropogon contortus*
Blue grasses	*Bothriochloa and Dichanthium spp.*
Brown sorghum	*Sorghum nitidum*
Cane grass	*Ophiuros megaphyllus*
Flinders grass	*Iseilema spp.*

APPENDIX I (Continued)

Giant spear grass	*Heteropogon triticeus*
Kangaroo grass	*Themeda australis*
Purple top Rhodes grass	*Chloris barbata*
Red natal grass	*Rhynchelytrum repens*
Button grass	*Dactyloctenium radulans*

Species of Sparse Occurrence:

Trees and Shrubs:

Bauhinia	*Lysiphyllum carronii*
Chinee apple	*Ziziphus mauritiana*
Corkwood wattle	*Acacia bidwillii*
Prickly acacia	*Acacia farnesiana*
Mimosa	*Mimosa pudica*
Native ebony	*Lysiphyllum hookeri*
Bull-oak	*Casuarina luehmannii*
Tristinia spp.	*Tristinia spp.*
Jerusalem thorn	*Parkinsonia aculeata*
Red siris	*Albizia toona*
Rubber vine	*Cryptostegia grandiflora*
Whitewood	*Atalaya hemiglauca*
Willow wattle	*Acacia salicina*
Burdekin plum	*Pleiogynium timorense*
Dead finish	*Albizia basaltica*

APPENDIX I (Continued)

Grasses:

Golden beard grass	*Chrysopogon fallax*
Love grasses	*Eragrostis spp.*
Wild rice	*Oriza spp.*
Wire grass	*Aristida spp.*
Native panic	*Panicum spp.*

Exotic grasses also occur, including guinea grass (*Panicum maximum*), para grass (*Brachiaria mutica*) and various species of couch grasses (*Cynodon spp. and Digitaria spp.*).

Although not grasses, sedges (*Cyperus spp.*) are common in the wetter areas on a seasonal basis.

APPENDIX II RELATIONSHIPS BETWEEN SOIL TYPES AND SOIL SERIES

Soil Type	Soil Series[1]
1Uga, f	Barrunga
1Dyb, 1Dyc3, 1Dda	Gaynor
2Ugc,d,e,f,g,k	Barratta
2Ugh	Barratta, Yalinga
2Dyc	Barratta clay loam variant
2Dba, 2Ddb	Dowie
2Dbb,c,d,e, 2Dya,b, 2Dda	Oakey
4Ucf	Panwood
4Gna2	Wenlee
4Dye	Vendave
4Dyg	Bambave
4Dga	Grendal
5Uga	Wygong
5Dye	Yalboota
5Dra	Dalrymple
5Dyb	Kyanoota
5Dyc	Ranly
6Uca	Yellabin
6Ucc, 6Umb2	Burdekin
6Gnd	Elkin

[1] Hubble, G.D. and Thompson, C.H. (1953), *The soils and land use potential of the Lower Burdekin Valley, North Queensland,* CSIRO, Australian Soils and Land Use Series, No 10.

APPENDIX II (Continued)

6Drb	Lancer
6Drc	Lanona
6Dbb, 6Dyg	Kelona
6Dbe	Glenalder
6Dyc,d	Tootra

APPENDIX III EXPLANATION OF CONVENTIONS USED IN DETAILED DESCRIPTIONS OF MORPHOLOGY OF SOIL TYPES

(a) Nomenclature and definitions are consistent with McDonald *et al.*, (1984) except for A2 horizon which is consistent with Northcote (1979).

(b) Principle Profile Forms (Northcote 1979) are listed in order of occurrence.

(c) Soil types have been placed in Great Soil Groups (Stace *et al.* 1968) where possible. Bracketed qualifiers have been used to distinguish variations to Great Soil Groups. Where soil types cannot be placed in a Great Soil Group, soil names of Northcote *et al.* (1975) have been used.

(d) Moist colours are those of Oyama and Takehara (1967). Where value/chroma ratings are separated by "to" the full range of ratings are inferred. (For example 10YR 2/1 to 4/2 includes 10YR 2/1, 2/2, 3/1, 3/2, 4/1 and 4/2). Colour nomenclature is that of R.C. McDonald (personal communication) based on the Value/Chroma ratings system of Northcote (1979) and utilising the following table:

Value/chroma rating group 2a = 4/1 - 4/2 to 6/1 - 6/2
Value/chroma rating group 2b = 5/3 - 5/4 to 6/3 - 6/4

Value/Chroma rating group	1	2a	2b	4	5
Hue					
10 R	dark	red-grey	red-brown	red	red
2.5 YR	dark	grey-brown	red-brown	red	red
5 YR	dark	grey-brown	brown	red-brown	red-brown
7.5 YR	dark	grey-brown	brown	yellow-brown	brown
10 YR	dark	grey	yellow-brown	yellow	brown
2.5 Y	dark	grey	yellow-grey	yellow	olive-brown
5 Y	dark	grey	yellow-grey	yellow	olive

(e) Self mulch:

Weak < 1cm depth of poorly developed self mulch.
Moderate 1-2cm depth of discrete aggregates breaking to granular peds.
Strong > 1-2cm depth of discrete aggregates breaking to granular peds.

(f) Horizon boundaries:

_____ indicates horizon below is always present.

---------- indicates horizon below is not always present.

APPENDIX III (Continued)

(g) Frequency of occurrence:

Frequently - on 40-80% of occasions.
Occasionally - on 20-40% of occasions.

APPENDIX IV DETAILED DESCRIPTIONS OF MORPHOLOGY OF SOIL TYPES.

Soil type	P.P F	pH	Profile diagram	Description of soil type	Landscape unit	Predominant natural vegetation
1Uga	Ug5 16 Ug5 24 Ug5.28	6 0-7 0 6 5-9.0 7 5-9 5 8 0-9 5 8.0-9 5 8.0-9 5	m A11 m 0.01- 0.05- A12 -0.05 -0.15 0.3- 0.4- B21 0.6- 0.9- B22 -0.9 1.2- B23k 1.5-	Black earth - grey clay Normal gilgai, 0 05 to 0.3 m vertical interval, moderately cracking Few to common small to medium subrounded to rounded pebbles and very few to few fine to medium ferromanganiferous nodules throughout profile Mound A11. Weak to moderate medium to fine granular self mulch. A12- Dark to grey (10YR 2/1 to 3/2, 4/1), occasionally 5 10% distinct brown mottles, light medium to medium clay, moderate to strong 5-20 mm sub-angular to angular blocky; dry very firm Clear to - B21 Dark to grey (10YR, 2 5Y 2/1 to 4/1), medium to medium heavy clay, strong 10-20 mm prismatic to 5-20 mm lenticular to angular blocky, dry moderately strong. Gradual to diffuse to - B22 As above but grey (10YR, 2 5Y 4/1 to 5/2), occasionally very few fine to coarse calcareous nodules. Clear to - B23k- Grey to yellow-brown (10YR, 2 5Y 5/1, 5/2, 5/3 to 6/4), occasionally 10-25% distinct yellow mottle; medium to medium heavy clay, strong 10-20 mm prismatic to angular blocky to 5-20 mm lenticular, dry moderately strong; few fine to coarse calcareous nodules Depression. Similar morphology but greater depth to calcareous nodules and usually lower pH in upper B horizon.	Local alluvial plains and associated pediments Low lying flats and drainage depressions	Low to mid-high open woodland of poplar gum and carbeen with cabbage gum, beef-wood and broad leaf tea-tree associated with Tussock grassland of cane grass and blue grasses
1Ugf	Ug3 2 Ug2	6 0-6.5 6 5-8.5 7 5-9.0 7 5-9 0 8 5-9 5 8.5-9 5	m A11 m 0 -0.02 0.05- A12 0.15- A2 -0.15 0.3- -0.3 0.4- B21 0.6- 0.7- B22 -0.8 0.9- 1.2- B23 or B23k 1.5-	(Bleached grey clay)- Normal gilgai, 0 05 to 0.3 m vertical interval, weakly cracking Few to common small to medium subrounded to rounded pebbles and very few to few fine to medium ferromanganiferous nodules or veins throughout profile. Mound- A11. (Occassionally present) weak medium granular self mulch (when absent surface is hard setting). A12 Dark to grey (10YR 3/1, 4/1, 4/2); 10-25% distinct brown mottles, light to light medium clay, weak to moderate 5-20 mm angular blocky; dry moderately firm. Abrupt to clear to- A2. As above with conspicuous or sporadic bleach Abrupt to - B21 Grey (10YR, 2.5Y 4/1 to 5/2); occasionally 10-25% distinct brown mottles, medium clay; strong 10-20 mm prismatic to angular blocky to lenticular; dry very firm. Gradual to - B22- Grey to yellow-grey (10YR, 2 5Y 4/1 to 5/2, 5/3), medium to medium heavy clay, strong 10-20 mm lenticular to angular blocky; dry very firm Clear to - B23 or B23k. Grey to yellow-grey (10YR, 2 5Y 4/1 to 5/2, 5/3, to 6/4), medium to medium heavy clay, strong 10-20 mm lenticular to angular blocky; dry very firm, occasionally few fine to coarse calcareous nodules and soft segregations. Depression. Similar morphology but A horizon may have 50% distinct brown mottles and texture of medium clay, A2 horizon usually with conspicuous bleach and B21 horizon dark to grey (10YR, 2.5Y 3/1, 4/1).	Local alluvial plains and associated pediments Low lying flats and drainage depressions	Low to mid-high open woodland of poplar gum and cabbage gum with carbeen, beefwood and broad leaf tea-tree associated with Tussock grassland of blue grasses, black spear grass and brown top
1Dyb	Dy2 33 Dy2 43	6 0-6.5 8 0-8 5 7 5-9 0 8 5-10 0 8 5-10 0 8 5-10 0	m m 0- 0.1- A1 -0.15 0.3- B2t 0.4- 0.6- -0.6 0.9- Dk 1.2- 1.5-	Grey solodic-solodized solonetz- Hard setting surface Few to common small to medium subrounded to rounded pebbles throughout profile. A1- Dark to grey or brown (7 5YR, 10YR 2/2, 3/2, 4/2, 4/3), occasionally 5-10% distinct brown mottles; sandy loam to clay loam, massive, dry moderately firm; sporadic or conspicuous bleach throughout or near base. Abrupt to - B2t: Grey to yellow-brown (7.5YR, 10YR 4/1, 5/2, 6/2, 5/3), light to light medium clay; strong 20-100 mm columnar to 20-50 mm prismatic to angular blocky parting to 5-10 mm prismatic to subangular blocky, dry moderately strong Abrupt to clear to - Dk. Yellow-brown to light grey (10YR, 2 5Y 5/3 to 6/1, 7/4), sandy clay loam to light clay, weak to strong 5-20 mm subangular to angular blocky, dry very firm, few fine to medium calcareous nodules Very few to few fine to medium ferromanganiferous nodules throughout B horizon	Local alluvial plains and associated pediments Pediments and slightly elevated flats	Low to mid-high woodland to open woodland of cabbage gum, poplar gum, carbeen, beefwood and false sandal-wood with Tussock grassland of black spear grass and blue grasses

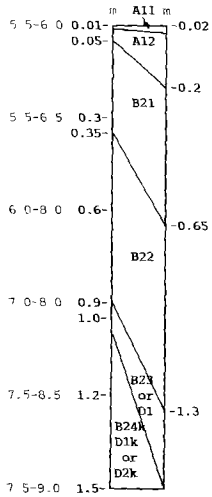
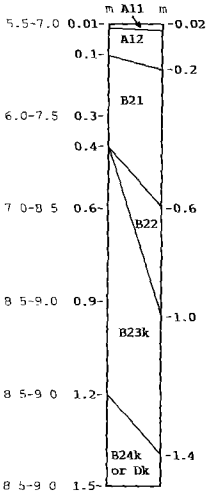
APPENDIX IV (continued)

Soil type	P P F	pH	Profile diagram	Description of soil type	Landscape unit	Predominant natural vegetation
1Dyc	Dy2.43 Dy2 33 Dy3 43 Dy3 33	5 5-6 5 6 5-9 0 8 0-9.5 8 5-9 5 8 5-9 5 8.5-10.0	m m 0- 0.05- A1 0.1- A2 -0.1 -0.15 0.3- B21t 0.4- 0.6- -0.8 0.9- B22t or B22tk 1.2- 1.5-	Grey solodic-solodized solonetz: Hard setting surface Few to common small to medium subrounded to rounded pebbles throughout profile. A1 Dark to grey or brown (7.5YR, 10YR 3/2, 4/2, 4/3, 4/4); frequently 5-25% distinct brown mottles; clay loam, massive to weak 5-10 mm subangular to angular blocky, dry moderately firm. Abrupt to - A2. As above with conspicuous or sporadic bleach Abrupt to - B21t. Grey (10YR, 2.5Y 4/1 to 5/2); occasionally 10-25% distinct brown mottles, medium to medium heavy clay; strong 20-100 mm columnar to 20-50 mm prismatic to angular blocky parting to 5-20 mm lenticular, angular blocky to prismatic; dry moderately strong Clear to - B22t or B22tk. Grey to yellow-brown (10YR, 2.5Y 4/2, 5/2 to 6/4), medium clay; strong 5-20 mm lenticular to prismatic to angular blocky; dry moderately strong, very few to few fine to coarse calcareous nodules and soft segregations. Very few to few fine to medium ferromanganiferous nodules throughout B horzions Variations. Linear gilgai present with <0.1 m vertical interval and cracking clay on the mound. Few to common fine to medium ferromanganiferous nodules throughout A2 horizon. Variant. 1Dyc3 - Texture of A horizon light clay (PPF Uf3, Uf2).	Local alluvial plains and associated pediments Pediments and slightly elevated flats	Low to mid-high open woodland of cabbage gum, poplar gum and beefwood with carbeen and false sandalwood associated with Tussock grassland of blue grasses and black spear grass
1Dda	Dd1.33 Dd1.43 Db1.33	5.5-6.5 6 5-8 5 7 5-9.0 8.0-9.5 8.5-9 0 8 5-10 0	m m 0- 0.05- A1 0.1- A2 -0.1 -0.15 B21t 0.3- 0.6- B22t -0.6 0.9- 1.2- -1.2 B23tk or Dk 1.5-	Dark and brown solodic-solodized solonetz: Hard setting surface Few to common small to medium subrounded to rounded pebbles throughout profile. A1. Dark to grey (7.5YR, 10YR 1.7/1, 3/1 to 4/2); frequently 5-10% distinct brown mottles; clay loam; massive to weak 5-10 mm subangular to to angular blocky, dry modertely firm. Abrupt to - A2. Grey to dark (7 5YR, 10YR 3/2, 4/2); frequently 5-10% distinct brown mottles; clay loam, massive, dry moderately firm; sporadic or conspicuous bleach. Abrupt to - B21t: Dark to brown (7.5YR, 10YR 2/1, 3/1, 3/2, 3/3), medium to medium heavy clay, strong 20-100 mm columnar or prismatic to 20-50 mm angular blocky parting to 5-10 mm lenticular to subangular or angular blocky; dry moderately strong. Gradual to diffuse to - B22t. Dark to grey (10YR, 2.5Y 3/1, 3/2, 4/1, 4/2); medium to medium heavy clay; strong 5-20 mm lenticular to angular blocky; dry moderately strong. Clear to - B23tk or Dk. Grey to yellow-brown (10YR, 2 5Y 4/1, 4/2 to 6/2, 5/3 to 6/4), light to medium clay; strong 5-20 mm lenticular to angular blocky; dry moderately strong, few fine to coarse calcareous nodules and soft segregations. Very few to few fine to medium ferromanganiferous nodules throughout B horizons.	Local alluvial plains and associated pediments Pediments and slightly elevated flats	Low to mid-high open woodland of poplar gum and carbeen with cabbage gum, beef-wood and willow wattle associated with Tussock grassland of black spear grass and blue grasses with kangaroo grass associated
2Ugc	Ug5.28 Ug5.29 Ug5 24 Ug5.25 Ug5 35 Ug5 34 Ug3 2	5.5-6.5 6.0-7.0 7 5-8 0 7 5-8.5 7.5-8 5 7 5-9 0	m A11 m 0- -0.01 0.05- A12 0.1- A2 -0.1 -0.15 B21 0.3- 0.6- 0.9- 1.2- B22 or B22k -1.2 1.5-	Grey and brown clay and (bleached) grey clay: Normal gilgai, 0.05-0.3 m vertical interval, weakly cracking. Mound: A11. (Occasionally present) weak medium to fine granular self mulch (when absent, surface is hard setting). A12. Dark to grey (10YR 3/2 to 4/2), 5-25% distinct brown mottles; light to light medium clay; moderate to strong 5-20 mm subangular blocky; dry moderately strong Abrupt to clear to - A2 (Occasionally present) as above with sporadic bleach. Abrupt to - B21. Grey to brown (10YR, 2.5Y 4/1, 4/2, 3/3), occasionally 10-25% distinct brown mottles, medium to medium heavy clay; strong 5-20 mm subangular blocky to lenticular, dry moderately strong Gradual to diffuse to - B22 or B22k. Grey to brown (10YR, 2.5Y 4/1 to 4/6), medium to medium heavy clay; strong 5-20 mm lenticular to subangular blocky; dry moderately strong, occasionally very few to few fine to coarse calcareous nodules Very few to few fine to medium ferromanganiferous nodules throughout B horizons. Depression Similar morphology but A horizon with 25-50% distinct brown mottles and frequently bleached. Variation. Colour of B horizons 10YR, 2.5Y 5/1, 5/2.	Burdekin River alluvial plain Low lying flats	Low to mid-high open woodland to woodland of poplar gum with cabbage gum, carbeen, scattered broad leaf tea-tree and beefwood associated with Tussock grassland of cane grass and blue grasses

APPENDIX IV (continued)

Soil type	U.S.P.	pH	Profile diagram	Description of soil type	Landscape unit	Predominant natural vegetation
2Ugd	Ug3.2 Ug3.3 Ug3.1 Ug2	5.5-6.0 5.5-7.0 7.0-8.0 8.0-9.0 8.5-9.0 8.5-9.0	m A11 m 0- -0.02 A12 or A2 0.1- -0.25 0.3- B21 0.4- B22 -0.6 0.6- 0.9- B23k -0.95 1.0- -1.2 1.2- B24k or Dk 1.5-	(Bleached) grey and brown clay and (bleached) black earth. Normal galgai, 0.1 to 0.5 m vertical interval, weakly to moderate cracking. Very few to few fine to medium ferromanganiferous nodules throughout profile. Mound: A11. (Occasionally present) weak medium to fine granular self mulch (when absent, surface is hard setting). A12 or A2. Grey to dark (10YR 2/2 to 4/2), 10-25% distinct brown mottles; light to light medium clay, moderate 10-20 mm angular blocky, dry moderately firm; sporadic or conspicuous bleach throughout or near base. Abrupt to clear to - B21: Grey to brown or dark (10YR, 2.5Y 3/2, 4/1 to 5/2, 4/3), 10-25% distinct brown mottles, light medium to medium heavy clay, strong 10-20 mm angular blocky; dry very firm. Gradual to diffuse to - B22. As above but strong 10-50 mm lenticular parting to 5-20 mm angular blocky. Clear to - B23k. As above with few fine to coarse calcareous nodules. Gradual to diffuse to (when present) - B24k or Dk: (Frequently present) yellow to brown or grey (7.5YR, 10YR, 2.5Y 3/4, 4/2 to 4/6, 5/3 to 5/6); occasionally 10-25% dark mottles; light to medium clay; moderate to strong 10-20 mm angular blocky; dry moderately firm to very firm, few fine to coarse calcareous nodules. Depression: Similar morphology but greater depth to calcareous nodules and lower pH.	Burdekin River alluvial plain Low lying flats	Low to mid-high open woodland to woodland of poplar gum and carbeen with broad leaf tea-tree associated with Tussock grassland of blue grasses, kangaroo grass and black spear grass
2Uge	Ug5.29 Ug5.25 Ug5.28 Ug3.2 Ug5.15 Ug5.24 Ug3.1 Ug5.34 Ug5.35 Ug3.3	5.5-7.0 6.5-8.5 8.5-9.0 8.5-9.0 8.5-9.0	m A11 0.01- -0.02 0.05- A12 or A2 0.1- B21 -0.25 0.3- B22 -0.4 -0.6 0.6- B23k 0.8- 0.9- 1.2- -1.3 B24k or Dk 1.5-	Grey and brown clay and black earth, (bleached) grey and brown clay and (bleached) black earth: Normal gilgai, 0.05-0.3 m vertical interval; weakly to moderately cracking. Mound: A11 (Occasionally present) weak medium to fine granular self mulch (when absent, surface is hard setting) A12 or A2. Dark to grey (10YR, 2.5Y 3/1 to 4/2); 10-25% distinct brown mottles; light to light medium clay, moderate to strong 5-20 mm angular blocky; dry moderately firm to very firm; occasionally with sporadic bleach. Abrupt to clear to - B21 Dark to grey or brown (10YR, 2.5Y 3/1 to 4/2, 4/3); 10-25% distinct brown mottles; medium to heavy clay; strong 10-20 mm angular blocky parting to 5-10 mm angular blocky; dry very firm to moderately strong. Gradual to diffuse to - B22. As above but frequently 10-25% distinct brown mottles, strong 20-50 mm lenticular parting to 5-10 mm angular blocky. Clear to - B23k. As above with few fine to coarse calcareous nodules. Gradual to diffuse to - B24k or Dk Brown to yellow or grey (7.5YR, 10YR 4/2 to 4/6, 5/4, 5/6), occasionally 10-25% distinct dark mottles, light to medium clay, moderate to strong 5-20 mm angular blocky, dry moderately firm to very firm; few fine to coarse calcareous nodules Very few to few fine to medium ferromanganiferous nodules throughout B and D horizons. Depression Similar morphology but A horizon frequently bleached, greater depth to calcareous nodules and lower pH. Variation: Colour of B horizons 10YR, 2.5Y 5/1, 5/2	Burdekin River alluvial plain Low lying flats	Low to mid-high open woodland to woodland of poplar gum with carbeen, beefwood and cabbage gum associated with Tussock grassland of blue grasses, black spear grass and kangaroo grass

APPENDIX IV (continued)

Soil type	? ? ?	pH	Profile diagram	Description of soil type	Landscape unit	Predominant natural vegetation
2Ugf	Ug3.2 Ug5 2 Ug5 24 Ug5 25 Ug5 28 Ug5 29	5 5-6 0 5 5-6 5 6 0-8 0 7 0-8 0 7.5-8.5 7 5-9.0		Grey clay and (bleached) grey clay Normal gilgai, 0 1 to 0 5 m vertical interval, moderately to strongly cracking Very few to few fine to medium ferromanganiferous nodules throughout profile Mound A11 (Frequently present) weak to moderate medium to fine granular self mulch (when absent surface is hard setting). A12 Grey (10YR 4/1,4/2), 10-25% distinct brown mottles, medium to heavy clay, strong 10-20 mm angular blocky, dry very firm to moderately strong, frequently sporadic bleach towards base. Abrupt to clear to - B21. Grey (10YR, 2.5Y 4/1 to 5/2), 10-25% distinct brown mottles, medium to heavy clay, strong 10-20 mm angular blocky, dry moderately strong. Clear to gradual to - B22. Grey (10YR, 2 5Y 4/1 to 5/2, 6/2); 10-25% distinct brown mottles; medium to heavy clay; strong 20-50 mm lenticular parting to 5-10 mm angular blocky, dry moderately strong. Clear to gradual to - B23 or D1 Grey to yellow-brown or brown (10YR, 2.5Y 4/2 to 5/6, 6/2); occasionally 10-25% dark mottles; light medium to heavy clay, strong 10-20 mm lenticular parting to 5-10 mm subangular blocky, dry very firm. Clear to gradual to - B24k, D1k or D2k As above with few fine to coarse calcareous nodules Depression. Similar morphology but A and B21 horizons frequently dark	Burdekin River alluvial plain Low lying flats	Low to mid-high open woodland of open forest of carbeen, poplar gum and broad leaf tea-tree with Open tussock grassland of blue grasses Occasionally only grassland present
?Ugg	Ug5.29 Ug5 24 Ug5.28 Ug5.25 Ug5.2 Ug3.2 Ug3.1 Ug3 3	5.5-7.0 6.0-7.5 7 0-8 5 8 5-9.0 8 5-9 0 8 5-9 0		Grey clay, (bleached) grey and brown clay and (bleached) black earth· Normal gilgai, 0.1 to 0.5 m vertical interval, moderately to strongly cracking. Very few to few fine to medium ferromanganiferous nodules throughout profile Mound: A11· Weak to moderate medium to fine granular self mulch. A12· Grey to dark (10YR 3/1 to 4/2), frequently 10-25% distinct brown mottles; medium to heavy clay, strong 10-20 mm angular blocky, dry very firm, occasionally with sporadic bleach Clear to - B21: Grey to dark or brown (10YR, 2.5Y 3/2, 4/1 to 4/3, 5/1, 5/2), frequently 5-25% distinct brown mottles, medium to heavy clay; strong 10-20 mm angular blocky, dry moderately strong. Gradual to diffuse to - B22· As above but occasionally 5-25% distinct brown mottles; strong 20-50 mm lenticular parting to 10-20 mm angular blocky. Clear to - B23k As above with few fine to coarse calcareous nodules Clear to - B24k or Dk: Yellow-brown to grey (10YR, 2.5Y 4/2 to 5/3); occasionally 10-25% dark mottles, light medium to medium heavy clay, moderate to strong 10-20 mm angular blocky, dry moderately firm to very firm; few fine to coarse calcareous nodules. Depression: Similar morphology but A and B21 horizons frequently dark.	Burdekin River alluvial plain Low lying flats	Low to mid-high open woodland to woodland of poplar gum with carbeen and broad leaf tea-tree associated with Tussock grassland of blue grasses and cane grass

APPENDIX IV (continued)

Soil type	P P F	pH	Profile diagram	Description of soil type	Landscape unit	Predominant natural vegetation
2Ugh	Ug5 29 Ug5 28 Ug5 15 Ug5.25 Ug5 35 Ug5 24 Ug5.2	6 0-8 5 8.5-9 0 8.5 9 5 8 5-9.5 8.5-9.5 8 5-9 5	m A11 m 0.01 -0.02 A12 0.1 -0.15 B21 0.3 0.45 B22k 0.6 0.9 1.0 -0.75 1.2 B23k or Dk -1.4 1.5	Grey clay, brown clay and black earth: Normal gilgai, 0 1 to 0 5 m vertical interval, moderately to strongly cracking Mound. A11 Weak to strong medium to fine granular self mulch. A12 Grey to dark (10YR, 2.5Y 3/1 to 4/2), 5-25% distinct brown mottles; medium to medium heavy clay, strong 5-20 mm angular blocky; dry moderately strong. Clear to - B21 Grey to dark or brown (10YR, 2.5Y 3/2, 4/1, 4/2, 4/3); occasionally 5-25% distinct brown mottles, medium to heavy clay; strong 5-20 mm angular blocky, dry moderately strong Gradual to diffuse to - B22k. Grey to dark (10YR, 2.5Y 3/2, 4/1, 4/2), medium to heavy clay, strong 10-50 mm lenticular breaking to 5-10 mm angular blocky, dry moderately strong; few fine to coarse calcareous nodules, occasionally very few to few fine to medium gypseous crystals. Gradual to diffuse to - B23k or Dk Yellow-brown to brown or grey (7.5YR, 10YR 4/2 to 5/4), ocasionally 10-25% dark mottles; light medium to medium heavy clay, moderate to strong 5-20 mm angular blocky; dry very firm; few fine to coarse calcareous nodules. Very few to few fine to medium ferromaganiferous nodules throughout B and D horizons Very few to few medium to coarse calcareous nodules may be present from the surface Depression. Similar morphology but A and B21 horizons frequently dark, greater depth to calcareous nodules and lower pH.	Burdekin River alluvial plain Low lying flats	Tussock grassland of blue grasses, Flinders grass and cane grass occasionally with Low to tall isolated trees to low to mid-high open woodland of carbeen, poplar gum and cabbage gum
2Ugk	Ug5 2 Ug5 29 Ug5.28 Ug5.24	5 5-7 0 6.5-9 0 8 5-9 0 8.5-9.5 8 5-9 5 8 5-9 5	m A11 m 0.01 -0.02 A12 0.05 -0.12 B21 0.3 0.4 B22k 0.6 -0.65 0.9 1.0 B23 or B23k 1.2 -1.2 D or Dk -1.4 1.5	Grey clay· Normal gilgai, 0.1 to 0.3 m vertical interval; moderately to strongly cracking. Mound: A11: Weak to strong medium to fine granular self mulch. A12. Grey to dark (10YR, 2.5Y 3/1 to 4/2), occasionally 5-10% distinct brown mottles, medium to medium heavy clay, moderate to strong 5-10 mm subangular to angular blocky; dry very firm to moderately strong. Abrupt to clear - B21· Grey (10YR, 2.5Y 4/1, 4/2); occasionally 5-10% faint brown mottles, medium to medium heavy clay; strong 5-20 mm subangular to angular blocky; dry moderately strong to very strong. Abrupt to clear to - B22k· Grey (10YR, 2.5Y 4/1, 4/2), medium to medium heavy clay; strong 5-20 mm lenticular; dry moderately strong to very strong, few fine to coarse calcareous nodules. Clear to gradual to (when present) - B23 or B23k. (Frequently present) as above but brown to yellow-brown (7 5YR, 10YR 4/3 to 5/4), and frequently very few to few fine to coarse calcareous nodules. Clear to gradual to (when present) - D or Dk. (Occasionally present) brown (10YR, 7.5Y 4/3 to 5/4); light to light medium clay, moderate to strong 5-20 mm lenticular to subangular or angular blocky, dry moderately strong, occasionally very few to few fine to coarse calcareous nodules. Very few to few fine to medium ferromaganiferous nodules throughout B and D horizons. Variation. Very few to few fine to coarse calcareous nodules present from the surface	Burdekin River alluvial plain Low lying flats	Mid-high open woodland of carbeen, poplar gum and cabbage gum with broad leaf tea-tree associated in poorly drained areas with Tussock grassland of blue grasses, Flinders grass and cane grass Cane grass dominates grass-land in some areas

APPENDIX IV (continued)

Soil type	P P F	pH	Profile diagram	Description of soil type	Landscape unit	Predominant natural vegetation
2Ugk	Ug3 2 Ug5.2 Uf6.33	5 5-6 5 6 0-7 5 6 5-8 0 7 5-9 5 7.5-9 5 7 5-9.5	m m 0- 0.05- A -0.1 B21 0.3- 0.6- B22 or B22k -0.6 0.8- 0.9- 1.2- D or Dk 1.5-	(Bleached) grey clay, grey clay and non-cracking clay: Normal gilgai, 0 1 to 0 3 m vertical interval, weakly cracking to non-cracking, hard setting surface. Depression. A: Grey to brown (7.5YR, 10YR, 2.5Y 4/1 to 4/3 5/1, 5/2), frequently 10-20% distinct brown mottles; light to light medium clay, moderate to strong 5-10 mm subangular to angular blocky; dry very firm to moderately strong; frequently sporadic bleach throughout or near base. Abrupt to clear to - B21.: Grey (10YR, 2 5Y 4/1, 4/2); frequently 5-10% distinct brown mottles, light medium to medium clay, moderate to strong 10-20 mm subangular to angular blocky; dry very firm to moderately strong. Abrupt to clear to - B22 or B22k: Grey to yellow-brown (10YR 4/1 to 4/3, 5/3), medium clay; strong 10-20 mm lenticular; dry moderately strong; frequently few fine to coarse calcareous nodules. Clear to gradual to - D or Dk: Brown (7.5YR 4/3 to 5/4), light to light medium clay, moderate to strong 5-20 mm subangular to angular blocky; dry moderately strong, frequently few fine to coarse calcareous nodules Very few to few fine to medium ferromanganiferous nodules throughout B and D horizons. Variation: A horizon conspicuously bleached (PPF Ug2).	Burdekin River alluvial plain Low lying flats	Mid-high open woodland of carbeen, poplar gum and cabbage gum with broad leaf tea-tree associated in poorly drained areas with Tussock grassland of blue grasses, Flinders grass and cane grass Cane grass dominates grassland in some areas
2Dba	Db1 43 Db1 33	6.0-7 5 8 5-9 0 8 5-9 5 9.0-9.5 9.0-9.5 9 0-9 5	m A1 m 0.03- 0.05- A2 -0.05 -0.1 B21t 0.25- 0.3- -0.45 0.6- B22tk 0.9- 1.0- 1.2- Dk 1.5-	Brown solodic-solodized solonetz: Hard setting surface. A1.: Brown (7.5YR, 10YR 3/3 to 4/4); occasionally 10-25% distinct brown mottles; clay loam; massive to weak 10-20 mm subangular blocky to 2-10 mm platy, dry very firm, frequently with conspicuous or sporadic bleach Abrupt to - A2: (Present when A1 not bleached) as above with sporadic or conspicuous bleach. Abrupt to - B21t: Brown (7 5YR, 10YR 3/3, 4/3 to 4/6); light medium to medium heavy clay, strong 50-100 mm columnar to 20-50 mm angular blocky parting to 5-20 mm subangular blocky to prismatic, dry moderately strong Clear to - B22tk: Brown to yellow-brown (7 5YR, 10YR 3/3, 4/3 to 4/6, 5/3, 5/4); light medium to medium clay, strong 5-20 mm subangular blocky; dry moderately strong, few to common fine to coarse calcareous nodules. Clear to - Dk: Brown (7.5YR 4/3, 4/4, 5/3 to 5/6), sandy clay to light medium clay; moderate to strong subangular blocky; dry moderately firm, few to common fine to coarse calcareous nodules Very few to few fine to medium ferromanganiferous nodules throughout B horizons Variation: Normal gilgai present, <0.05 m vertical interval and depression with similar morphology but A horizon frequently with 5-25% distinct brown mottles	Burdekin River alluvial plain Slightly elevated flats	Low to tall shrubland of false sandalwood and beefwood with cabbage gum, poplar gum and carbeen associated with Open to sparse tussock grassland of blue grasses, black spear grass, purple top Rhodes grass and button grass
2Dbb	Db1.33 Db1 43 Db2.33 Dd1 43	5.5-6.5 7.0-9.0 8.5-9 0 8 5-9 0 8 0-9 0 8 0-9 0	m m 0- 0.05- A1 0.12- A2 -0.15 -0.2 0.3- B21t 0.35- 0.6- 0.9- B22t or B22tk -0.9 1.2- Dk 1.5-	Brown and dark solodic-solodized solonetz: Hard setting surface. A1: Dark to brown (7.5YR, 10YR 3/1 to 4/3); occasionally 10-25% distinct brown mottles, clay loam, massive to weak 10-20 mm subangular blocky to 2-5 mm platy, dry moderately firm. Abrupt to - A2- As above with sporadic or conspicuous bleach. Abrupt to - B21t. Brown to dark (7 5YR, 10YR 3/2, 3/3, 4/3 to 4/6), occasionally 10-25% distinct yellow mottles; medium clay; strong 20-100 mm columnar to 20-50 mm angular blocky parting to 5-20 mm angular blocky to prismatic, dry moderately strong Clear to - B22t or B22tk- Brown (7.5YR, 10YR 4/3 to 5/4), medium clay, strong 5-20 mm subangular blocky to prismatic, dry moderately strong; very few to common fine to coarse calcareous nodules and soft segregations. Clear to - Dk- Brown to yellow-brown (7.5YR, 10YR 4/3 to 4/6, 5/3, 5/4, 6/6), sandy clay to light medium clay; moderate 5-20 mm subangular blocky, dry moderately firm; very few to common fine to coarse calcareous nodules and soft segregations Very few to vew fine to medium ferromanganiferous nodules throughout B and D horizons.	Burdekin River alluvial plain Slightly elevated flats	Low to mid-high woodland of poplar gum, carbeen and cabbage gum with beefwood and minosa associated with Tussock grassland of purple top Rhodes grass and black spear grass

APPENDIX IV (continued)

Soil type	P.P.F.	pH	Profile diagram	Description of soil type	Landscape unit	Predominant natural vegetation
2Dbc	Db2 43 Db2.33 Db1 33 Dy3 43 Dd1 43 Dy3.33	5 8-7 0 6.0-7.0 7.0-8 0 8 0-9 0 8.5-9 0 8.5-9.0	m m 0- 0.05- A1 -0.2 0.2- A2 -0.35 0.3- B21t 0 5- 0.6- -0.7 B22t or B22tk 0.9- 1.0- 1.2- D or Dk 1.5-	Brown, grey and dark solodic-solodized solonetz. Hard setting surface. Very few to few fine to medium ferromanganiferous nodules throughout profile A1. Dark to grey (10YR 3/1 to 4/2); 10-25% distinct brown mottles, loam to clay loam; massive to weak 10-20 mm subangular blocky; dry moderately firm. Abrupt to - A2. As above with sproadic or conspicuous bleach. Abrupt to - B21t: Brown to dark (10YR 3/2 to 4/3); frequently 10-25% distinct brown mottles, light medium to heavy clay; strong 20-100 mm columnar to 20-50 mm angular blocky parting to 5-20 mm angular blocky to prismatic; dry moderately strong Clear to - B22t or B22tk. Brown to dark (10YR 3/2 to 4/3), light medium to heavy clay, strong 5-20 mm angular blocky to prismatic, dry moderately strong; very few to few fine to medium calcareous nodules. Clear to gradual to - D or Dk: Brown to yellow-brown (7.5YR, 10YR 4/3 to 4/6, 5/4 to 6/6), frequently 10-25% distinct dark mottles; sandy clay to light medium clay; moderate 5-20 mm angular blocky, dry moderately firm; very few to few fine to medium calcareous nodules. Variation. Common fine to medium ferromanganiferous nodules throughout A or B21t horizons.	Burdekin River alluvial plain Slightly elevated flats	Low to mid-high open woodland of poplar gum, carbeen and cabbage gum with Tussock grassland of black spear grass, blue grasses and kangaroo grass
2Dbd	Db1.43 Db1.33 Db2.33 Dy3.43 Dd1.33 Dy3.33 Db2.43	5.8-6.5 6 0-8.0 8.5-9.0 8 5-9 0 8.5-9.0 8 5-9.0	m m 0- 0.1- A1 0.2- A2 -0.2 0.3- -0.35 B21t 0.5- 0.6- -0.6 B22tk 0.7- 0.9- -1.0 1.2- Dk 1.5-	Brown, grey and dark solodic-solodized solonetz: Hard setting surface. A1. Dark to brown (10YR 3/1 to 4/3), 10-25% distinct brown mottles; loam to clay loam, massive to weak 10-20 mm subangular blocky, dry moderately firm Abrupt to - A2: As above with sporadic or conspicuous bleach. Abrupt to - B21t. Brown to dark (7.5YR, 10YR 3/2 to 4/4); occasionally 10-25% distinct orange mottles; medium to heavy clay; strong 20-100 mm columnar to prismatic to 20-50 mm angular blocky parting to 5-20 mm angular blocky to prismatic; dry moderately strong Clear to gradual to - B22tk. As above but strong 5-20 mm angular blocky to lenticular; few to common fine to coarse calcareous nodules. Clear to - Dk: Brown to yellow-brown (7 5YR, 10YR 4/4, 4/6, 5/6, 6/4); frequently 10-25% distinct brown mottles; sandy clay to medium clay, moderate to strong 5-20 mm subangular blocky; dry moderately firm, few to common fine to coarse calcareous nodules. Very few to few fine to medium ferromanganiferous nodules throughout B and D horizons. Variation: Common fine to medium ferromanganiferous nodules throughout A or B21t horizons.	Burdekin River alluvial plain Slightly elevated flats	Low to mid-high open woodland of cabbage gum, carbeen and poplar gum with Tussock grassland of black spear grass, blue grasses and kangaroo grass
2Dbe	Db2 43 Db2.33 Db1 33 Dd1.33 Dy2.33	5.8-6 5 5.8-7.0 7.0-8 3 8 0-9 0 8.5-9 0 8 5-9 0	m m 0- 0.05- A1 -0.1 0.12- A2 -0.2 0.3- B21t 0.45- 0.6- 0.7- B22t -0.7 0.9- B23t or B23tk -1.1 1.15- 1.2- -1.25 Dk 1.5-	Brown, dark and grey solodic-solodized solonetz. Hard setting surface. A1. Dark to grey (10YR 3/1 to 4/2); 10-25% distinct brown mottles, loam to clay loam; massive to moderate 10-20 mm subangular blocky, dry moderately firm. Abrupt to - A2· As above with sporadic or conspicuous bleach. Abrupt to - B21t. Brown to dark (10YR 3/1 to 4/2, 4/3, 4/4); frequently 10-25% distinct brown mottles, medium to heavy clay; strong 20-100 mm columnar to prismatic to 20-50 mm angular blocky parting to 5-20 mm angular blocky; dry moderately strong. Gradual to diffuse to - B22t As above but whole coloured, strong 5-20 mm subangular blocky. Clear to - B23t or B23tk. As above with very few to few fine to medium calcareous nodules Clear to gradual to (when present) - Dk (Frequently present) yellow-brown to brown (7.5YR, 10YR 4/4 to 5/6, 6/4), occasionally 10-25% distinct dark mottles, light to medium clay, moderate 5-20 mm subangular blocky, dry moderately firm, few medium calcareous nodules. Very few to very few fine to medium ferromanganiferous nodules throughout B and D horizons	Burdekin River alluvial plain Slightly elevated flats	Low to mid-high open woodland of poplar gum, cabbage gum and carbeen with beef-wood associated with Tussock grassland of black spear grass, blue grasses and kangaroo grass

APPENDIX IV (continued)

Soil type	P.P.F.	pH	Profile diagram	Description of soil type	Landscape unit	Predominant natural vegetation
2Dya	Dy3.33 Dy2.33 Dy2.43 Db2.33	5.5-6.5 6.5-8.4 8.5-9.0 8.5-9.0	m A1 m 0.03- 0.05- A2 -0.05 -0.1 B21t 0.2- -0.25 0.3- B22t 0.4- 0.6- B23t 0.9- or -0.9 B23tk 1.2- D or Dk 1.5-	Grey and brown solodic-solodized solonetz: Hard setting surface A1. Dark to brown (7.5YR, 10YR 3/1 to 4/2, 4/3), frequently 10-25% distinct brown mottles; clay loam, massive to weak 2-10 mm platy to 5-20 mm subangular blocky, dry moderately firm, frequently with conspicuous or sporadic bleach. Abrupt to - A2. (Present when A1 not bleached) as above with sporadic or conspicuous bleach. Abrupt to - B21t: Grey to brown (10YR, 2.5Y 4/1 to 4/4); frequently 10-25% distinct brown mottles, light medium to medium heavy clay; strong 20-100 mm columnar to 20-50 mm prismatic parting to 5-20 mm subangular blocky to prismatic; dry moderately strong. Diffuse to - B22t: As above but whole coloured; strong 5-20 mm angular blocky to lenticular. Clear to - B23t or B23tk: Brown to grey (7.5YR, 10YR 4/1 to 4/3, 5/3, 5/4); medium clay; strong 5-20 mm subangular blocky to lenticular, dry moderately strong, very few to common fine to coarse calcareous nodules and soft segregations. Clear to - D or Dk. Brown (7.5YR, 10YR 4/3 to 5/4), sandy clay to light medium clay, moderate 5-20 mm subangular blocky; dry moderately firm; very few to common fine to coarse calcareous nodules. Very few to few fine to medium ferromanganiferous nodules throughout B horizons Variation: Normal gilgai present, <0.1 m vertical interval and depression with similar morphology.	Burdekin River alluvial plain Slightly elevated flats	Low to mid-high open woodland to woodland of poplar gum, cabbage gum and carbeen with beefwood and broad leaf tea-tree associated with Tussock grassland of blue grasses and kangaroo grass
2Dyb	Dy3.33 Dy2.33 Dy2.43 Dd1.43	5.5-6.5 6.5-9.0 8.5-9.0 8.5-9.5 8.5-9.5	m m 0- 0.05- A1 -0.1 0.12- A2 -0.2 0.3- B21t 0.6- B22t -0.7 or B22tk 0.9- 1.2- Dk 1.5-	Grey and dark solodic-solodized solonetz: Hard setting surface. A1: Dark to grey or brown (7.5YR, 10YR 3/1 to 4/2, 4/3), 10-25% distinct brown mottles, loam to clay loam, massive to weak 10-20 mm subangular blocky to 2-5 mm platy; dry moderately weak. Abrupt to - A2: As above with sporadic or conspicuous bleach. Abrupt to - B21t. Grey to dark (10YR, 2.5Y 3/1, 4/1, 4/2); frequently 10-25% distinct brown mottles, medium to heavy clay, strong 20-100 mm columnar to 20-50 mm prismatic parting to 10-20 mm subangular blocky to prismatic; dry moderately strong. Gradual to - B22t or B22tk: Grey to brown or dark (7.5YR, 10YR, 2.5Y 3/1 to 4/2, 4/3, 4/4); medium to heavy clay; strong 5-20 mm subangular blocky to lenticular; dry moderately strong; very few to common fine to coarse calcareous nodules. Clear to - Dk: Brown (7.5YR, 10YR 4/3 to 5/4), occasionally 10-25% dark mottles; light to medium clay; moderate 5-20 mm subangular blocky; dry moderately firm, few to common fine to coarse calcareous nodules. Very few to few fine to medium ferromanganiferous nodules throughout B horizons Variations: Few fine to medium gypseous crystals in B22t horizon.	Burdekin River alluvial plain Slightly elevated flats	Low to mid-high open woodland of cabbage gum and poplar gum with beefwood associated with Tussock grassland of black spear grass, blue grasses and purple top Rhodes grass
2Dyc	Dy3.33 Dy3.43 Db2.33	5.5-6.0 5.5-7.5 6.0-8.0 8.0-8.5 8.5-9.0 8.5-9.0	m m 0- 0.05- A1 -0.1 0.12- A2 -0.25 0.3- B21t -0.5 0.6- B22t 0.7- 0.9- B23t or 1.1- B23tk -1.1 1.2- B24tk -1.3 or Dk 1.5-	Grey and brown solodic-solodized solonetz: Normal gilgai, 0.1 to 0.3 m vertical interval, hard setting surface. Mound: A1: Dark to brown (10YR 3/1 to 4/2, 4/3); 10-25% distinct brown mottles; sandy clay loam to clay loam; weak 10-20 mm subangular blocky to 2-5 mm platy, dry moderately firm Abrupt to - A2: As above with sporadic or conspicuous bleach. Abrupt to - B21t: Grey to brown (10YR, 2.5Y 4/1 to 4/3, 5/2 to 5/4), 10-25% distinct brown mottles; medium to heavy clay, strong 20-100 mm columnar to 20-50 mm prismatic to angular blocky parting to 5-20 mm angular blocky dry moderately strong. Gradual to - B22t. As above but whole coloured; strong 10-50 mm lenticular parting to 5-10 mm blocky Clear to - B23t or B23tk. As above, with very few to few fine to coarse calcareous nodules. Clear to gradual to - B23tk or Dk: Grey to yellow-brown (10YR 4/3, 4/4, 5/2 to 5/6); frequently 10-25% distinct dark mottles, light to medium clay, moderate to strong 5-20 mm angular blocky, dry moderately firm, few medium to coarse calcareous nodules Very few to few fine to medium ferromanganiferous nodules throughout B and D horizons. Depression: Similar morphology	Burdekin River alluvial plain Low lying flats	Low to mid-high open woodland of poplar gum and cabbage gum with Tussock grassland of blue grasses, black spear grass and kangaroo grass

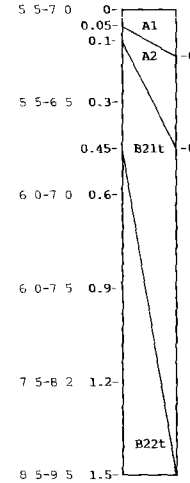
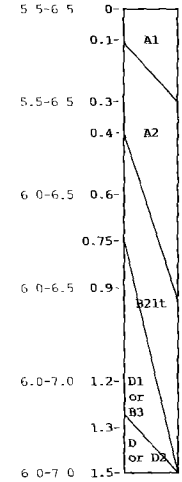
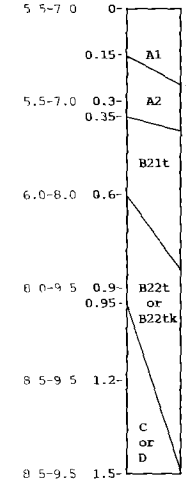
APPENDIX IV (continued)

Soil type	P P F.	pH	Profile diagram	Description of soil type	Landscape unit	Predominant natural vegetation
2Dda	Dd1.33 Dd1.43 Dd2.33 Db1.33	5.5-6.2 7.0-8.2 8.0-9.0 8.5-9.2 8.5-8.8 8.5-8.8	m m 0- 0.07- A -0.12 0.3- B21t 0.5- 0.6- 0.9- B22tk -1.0 1.2- -1.2 Dk 1.5-	Dark and brown solodic-solodized solonetz: Hard setting surface. Very few to few fine to medium ferromanganiferous nodules throughout profile. A: Dark to brown (10YR 3/1, 3/2, 4/1 to 4/4), 10-25% distinct brown mottles; loam to clay loam; massive to weak 10-20 mm subangular blocky; dry moderately weak to moderately firm; conspicuous or sporadic bleach throughout or near base. Abrupt to - B21t. Dark to brown (10YR, 2.5Y 2/2, 3/1 to 3/3), occasionally 10-25% distinct brown mottles; medium clay; strong 50-100 mm columnar to prismatic parting to 5-10 mm subangular blocky to prismatic; dry moderately strong. Clear to - B22tk. Dark to brown (10YR, 2.5Y 3/1 to 4/3); medium clay; strong 10-20 mm blocky to lenticular; dry moderately strong; few fine to medium calcareous nodules. Clear to - Dk. Brown to yellow-brown (7.5YR, 10YR 4/4 to 5/6); frequently 10-25% distinct dark mottles, light to medium clay; moderate to strong 10-20 mm subangular blocky; dry moderately firm to very firm; few medium calcareous nodules. Variation Normal gilgai present, <0.05 m vertical interval and depression with similar morphology but A horizon may be 0.2 m deep.	Burdekin River alluvial plain Slightly elevated flats	Low to mid-high open woodland of cabbage gum with carbeen and beefwood associated or Occasionally low to tall shrubland of false sandalwood with Tussock grassland of black spear grass, purple top Rhodes grass and and blue grasses
2Ddb	Dd1.33 Dy2 33 Dd1 43	6 0-6 5 8 5-9.0 8.5-9.0 9.0-9.5 9.0-9.5 9 0-9.5	m m 0- 0.05- A -0.12 B21t 0.3- -0.55 0.6- B22tk 0.65- 0.9- -1.0 Dk 1.2- 1.5-	Dark and grey solodic-solodized solonetz. Hard setting surface. A1. Dark to brown (7.5YR, 10YR 3/2, 4/2, 4/3), 10-25% distinct brown mottles; loam to clay loam; massive to weak 10-20 mm subangular blocky to 2-10 mm platy; dry very firm; conspicuous or sporadic bleach throughout or near base. Abrupt to - B21t. Dark to grey (10YR, 2.5Y 3/1 to 4/2); medium to medium heavy clay, strong 20-100 mm columnar to 20-50 mm prismatic parting to 5-20 mm subangular blocky to prismatic, dry moderately strong. Clear to - B22tk: Dark to brown (10YR, 2 5Y 3/1 to 4/2, 4/3, 4/4), medium to medium heavy clay, strong 5-20 mm subangular blocky, dry moderately strong, few to common fine to coarse calcareous nodules Clear to - Dk. Brown (7 5YR, 10YR 4/3 to 5/4), light to medium clay, moderate to strong 5-20 mm blocky to prismatic, dry very firm, few to common fine to coarse calcareous nodules Very few to few fine to medium ferromanganiferous nodules throughout B and D horizons Variations: Very few to few fine to medium gypseous crystals in B22 horizon. Normal gilgai present, <0.05 m vertical interval and depression with similar morphology but A horizon may be 0.2 m deep	Burdekin River alluvial plain Slightly elevated flats	Low open woodland of beefwood and cabbage gum or Low to tall shrubland of false sandalwood and beefwood with Open to sparse tussock grassland of black spear grass, blue grasses, purple top Rhodes grass and kangaroo grass
?Ddc	Dd1 33 Dd2 33 Dd1 43 Dy2 33	5 8-6 2 6.5-7.5 8 4-10 0 8.8-9.5 8 8-9 5 8 8-9 5	m m 0- 0.05- A1 0.2- A2 -0.2 0.3- -0.35 0.6- B21t 0.8- 0.9- 1.0- B22tk 1.2- -1.2 Dk -1.4 1.5-	Dark and grey solodic-solodized solonetz. Linear gilgai, <0.1 m vertical interval; hard setting surface. Very few to few fine to medium ferromanganiferous nodules throughout profile. Depression: A1 Dark (10YR 2/2, 3/1, 3/2); 10-25% distinct brown mottles, clay loam; massive to weak 10-20 mm subangular blocky; dry moderately weak to moderately firm Abrupt to - A2: As above with sporadic or conspicuous bleach. Abrupt to - B21t. Dark to grey (10YR, 2.5Y 2/2, 3/1, 3/2, 4/2); occasionally 5-25% distinct brown mottles; medium to heavy clay, strong 20-50 mm columnar to angular blocky parting to 5-10 mm angular blocky to prismatic, dry moderately strong Clear to gradual to - B22tk: Grey to brown (10YR 4/2 to 4/4), medium to heavy clay, strong 10-20 mm angular blocky, dry moderately strong; few fine to medium calcareous nodules. Clear to gradual to - Dk Yellow-brown (7.5YR, 10YR 4/4, 5/4, 5/6), light medium to medium clay, strong 5-10 mm angular blocky, dry moderately firm to very firm, few fine to medium calcareous nodules Mound: Soil type 2Ugi Note 2Ddc occupies 60-70% of complex 2Ddc-2Ugi	Burdekin River alluvial plain Slightly elevated flats	Mid-high isolated trees to open woodland of cabbage gum and carbeen with Open tussock grassland of blue grasses, Flinders grass, black spear grass and kangaroo grass

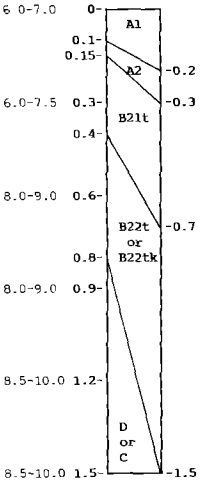
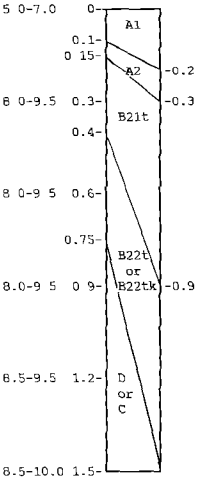
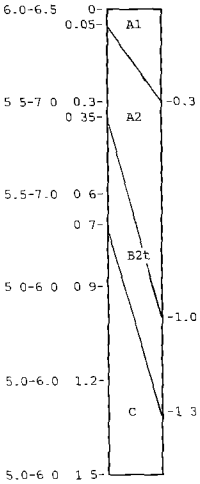
APPENDIX IV (continued)

Soil type	P P F	pH	Profile diagram	Description of soil type	Landscape unit	Predominant natural vegetation
2Ug1	Ug5 2 Ug5 3	8 5-9.0 0.01- 0.1- 9.5-9 5 0.3- 8 5-9 5 0.6- 8.5-9.5 0.9- 1.0- 8.5-9.5 1.2- 8.5-9 5 1.5-	m A11 m -0.02 A12 -0.2 B21k -0.6 B22k -1.3 D	Grey clay-brown clay Linear gilgai, <0 1 m vertical interval, moderately to strongly cracking Very few to few fine to medium ferromanganiferous nodules throughout profile Mound· A11 Moderate to strong medium to fine granular self mulch. A12· Grey to brown or dark (10YR, 2.5Y 3/2, 4/2, 4/3), medium heavy clay; strong 5-10 mm angular blocky; dry modertely strong; few fine to coarse calcareous nodules Clear to - B21k. Grey to brown (10YR, 2.5Y 4/2, 4/3); medium to heavy clay, strong 10-20 mm angular blocky; dry modertely strong, common to many fine to coarse calcareous nodules. Gradual to - B22k· As above but strong 20-50 mm lenticular parting to 5-10 mm angular blocky. Gradual to - D. Yellow-brown (7 5YR, 10YR 4/4, 5/4, 5/6); medium clay; strong 5-10 mm angular blocky; dry moderately firm to very firm, few to common fine to coarse calcareous nodules. Depression. Soil type 2Ddc. Note: 2Ug1 occupies 30-40% of complex 2Ddc-2Ug1.	Burdekin River alluvial plain Slightly elevated flats	Low to mid-high open woodland of cabbage gum and carbeen associated with Tussock grassland of blue grasses and Flinders grass
4Ucf	Uc5.11 Gn1.82 Um5 21 Um5.22 Um1 21	5.0-6 7 5 0-6.5 0.3- 5 0-6.5 0.6- 5 5-7 5 0.9- 5 5-7 5 1.2- 5.5-7.0 1.5-	m m 0- 0.05- A -0.15 B2 -1.1 C	Brownish sand, non-calcareous loam and siliceous loam: Loose to hard setting surface, common to many small pebbles to cobbles on surface A. Grey to yellow-brown (10YR 3/4 to 5/4, 4/2, 5/6), coarse sand to sandy clay loam; few to abundant medium pebbles, angular quartz; massive to single grain to weak 5-10 mm subangular blocky, sandy fabric, dry loose to moderately weak Clear to gradual to - B2. Grey to yellow-brown (10YR 5/2 to 7/4); coarse sand to sandy clay loam; few to abundant medium pebbles, angular quartz, massive to weak 5-10 mm subangular blocky, sandy fabric; dry loose to moderately firm. Gradual to diffuse to - C: Decomposing acid rock or rounded colluvial cobble. Variations: Depth of A horizon to 0 5 m Bleached A2 horizon present immediately overlying decomposing rock (PPF Uc2.21, Uc2 23) Unbleached A2 horizon present with B horizon of earthy fabric (PPF Gn2.85). BC horizon with 10-25% mottles present.	Gently undulating rises on acid intrusive rocks, pediments and prior streams All slope positions	Low to mid-high open woodland to mid-high to tall open forest of poplar gum, cabbage gum, grey bloodwood and grey ironbark with narrow leaf tea-tree, broad leaf tea-tree, quinine bush, Tristania spp., pandanus and cocky apple associated with Sparse to open tussock grassland of giant spear grass and black spear grass with Panicum spp., wire grass and red natal grass associated
4Gna	Gn2 95 Gn2.92	5 5-7.0 5.5-7 0 0.3- 6.0-7.0 0.6- 0.8- 6 5-7.5 0.9- 6 5-7 5 1.2- 6 5-7.5 1.5-	m m 0- 0.05- A1 -0.1 A2 -0.6 B21 -1.0 B22	Gradational sand and yellow earth: Hard setting surface. A1. Grey (10YR 4/2 to 6/2); coarse sand to coarse sandy loam; massive; dry very weak. Abrupt to - A2· As above with conspicuous or sporadic bleach. Abrupt to - B21. Grey to light yellow-grey (10YR, 2.5Y 6/2 to 7/4); occasionally 10-25% distinct orange mottles, sandy clay loam; massive to weak 5-20 mm angular blocky, earthy fabric, dry moderately to very firm. Gradual to - B22. Light yellow-grey (2.5Y, 5Y 7/3, 7/4), frequently 25-50% distinct orange mottles; sandy clay loam, massive to weak 5-20 mm angular blocky; earthy fabric, very few to few fine to medium ferromanganiferous nodules, dry moderately firm to very firm. Variant· 4Gna2 - D horizon of coarse sandy loam present below 0.65-1.0 m.	Gently undulating rises on acid intrusive rocks, pediments and prior streams Lower slopes, pediments and prior streams	Low to mid-high woodland of poplar gum and grey bloodwood with cocky apple and pandanus associated with Open tussock grassland of black spear grass and giant spear grass with kangaroo grass occasionally associated

APPENDIX IV (continued)

Soil type	P P F	pH	Profile diagram	Description of soil type	Landscape unit	Predominant natural vegetation
4Dya	Dy3.43 Dy2 43 Dy3 33 Dy2 33	5 5-7 0 5 5-6 5 6 0-7 0 6 0-7 5 7 5-8 2 8 5-9 5		Grey solodic-solodized solonetz: Hard setting surface A1. Grey (10YR 4/2 to 5/2), coarse sand to sandy loam; massive; dry moderately weak. Abrupt to - A2. As above with conspicuous or sporadic bleach. Abrupt to - B21t Grey (10YR, 2.5Y 4/2, 5/2), frequently 10-25% distinct brown mottles, light to light medium clay, strong 20-50 mm prismatic parting to 5-10 mm subangular to angular blocky; dry moderately strong. Clear to gradual to - B22t. As above but yellow-brown to brown (10YR 4/4, 5/3) Very few to few fine to medium ferromanganiferous nodules below 0.45 m. Variations. Sand layers < 2 cm in width through B horizons. Very few to few fine to coarse calcareous nodules present below 1 2 m Variant. 4Dya3 - Texture of A horizon clay loam.	Gently undulating rises on acid intrusive rocks, pediments and prior streams Mid to lower slopes, prediments and prior streams	Low to mid-high open woodland of poplar gum, carbeen and grey ironbark with broad leaf tea-tree and beefwood associated with Tussock to open tussock grassland of black spear grass, blue grasses and purple top Rhodes grass
4Dyd	Dy3 42 Dy3 41 Dy3.32 Dy3.31 Dy2 41 Dy2 31	5 5-6 5 5.5-6 5 6 0-6.5 6 0-6.5 6.0-7.0 6 0-7 0		Grey and yellow soloth-solodic-solodized solonetz: Hard setting surface A1 Grey to brown (10YR 4/2 to 4/4); coarse sand to light sandy clay loam; massive to single grain, dry moderately weak Abrupt to - A2 As above with conspicuous or sporadic bleach, very few medium manganiferous nodules. Abrupt to - B21t. Grey to yellow-brown (10YR 5/4, 6/2 to 6/4), frequently 10-25% distinct brown mottles, light to light medium clay, few small pebbles, angular quartz, strong 50-100 mm columnar to angular blocky parting to 5-10 mm angular blocky, dry moderately firm Clear to gradual to - D1 or B3. Grey to yellow-brown (10YR 5/2 to 6/4, 7/2); 5-25% distinct brown mottles; sandy clay to light clay, few small pebbles, angular quartz, moderate 10-20 mm subangular blocky, dry moderately firm. Clear to D or D2. Grey to yellow-brown (10YR 5/2 to 6/4, 7/2); 5-50% prominent red mottles; sandy clay loam to sandy clay, few to common small to medium pebbles, angular quartz, weak to moderare 10-20 mm subangular to angular blocky; dry moderately firm Seasonal water tables. Very few to few fine to medium ferromanganiferous nodules and soft segregations throughout B horizons Variations. Silica cemented pan below 0 8 m C horizon present below 1.3 m (sedentary soils). Debil-debil microrelief present.	Gently undulating rises on acid intrusive rocks pediments and prior streams Mid to lower slopes and pediments	Mid-high open woodland to woodland of poplar gum and cocky apple with broad leaf tea-tree and pandanus associated with Open to sparse tussock grassland of black spear grass and giant spear grass with wire grass associated in more open areas
4Dye	Dy3.43 Dy3 33	5 5-7 0 5.5-7.0 6.0-8.0 8 0-9 5 8 5-9 5		Grey and yellow solodic-solodized solonetz: Hard setting surface. A1 Dark to grey (10YR 3/2 to 4/2); light sandy clay loam to clay loam, massive to weak 10-20 mm subangular blocky, dry moderately weak Abrupt to - A2 As above with sporadic or conspicuous bleach Abrupt to - B21t Grey to yellow (10YR 4/2, 5/2 to 5/6); 25-50% prominent red mottles; light to medium clay; frequently few small to medium pebbles, angular quartz, strong 20-100 mm columnar to 20-50 mm prismatic parting to 5-20 mm subangular blocky, dry moderately strong; occasionally very few to few fine to medium ferromanganiferous nodules Clear to - B22t or B22tk. Grey to yellow-brown (10YR 5/1 to 5/4), 25-50% prominent red mottles; light to medium clay; frequently few small to medium pebbles, angular quartz, strong 5-20 mm subangular blocky, dry moderately strong, very few to few fine to medium ferromanganiferous and calcareous nodules. Gradual to - C or D. Decomposing acid rock or layered sand Variation. Texture of A horizon clayey sand.	Gently undulating rises on acid intrusive rocks, pediments and prior streams Lower slopes and pediments	Mid-high open woodland to woodland of poplar gum with grey bloodwood, cabbage gum, broad leaf tea-tree, prickly pine and beefwood associated with Tussock to open tussock grassland of giant spear grass and black spear grass with wire grass and blue grasses associated

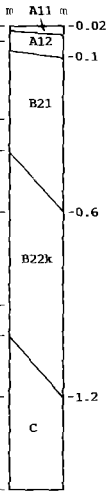
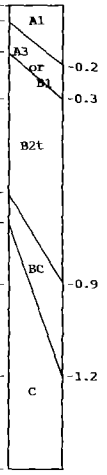
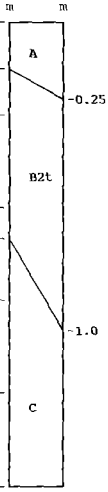
APPENDIX IV (continued)

Soil type	P.P.F.	pH	Profile diagram	Description of soil type	Landscape unit	Predominant natural vegetation
4Dyg	Dy2 43 Dy2 33 Dy3 43 Dy3 33 Db1 43 Db2 43	6 0-7.0 6.0-7.5 8.0-9.0 8.5-10.0 8.0-9.0 8.5-10.0		Grey, yellow and brown solodic-solodized solonetz Hard setting surface. A1. Dark to grey to yellow-brown (7.5YR, 10YR 2/1 to 3/2, 4/2 to 5/4), clayey sand to clay loam; few small pebbles, subangular quartz; massive to weak 10-20 mm subangular blocky, dry moderately weak; occasionally with conspicuous bleach Abrupt to - A2 As above with sporadic or conspicuous bleach. Abrupt to - B21t: Grey to yellow or brown (10YR, 2 5Y 4/2 to 5/6); occasionally 25-50% distinct yellow or brown mottles, light medium to medium clay, strong 20-100 mm columnar to 20-50 mm prismatic parting to 5-20 mm subangular blocky to prismatic; dry moderately strong. Clear to - B22t or B22tk: Grey to yellow (10YR, 2.5Y 5/1 to 6/4, 6/6); frequently 25-50% distinct yellow mottles; light medium to medium clay; strong 5-20 mm subangular blocky, dry moderately strong, very few to few fine to medium calcareous nodules and soft segregations Gradual to D or C Grey to yellow-brown (10YR 5/2 to 6/3), 25-50% distinct yellow mottles; sandy clay, light clay or decomposing acid rock; very few to common small pebbles, angular quartz. Very few to many fine to medium ferromanganiferous nodules throughout B horizons. Variations: A2 horizon absent or not bleached (PPF Dy2 13 or Dy2 33) Solum has neutral Soil Reaction Trend, underlain by alkaline silica cemented pan below 0 8 m (PPF Dy3.42).	Gently undulating rises on acid intrusive rocks, pediments and prior streams Lower slopes and pediments	Low to mid-high open woodland to woodland of cabbage gum, grey ironbark, poplar gum and broad leaf tea-tree with bullock and false sandalwood associated with Tussock to open tussock grassland of black spear grass, kangaroo and blue grasses with wire grass and purple top Rhodes grass associated
4Dyh	Dy2.43 Dy2 33 Dy3.43 Dd1 43 Dd1.33 Db1 43 Db2.43	5 0-7.0 8 0-9.5 8 0-9 5 8.0-9 5 8.5-9.5 8.5-10.0		Grey, dark and brown solodic-solodized solonetz: Hard setting surface. A1· Dark to grey (10YR, 2 5Y 3/2 to 4/2), light sandy clay loam to clay loam; massive to weak 2-5 mm platy, dry moderately firm Abrupt to - A2· As above with conspicuous or sporadic bleach. Abrupt to - B21t. Grey to yellow-brown or dark (10YR, 2.5Y 3/2 to 5/3), occasionally 10-25% distinct brown mottles; light medium to medium clay; strong 20-100 mm columnar to prismatic parting to 5-20 mm subangular blocky; dry moderately strong Clear to gradual to - B22t or B22tk· Grey to yellow-brown (10YR, 2.5Y 4/2 to 5/4), light medium to medium clay; strong 5-20 mm subangular blocky, dry moderately strong, very few to few fine to medium calcareous nodules and soft segregations Gradual to - D or C. Sandy clay or light clay with few small pebbles, or decomposing acid rock. Very few to few fine to medium ferromanganiferous nodules throughout B horizons Variations: Only upper 0.1 m of B21t horizon with 10-25% distinct brown mottles Texture of B horizons sandy clay or light clay with few small pebbles, angular quartz	Gently undulating rises on acid intrusive rocks, pediments and prios streams Lower slopes and pediments	Low open woodland to woodland of carbeen, cabbage gum and broad leaf tea-tree with beefwood, grey ironbark and false sandalwood associated with Open tussock grassland of purple top Rhodes grass, love grass, wire grass and blue grasses
4Dyk	Dy2.41 Dy3.41 Dy2 31 Dy3.31	6.0-6.5 5 5-7 0 5.5-7.0 5 0-6 0 5.0-6.0 5.0-6 0		Grey and yellow soloth. Hard setting surface. A1· Grey (10YR 4/2, 5/2), coarse sand to loam, very few small pebbles, angular quartz; massive to weak 2-5 mm platy, dry moderately weak Abrupt to - A2 As above with conspicuous or sporadic bleach Abrupt to - B2t. Grey (10YR, 2.5Y 5/2 to 6/4), occasionally 10-25% distinct red mottles; sandy clay loam to light medium clay, few small pebbles, angular quartz, moderate to strong 10-20 mm subangular blocky, dry moderately strong Abrupt to clear to - C. Decomposing acid rock. Variation. Very few fine to medium ferromanganiferous nodules throughout profile	Gently undulating rises on acid intrusive rocks, pediments and prior streams Lower slopes and pediments	Mid-high open woodland to woodland of poplar gum and grey bloodwood with broad leaf tea-tree and quinine bush associated with Open tussock grassland of black spear grass, giant spear grass, wire grass and purple top Rhodes grass

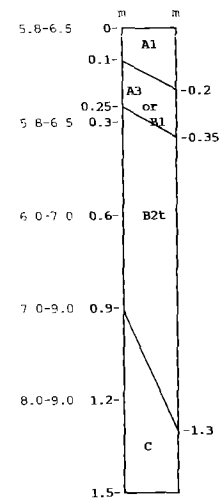
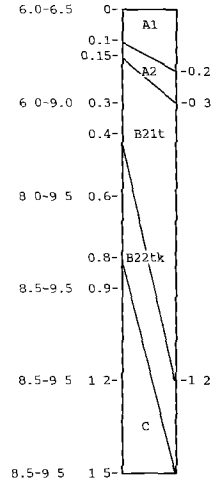
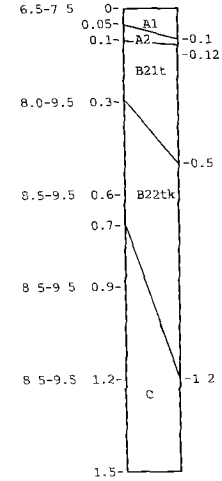
APPENDIX IV (continued)

Soil type	P.F.F	pH	Profile diagram	Description of soil type	Landscape unit	Predominant natural vegetation
4Dga	Dg2 41 Dg2 31	5 5-6 0 5.5-6.5 5.5-6.5 5 5-6 5 5.5-6 5 5.5-6.5	m m 0-A1-0.1-0.2 0.3-A2-0.35-0.65 0.6-B2t-0.85-1.0 0.9-D-1.2-1.5	Gleyed podzolic soil· Hard setting surface. A1· Grey to brown (7 5YR, 10YR 4/1 to 6/2, 4/3); frequently 10-25% distinct brown mottles; loamy sand to loam; massive to weak 10-20 mm subangular blocky, dry very weak to moderately weak. Abrupt to - A2. As above with conspicuous or sporadic bleach; occasionally few medium manganiferous nodules Abrupt to - B2t: Light grey (7.5YR, 10YR, 2 5Y 7/1, 7/2), 10-25% prominent red, orange or brown mottles, clay loam to sandy clay, strong 10-20 mm subangular blocky; dry very firm to moderately strong, occasionally few fine to medium ferromanganiferous nodules Clear to gradual to - D. As above but sandy clay loam. Variations· Silica cemented pan or hard rock present below 1 0 m Neutral to alkaline pH in D horizon.	Gently undulating rises on acid intrusive rocks, pediments and prior streams Drainage depressions, mid to lower slope positions and pediments	Low to mid-high open woodland to open forest of cabbage gum, poplar gum, carbeen, grey bloodwood and broad leaf tea-tree with Sparse tussock grassland of black spear grass
5Uga	Ug5.12 Ug5 14 Ug5 22	5.5-6.5 5 5-8 0 6.5-8.5 6 5-9.0 7.5-9.0	m A11 m 0.02-A12-0 05-0.12 0 3-B2-0 5 0.6-0.7-BC-0.9-1.0 C-1 5	Black earth. Moderately to strongly cracking. A11. Moderate to strong medium to fine granular self mulch A12 Dark (7.5YR, 10YR 3/1, 3/2); medium to medium heavy clay, strong 5-20 mm angular blocky, dry moderately firm. Clear to - B2: Dark to grey (7.5YR, 10YR 3/1, 3/2, 4/1), medium to medium heavy clay; strong 5-20 mm lenticular to subangular blocky, dry moderately strong Gradual to - BC. Grey (10YR, 2.5Y 4/1, 4/2); light medium to medium clay; moderate to strong 5-20 mm subangular blocky to lenticular, dry moderately firm. Gradual to - C· Decomposing rock Variations· Normal gilgai present, <0.05 m vertical interval and depression with similar morphology Very few to few fine to medium calcareous nodules present in lower B2 or BC horizons.	Gently undulating rises on an intrusive rock complex No fixed slope position	Low to mid-high isolated trees to open woodland of cabbage gum, grey ironbark and poplar gum with carbeen associated with Tussock grassland of blue grasses, cane grass and Chloris spp. Occasionally only grassland present
5Ugc	Ug5.14 Ug3.1 Ug5.13	6.0-7.0 6.5-8 0 8 0-9.0 8.5-9 0 8 5-9 0	m A11 m 0-A12-0.1-0.15-A2-0.2 0.3-B21-0.5 0.6-0.8-B22k-0.9-1.1 1.2-C-1.5	Black earth: Linear gilgai, < 0 1 m vertical interval; weakly to moderately cracking The proportion of mound (5Ugd), shelf (5Dyf) or depression (5Ugc) may vary between individual map units. Depression· A11 (Frequently present) weak to moderate medium to fine granular self mulch (when absent surface is hard setting) A12: Dark (10YR 2/1 to 3/1), light to light medium clay, moderate to strong 5-20 mm angular blocky, dry moderately firm Abrupt to clear to - A2. (Occasionally present) as above with sporadic bleach. Abrupt to clear to - B21. Dark (7 5YR, 10YR 2/1 to 3/1); medium clay, strong 10-20 mm angular blocky to lenticular; dry very firm Clear to - B22k· Grey to brown (10YR 4/2 to 4/4, 5/4), medium clay, strong 5-20 mm lenticular, dry very firm, very few to few fine to medium calcareous nodules and soft segregations. Gradual to - C. Decomposing rock Very few to few fine to medium ferromanganiferous nodules throughout B horizons Very few small subrounded pebbles throughout profile Variations· Texture of A horizon clay loam (PPF Dd1 33) Surface non-cracking (PPF Uf6 32, Uf3)	Gently undulating rises on an intrusive rock complex Mid to lower slopes	Tussock grassland of black spear grass, giant spear grass and cane grass with blue grasses, kangaroo grass and Panicum spp. associated

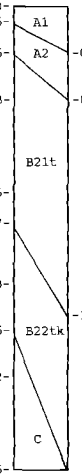
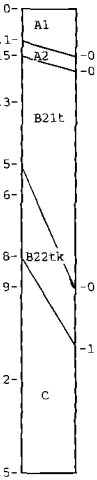
APPENDIX IV (continued)

Soil type	P P F	pH	Profile diagram	Description of soil type	Landscape unit	Predominant natural vegetation
5Ugd	Ug5.22 Ug5 26 Ug5.27 Ug5.23	6 0-7 0 8 0-9 0 8.5-9 0 8.5-9.0 8 5-9.0		Grey clay. Linear gilgai, <0.1 m vertical interval; weakly to moderately cracking The proportion of mound (5Ugd), shelf (5Dyf) or depression (5Ugc) may vary between individual map units. Mound A11: Weak to moderate medium to fine granular self mulch. A12. Grey (10YR, 2.5Y 4/1, 4/2), light to light medium clay; strong 5-20 mm granular to angular blocky, dry moderately firm. Clear to - B21 Grey (10YR, 2.5Y 4/2); medium clay; strong 10-20 mm angular blocky to prismatic, dry very firm. Clear to - B21k: Grey to brown (10YR, 2.5Y 4/2, 4/3, 5/3), medium clay; strong 5-20 mm lenticular, dry moderately strong; few fine to medium calcareous nodules and soft segregations. Gradual to - C· Decomposing rock Variations. Very few to few small subrounded to rounded pebbles on surface and throughout profile. Very few fine to medium ferromanganiferous nodules throughout B horizons. Very few to few fine to medium calcareous nodules on surface and throughout profile, usually increasing with depth.	Gently undulating rises on an intrusive rock complex Mid to lower slopes	Open tussock grassland of black spear grass, giant spear grass and blue grasses with Panicum spp associated
5Dra	Dr2 12 Dr2.11 Gn3 12 Dr3.12 Gn3 72 Gn3 11	6.0-6.5 6 0-6 5 6.0-7.0 6 0-7 0 6 0-7 5		Non-calcic brown soil. Hard setting surface. A1. Dark to brown (7.5YR, 10YR 3/1 to 3/4, 4/1, 4/2), sandy clay loam to clay loam; weak to moderate 5-20 mm angular blocky, dry moderately firm Abrupt to clear to - A3 or B1 (Occasionally present) dark to brown (7.5YR 3/1 to 3/3), light clay; moderate to strong 5-20 mm angular blocky, dry moderately firm Clear to gradual to - B2t: Red to red-brown (2 5YR, 5YR 3/3 to 3/6, 4/3 to 4/8, 5/6); occasionally 10-25% distinct yellow mottles, light medium to medium clay; strong 5-20 mm angular blocky to 10-20 mm prismatic; dry moderately firm. Clear to gradual to - BC· Red to brown (2.5YR, 5YR, 7.5YR 4/6 to 4/8, 5/3 to 5/6), light to medium clay, massive to weak 5-20 mm angular blocky; dry moderately firm Gradual to - C· Decomposing rock. Very few to common fine to medium ferromanganiferous nodules throughout B and BC horizons. Variants: 5Dra3 - Texture of A horizon light clay (PPF Uf6.31). 5Dra5 - B22t or BC horizon of yellow (10YR, 2.5Y 4/6 to 6/6, 5/4), frequently 10-25% distinct red mottles, light medium to medium clay present below 0.5 m. 5Dra1 - Depth to C horizon 0 5 m.	Gently undulating rises on an intrusive rock complex Crests, upper and mid slopes	Low to mid-high open woodland to woodland of grey ironbark and red bloodwood with poplar gum and grey bloodwood associated with Tussock grassland of black spear grass, giant spear grass, kangaroo grass and blue grasses
5Dya	Dy2.12 Dy2 11 Dy3.12	5 8-6.5 5 8-6.7 5 8-7.0 6.5-7.5 6 5-7 5		Hard pedal yellow duplex soil. Hard setting surface. A: Dark to brown (7 5YR, 10YR 3/1 to 3/3), sandy clay loam to clay loam; massive to weak 5-20 mm angular blocky; dry moderately firm. Abrupt to clear to - B2t: Yellow-brown (7 5YR, 10YR 5/4 to 5/8, 6/6), occasionally 10-25% distinct red mottles, light medium to medium clay; strong 5-20 mm angular blocky, dry moderately firm Gradual to - C· Decomposing rock Very few to common fine to medium ferromanganiferous nodules and veins throughout B horizon. Variant· 5Dya1 - Depth to C horizon 0.5 m	Gently undulating rises on an intrusive rock complex Upper to mid slopes	Low to mid-high open woodland to woodland of poplar gum, red bloodwood and grey ironbark with carbeen and grey bloodwood associated with Tussock grassland of black spear grass, giant spear grass and kangaroo grass

APPENDIX IV (continued)

Soil type	P P F	pH	Profile diagram	Description of soil type	Landscape unit	Predominant natural vegetation
5Dyb	Dy2 13 Dy3.13 Gn3.72 Gn3 23 Dy2.12	5.8-6.5 5 8-6 5 6 0-7 0 7 0-9.0 8.0-9.0		Hard pedal yellow duplex soil. Hard setting surface. Profiles with neutral soil reaction trend have alkaline C horizons. A. Dark to brown (7.5YR, 10YR 2/2, 3/1 to 3/3, 4/1), clay loam, massive to weak 5-20 mm subangular blocky to granular, dry moderately weak to moderately firm. Clear to - A3 or B1. (Occasionally present) dark to grey (7 5YR, 10YR 3/1 to 4/2), occasionally 10-25% red to brown mottles; light clay; moderate to strong 5-20 mm subangular blocky to 10-20 mm prismatic; dry moderately weak to moderately firm Gradual to - B2t. Yellow to brown (7 5YR, 10YR 4/4 to 6/6, 5/3), occasionally 10-25% red to brown mottles, light medium to medium clay; strong 5-20 mm lenticular to prismatic to subangular blocky; dry moderately firm. Gradual to - C: Decomposing rock. Very few to common fine to medium ferromanganiferous nodules throughout B horizons. Variations. Very few to few fine to medium calcareous nodules below 0.7 m. B3 horizons of medium to medium heavy clay present.	Gently undulating rises on an intrusive rock complex Mid to lower slopes	Low to mid-high open woodland to woodland of poplar gum, cabbage gum and grey bloodwood with scattered beefwood, red bloodwood and grey ironbark associated with Tussock grassland of black spear grass, giant spear grass, kangaroo grass and blue grasses
5Dyc	Dy2 43 Dy2.33 Dy3.33 Dy3 43	6.0-6.5 6 0-9.0 8 0-9 5 8.5-9.5 8.5-9 5 8.5-9 5		Grey solodic-solodized solonetz. Hard setting surface. A1. Dark to brown (7.5YR, 10YR 2/1 to 4/3); occasionally 5-25% distinct brown mottles, sandy clay loam to clay loam, massive to weak 2-5 mm platy to 5-10 mm subangular blocky; dry moderately firm Abrupt to clear to - A2: As above with conspicuous or sporadic bleach Abrupt to - B21t. Grey (10YR, 2 5Y 4/1, 4/2); occasionally 10-20% distinct yellow to brown mottles; medium to medium heavy clay, strong 20-100 mm columnar to 20-50 mm prismatic parting to 5-20 mm subangular blocky to prismatic, dry moderately firm to moderately strong. Clear to - B22tk: Grey to brown or yellow-grey (10YR 2 5Y 4/1 to 4/4, 5/3 to 5/6); medium to medium heavy clay; strong 5-20 mm subangular blocky to lenticular; dry moderately firm to moderately strong; few to common fine to medium calcareous ndoules and soft segregations. Gradual to - C: Decomposing rock or colluvia. Very few to common fine to medium ferromanganiferous nodules throughout B horizons. Variations. Depth of A horizon to 0.55 m. Colour of B21t horizon dark or brown to yellow-grey (10YR, 2.5Y 3/1, 4/3, 5/3, 5/4).	Gently undulating rises on an intrusive rock complex Lower slopes	Low to mid-high open woodland of cabbage gum, poplar gum and beefwood with carbeen associated with Tussock to open tussock grassland of black spear grass, purple top Rhodes grass and blue grasses with wire grass associated
5Dyd	Dy2.43 Dy2.33 Db1.43	6.5-7 5 8.0-9.5 8.5-9.5 8 5-9 5 8 5-9.5		Grey to brown solodic-solodized solonetz. Hard setting surface. A1: Dark to grey (10YR 3/2 to 4/2), sandy clay loam to clay loam; massive to weak 5-20 mm subangular blocky, dry moderately firm. Abrupt to - A2: As above with conspicuous or sporadic bleach. Abrupt to - B21t. Grey to yellow-brown (10YR, 2 5Y 4/2 to 4/4, 5/3, 5/4); light medium to medium clay, strong 50-100 mm columnar to 20-50 mm prismatic parting to 5-20 mm subangular blocky to prismatic, dry moderately firm to moderately strong Clear to - B22tk. Grey to yellow-brown (10YR, 2.5Y 4/2 to 5/4); light medium to medium clay, strong 5-20 mm lenticular to angular blocky, dry moderately firm to moderately strong, few to common fine to medium calcareous nodules and soft segregations Gradual to - C. Decomposing rock or colluvia. Very few to common fine to medium ferromanganiferous nodules throughout B horizons. Variation. B horizons with 10-25% distinct brown mottles (PPF Dy3.33).	Gently undulating rises on an intrusive rock complex Lower slopes	Low open woodland of cabbage gum and poplar gum with false sandalwood and beefwood associated or Low to tall open to sparse shrubland of false sandalwood with Open tussock grassland of black spear grass, purple top Rhodes grass and blue grasses

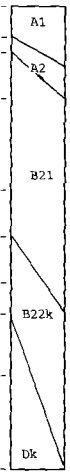
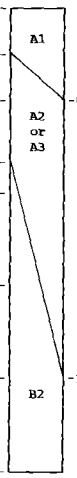
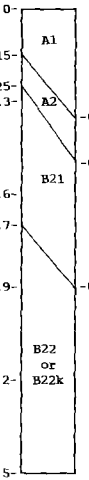
APPENDIX IV (continued)

Soil type	P.P F	pH	Profile diagram	Description of soil type	Landscape unit	Predominant natural vegetation
5Dye	Dy3 23 Dy3.22 Dy3.33 Dy2.23	6.0-6.5 6.0-7.0 6.0-7.0 7.0-8.5 7.5-9.0 7.5-9.0		Hard pedal mottled-yellow duplex soil and solodic soil. Hard setting surface Very few to common fine to medium ferromanganiferous nodules throughout profile. A1. Dark (7.5YR, 10YR 3/1, 3/2), sandy clay loam to clay loam, weak 10-20 mm subangular blocky, dry moderately weak Clear to gradual to - A2. As above but brown (7.5YR 4/3 to 4/6), occasionally with sporadic bleach Abrupt to - B21t. Yellow-brown (7.5YR, 10YR 5/4, 5/6, 6/6, 6/8), frequently 10-20% distinct orange mottles; light medium to medium heavy clay; moderate 10-20 mm subangular blocky; dry moderately firm. Clear to - B22tk. As above occasionally with 10-20% distinct orange mottles; strong 20-50 mm angular blocky; few medium calcareous nodules. Clear to gradual to - C: Decomposing rock or colluvia Variations. Depth to C horizon 0.6 m B1 horizon present between 0.3 and 0.6 m (PPF Gn3.76).	Gently undulating rises on acid intrusive rocks, pediments and prior streams All slope positions	Low to mid-high open woodland of poplar gum and cabbage gum with beefwood and grey ironbark associated in some areas with Tussock grassland of black spear grass, purple top Rhodes grass and blue grasses
5Dyf	Dy2.43 Dy2 33	5 5-6.0 7 0-8.0 8.5-9.0 8.5-9.5		Grey solodic-solodized solonetz. Linear gilgai, <0 1 m vertical interval, hard setting surface The proportion of mound (5Ugd), shelf (5Dyf) or depression (5Ugc) may vary betwen individual map units. Shelf. A1: Grey (10YR, 2.5Y 4/1, 4/2), occasionally 5-10% brown mottles, clay loam, massive to weak 10-20 mm angular blocky, dry moderately weak to moderately firm. Abrupt to - A2 As above with conspicuous or sporadic bleach. Abrupt to - B21t. Grey (10YR, 2.5Y 4/1, 4/2), light medium to medium clay; strong 20-100 mm columnar to prismatic parting to 5-10 mm angular blocky to prismatic, dry moderately strong, frequently very few fine to medium calcareous nodules Clear to gradual to - B22tk. Grey to brown (10YR, 2.5Y 4/2, 4/3); light medium to medium clay; strong 5-20 mm angular blocky to lenticular, dry moderately strong, few fine to medium calcareous nodules and soft segregations. Gradual to - C Decomposing rock. Very few to common fine to medium ferromanganiferous nodules throughout B horizons. Variation: Texture of A horizon light clay (PPF Uf6.33).	Gently undulating rises on an intrusive rock complex Mid to lower slopes	Low to mid-high open woodland of cabbage gum and poplar gum with red bloodwood associated with Open tussock grassland of black spear grass, blue grasses, brown top, kangaroo grass and purple top Rhodes grass
6Uca	Uc5 11 Uc5 21 Uc5 23	6 0-7 0 6 0-7 0 6 0-7 0 6 0-7 0 6.5-8.0 6 5-8.0		Brownish sand and earthy sand. Hard setting surface. A: Dark (10YR 3/1, 3/2), coarse sand to sandy loam, massive to single grain, dry loose to very weak. Gradual to diffuse to - B2. Brown to yellow-brown (7.5YR, 10YR 4/3, 4/6, 5/4, 6/4, 5/6), coarse sand to sandy loam; massive to single grain; dry very weak to moderately weak. Gradual to diffuse to - D: Mottled coarse sand with seasonal watertable	Miscellaneous alluvial landforms Prior streams, levees, flood-outs and fans	Low to mid-high open woodland to woodland of pandanus, broad-leaf tea-tree and grey bloodwood with cocky apple and poplar gum associated with Tussock grassland of giant spear grass and black spear grass

APPENDIX IV (continued)

Soil type	P P F	pH	Profile diagram	Description of soil type	Landscape unit	Predominant natural vegetation
6Uca	Uc4 24 Uc4 22 Uc4.21 Uc4 Uc5.21 Uc5 23 Uc5 11 Gn2 45 Gn2.82	5 5-6 5 6 0-7 0 6 0-7 0 6.0-7.5 6.0-7 5	m m 0- 0.05- A1 0.3- A12 or A2 0.5- -0.5 0.6- 0 9- A3 or B2 -1.1 1.2- 1.5-	Pale, earthy and weakly structured sand: Loose to hard setting surface. Fine sand and medium sand is common on Burdekin River levee. Coarse sand textures usually associated with creeks. A1. Grey to dark or brown (7.5YR, 10YR 3/1, 3/2, 4/2 to 4/4); sand to fine sandy loam, single grain to weak 10-20 mm angular blocky; dry loose to very weak. Gradual to diffuse to - A2 or A12 As above but brown to yellow (7.5YR, 10YR 3/4 to 4/6, 5/3 to 5/6) Gradual to diffuse to - B2 or A3: Brown to yellow (7 5YR, 10YR 3/3 to 5/6, 6/6, 7/6); sand to sandy clay loam; single grain to weak 10-20 mm angular blocky, dry loose to very weak. Variations: A3 or B2 horizon 5-10% distinct brown mottles. D horizon of grey to yellow-brown (10YR 4/2 to 5/5), 10-25% distinct brown mottles, sandy clay below 1 1 m Underlain by hard rock at 1.2 m.	Miscellaneous alluvial landforms Levees, flood-outs and fans	Mid-high to tall open woodland to open forest of poplar gum, carbeen, grey bloodwood and Burdekin Plum with broad leaf tea-tree, cocky apple, pandanus, prickly pine and quinine bush associated with Tussock grassland of giant spear grass, black spear grass and brown sorghum with golden beard grass and blue grasses associated
6Umb	Um4.42 Um4.4 Um5.52 Um6.31 Uf4.42 Gn3.41	5.5-6 5 6.0-6.5 6 5-7.0 6.5-7 5 7.0-8.0 7.0-8.5	m m 0- A1 0.2- A2 or A3 0.3- -0.3 B21 0.6- -0.6 0.9- -1.2 B22 1.2- 1.5-	Pale, friable and earthy loam and non-cracking clay: Hard setting surface. A1: Dark to grey (7.5YR, 10YR 2/2, 3/1 to 4/2); occasionally 10-25% distinct brown mottles, loam to sandy clay; weak to moderate 5-20 mm angular blocky to prismatic; dry moderately firm. Gradual to diffuse to - A2 or A3 (Frequently present) as above but brown to yellow-brown (7.5YR, 10YR 4/3 to 5/4) Gradual to diffuse to - B21: Brown to dark (7.5YR, 10YR 3/2 to 3/4, 4/3, 4/4); clay loam to light clay; weak to moderate 5-20 mm angular blocky, dry moderately firm. Gradual to diffuse to - B22. As above but yellow-brown to yellow (7.5YR, 10YR 5/3 to 5/6) Variant: 6Umb2-D horizons of clay loam to medium clay present below 0.55 m with B21 which may be grey (7 5YR, 10YR 4/1, 4/2) (PPF Gn3.91).	Miscellaneous alluvial landforms Levees and backplains	Mid-high to tall woodland of poplar gum, grey bloodwood and carbeen with cocky apple associated with Tussock grassland of brown sorghum, black spear grass and giant spear grass
6Uga	Ug5.16 Ug5 17 Ug5.2 Uf6 32 Uf6.33	6 0-8.0 7.0-9.0 8 0-9 0 8 0-9 0 8 0-9 5 8 0-9.5	m A11 m 0.01- -0.02 0.05- A12 -0.2 0.3- B21 0.5- 0.6- -0.8 B22 or B22k 0.9- 1.0- 1 2- D 1.5-	Black earth, grey clay and non-cracking friable clay: Weakly cracking to non-cracking. A11: (Occasionally present) weak to moderate fine granular self mulch (when absent surface is hard setting) A12: Dark to grey (7 5YR, 10YR 2/1 to 5/2), light to light medium clay; moderate to strong 5-10 mm subangular to angular blocky to granular; dry moderately firm Clear to - B21: Dark to grey (7.5YR, 10YR 2/1 to 4/2), light to medium clay, strong 5-20 mm subangular to angular blocky; dry moderately firm to very firm Clear to - B22 or B22k: Grey to brown (7.5YR, 10YR 4/1 to 5/4), frequently 10-25% distinct brown mottles, light to medium clay; strong 10-20 mm angular blocky to lenticular, dry very firm, frequently very few to few fine to medium calcareous nodules. Abrupt to clear to - D. Grey to brown (7 5YR, 10YR 4/2 to 5/4), occasionally 10-25% distinct brown mottles; sandy clay to medium clay, weak to moderate 10-20 mm angular blocky to lenticular; dry very firm, occasionally few small subrounded and rounded pebbles Variations: Normal gilgai present, 0.05-0 1 m vertical interval and depression with similar morphology. A horizon with 5-10% distinct brown mottles	Miscellaneous alluvial landforms Levees and closed and open depressions	Mid-high open woodland to woodland of poplar gum, cabbage gum and grey bloodwood with carbeen and red bloodwood associated with Tussock grassland of black spear grass and blue grasses Rubber vine has invaded some cleared areas

APPENDIX IV (continued)

Soil type	P P.F	pH	Profile diagram	Description of soil type	Landscape unit	Predominant natural vegetation
6Ugc	Ug2 Ug3.2 Uf3	5.5-6 5 6 0-7 0 7 5-8 5 8.0-9.0 8.5-9.0 8 5-9 0		(Bleached) grey clay and non-cracking clay: Normal gilgai, 0 05-0 1 m vertical interval, weakly cracking to non-cracking; hard setting surface. Mound. A1: Dark to grey (10YR, 2 5Y 3/1 to 4/2), 10-25% distinct brown mottle; light clay; massive to weak 10-20 mm subangular blocky, dry moderately firm Abrupt to clear to - A2. As above with sporadic or conspicuous bleach. Abrupt to clear to - B21. Grey (10YR, 2.5Y 4/1, 4/2); light medium to medium clay, strong 5-20 mm angular blocky to lenticular; dry moderately firm Clear to - B22k. As above but grey (10YR, 2.5Y 4/1 to 5/2); few fine to medium calcareous nodules Clear to - Dk Grey to brown (10YR 4/1 to 4/3); light clay; moderate 10-20 mm angular blocky, dry moderately firm, few fine to medium calcareous nodules Very few to few fine to medium ferromaganiferous nodules throughout B and D Depression: Similar morphology but weakly to moderately cracking and 10-50% distinct brown mottles in the A horizons.	Miscellaneous alluvial landforms Backplains and closed and open depressions	Low to mid-high open woodland to woodland of cabbage gum, poplar gum and carbeen with cocky apple associated with Tussock grassland of blue grasses, kangaroo grass and black spear grass Rubber vine has invaded some cleared areas
6Gnd	Gn3.75 Gn3 72 Gn3.22 Gn3 92 Gn3 82	6.0-7 0 6 0-7 0 6.5-7.0 6.5-7.5 6.5-8.0 7.0-8 0		Yellow and brown smooth-ped earth: Hard setting surface. A1: Grey to dark or brown (7 5YR, 10YR 3/1, 3/2, 4/2 4/3); sandy loam to clay loam; massive to weak 10-20 mm angular blocky; dry moderately weak Clear to - A2 or A3: Brown to yellow-brown (7.5YR, 10YR 4/2 to 4/6, 5/4, 5/6), fine sandy loam to clay loam, massive to weak 10-20 mm angular blocky; dry moderately firm, occasionally with sporadic bleach Clear to - B2: Brown to yellow-brown (7 5YR, 10YR 4/3 to 5/6, 6/6), clay loam to light clay, moderate 5-20 mm prismatic; dry moderately strong Very few to few fine to medium ferromanganiferous nodules throughout B2 horizon. Variation: D horizon of red to red-brown (5YR 4/4, 5/4) sandy clay loam to clay loam present below 1.0 m.	Miscellaneous alluvial landforms Levees, flood-outs and fans	Mid-high to tall woodland of carbeen, cabbage gum and poplar gum with red and grey bloodwood and cocky apple associated with Tussock grassland of black spear grass and giant spear grass with brown sorghum and blue grasses associated
6Gne	Gn3.49 Gn3 03 Gn3.06	5 5-6 5 6.0-7.0 6.5-8.5 7.5-9 0 8 5-9 0 8 5-9 0		Bleached black and grey smooth-ped earth: Hard setting surface. A1. Dark to grey (7 5YR, 10YR 3/1, 4/1), clay loam; massive to moderate 10-20 mm subangular blocky; dry moderately firm. Abrupt to clear to - A2: As above with sporadic or conspicuous bleach. Abrupt to clear to - B21: Dark to grey (7 5YR, 10YR 3/1, 4/1, 4/2), light clay; strong 5-20 mm subangular blocky; dry very firm. Clear to - B22 or B22k. As above with very few to few fine to medium calcareous nodules. Very few to few fine to medium ferromanganiferous nodules throughout B horizons. Variation D horizon of red to brown (5YR, 7 5YR 4/6, 5/4, 5/6) clay loam to fine sandy clay present below 1.0 m.	Miscellaneous alluvial landforms Backplains	Low to tall open woodland of poplar gum and cabbage gum with grey bloodwood, cocky apple, and occasionally whitewood and willow wattle associated with Tussock grassland of black spear grass and giant spear grass with blady grass and brown sorghum associated Rubber vine dominates in some areas

APPENDIX IV (continued)

Soil type	P.P.F.	pH	Profile diagram	Description of soil type	Landscape unit	Predominant natural vegetation
6Drb	Dr3 32 Dr3 42 Dr2 22 Dr2 32 Dr2 21	5.5-6.5 5.5-6.5 6.0-6.5 6.0-6.5 6.0-7.0 6.0-7.5	m m 0- 0.1- A1 0.2- A2 -0.2 0.3- -0.45 0.6- B21t 0.9- 1.0- 1.2- B22t or D -1.35 1.5-	Red podzolic soil: Hard setting surface. Very few to few fine to medium ferromanganiferous nodules throughout profile A1: Dark to grey (7.5YR, 10YR 2/1, 3/1, to 4/2), frequently 10-25% distinct brown mottles, loam to clay loam, moderate 10-20 mm subangular blocky, dry moderately firm. Abrupt to clear to - A2: As above but brown to grey (7.5YR, 10YR 4/2, 4/3, 4/4, 5/2), frequently with sporadic or conspicuous bleach. Abrupt to clear to - B21t: Red to red-brown (2.5YR, 5YR 3/6, 4/6, 4/8), frequently 10-25% distinct yellow mottles; light medium to medium heavy clay; strong 10-20 mm subangular blocky; dry very firm. Clear to gradual to - B22t or D: Brown to red-brown (5YR, 7.5YR 3/6, 4/4, 4/6); frequently 10-25% distinct yellow mottles, clay loam to light medium clay; strong 10-20 mm angular blocky, dry very firm.	Miscellaneous alluvial landforms Levees, flood-outs and fans	Mid-high to tall woodland to open woodland of poplar gum with carbeen, grey bloodwood and cocky apple associated with Open tussock grassland of black spear grass, giant spear grass and kangaroo grass
6Drc	Dr3 33 Dr3 43 Dr2 33 Dr2 43	5.5-6.5 6.0-7.0 6.5-8.0 8.0-9.0 1.0- 8.0-9.0 8.0-9.0	m m 0- 0.1- A1 0.2- A2 -0.2 0.3- 0.5- B21t -0.5 0.6- 0.75- B22t -0.7 0.9- B23tk -1.0 1.2- D or Dk -1.35 1.5-	Red solodic-solodized solonetz: Hard setting surface. Very few to few fine to medium ferromanganiferous nodules throughout profile. A1: Dark to grey (7.5YR, 10YR 2/1, 3/1, 3/2, 4/2), frequently 10-25% distinct brown mottles, loam to clay loam, weak to moderate 5-20 mm subangular blocky, dry moderately weak. Abrupt to - A2: As above but grey to brown (7.5YR, 10YR 4/2 to 4/4, 5/2, 6/2), with conspicuous or sporadic bleach. Abrupt to - B21t: Red to red-brown (2.5YR, 5YR 3/4, 3/6, 4/3 to 4/8), frequently 10-25% distinct yellow or grey mottles, medium to medium heavy clay, strong 20-100 mm columnar to prismatic parting to 5-20mm angular blocky, dry very firm to moderately strong. Gradual to diffuse to - B22t: As above but strong 5-20 mm prismatic to angular blocky. Gradual to diffuse to - B23tk: As above with few fine to medium calcareous nodules. Gradual to diffuse to - D or Dk: Red-brown to brown (5YR, 7.5YR 4/4 to 5/6), frequently 10-25% distinct yellow mottles, sandy clay to medium clay, strong 10-20 mm angular blocky to prismatic, dry moderately firm to very firm, very few to few medium calcareous nodules. Variations: A2 horizon not bleached (PPF Dr 2 33) Texture of D horizon sandy clay loam to clay loam Common small to medium subrounded to rounded pebbles throughout D horizon	Miscellaneous alluvial landforms Levees, flood-outs and fans	Mid-high to tall open woodland of grey bloodwood and poplar gum with carbeen, cabbage gum, cocky apple and beefwood associated with Tussock grassland of black spear grass, blue grasses and giant spear grass with kangaroo grass associated

APPENDIX IV (continued)

Soil type	P.P.F	pH	Profile diagram	Description of soil type	Landscape unit	Predominant natural vegetation
6Dba	Db1.33 Db1.43 Dy2 33	6 5-7 0 6.5-7.5 8 0-9 0 8.0-9.0 8.0-9.0	m m 0- 0.1- 0 15- 0.3- 0 6- 0.8- 0.9- 1.2- 1.5- A1 A2 B21t B22t or B22tk -0 2 -0.3 -1 0	Brown and grey solodic-solodized solonetz: Hard setting surface A1. Dark to brown or grey (7 5YR, 10YR 3/1 to 4/3); sandy loam to sandy clay loam, massive to weak 10-20 mm angular blocky, dry moderately firm Abrupt to - A2: As above with sporadic or conspicuous bleach Abrupt to - B21t Brown to yellow-brown or grey (7.5YR, 10YR 4/3 to 5/4, 5/2), occasionally 5-10% faint brown mottles, light to medium clay; strong 20-100 mm columnar to angular blocky parting to 5-20 mm angular blocky to prismatic, dry very firm; frequently very few to few medium calcareous nodules. Clear to gradual to - B22t or B22tk: As above but strong 5-20 mm angular blocky to to prismatic with very few to common fine to medium calcareous nodules and soft segregations Very few to few fine to medium ferromanganiferous nodules throughout B horizons. Variations. A2 horizon not bleached (PPF Db1.23). D horizon of sandy clay to medium clay present below 0 6 m	Miscellaneous alluvial landforms Flood-outs, fans and levees	Low to mid-high open woodland to woodland of carbeen, grey bloodwood and cabbage gum with poplar gum, whitewood, beefwood and mimosa associated with Tussock grassland of black spear grass, blue grasses and purple top Rhodes grass
6Dbb	Db1.33 Db1.43 Dy2.43 Dy2 33 Dd1.33	6.0-7 0 6.0-7.0 7.0-8.5 7.5-9.0 8.0-9.0 8 0-9 0	m m 0- 0.1- 0.3- 0.6- 0.9- 1.0- 1.2- 1.5- A1 A2 B21t B22t or B22tk D or Dk -0.25 -0.4 -1.0 -1.2	Brown, grey and dark solodic soil: Hard setting surface. A1. Dark to grey (7.5YR, 10YR 3/1 to 4/3); clay loam; massive; dry moderately firm. Abrupt to - A2 As above with sporadic or conspicuous bleach Abrupt to - B21t: Brown to grey or dark (7 5YR, 10YR 3/1 to 4/3, 4/4), light medium to medium clay; strong 20-100 mm prismatic parting to 5-20 mm prismatic to angular blocky, dry very firm. Clear to - D22t or B22tk: As above with very few to few medium to coarse calcareous nodules. Clear to - D or Dk. Brown to yellow-brown (7.5YR, 10YR 4/3, 5/3, 5/4); loam to light medium clay, massive to strong 10-100 mm prismatic, dry moderately firm, very few to few fine to medium calcareous nodules Very few to few fine to medium ferromanganiferous nodules throughout B and D horizons. Variation: Colour of D horizon brown to red-brown (5YR 4/4, 5/6)	Miscellaneous alluvial landforms Backplains and channel benches	Low to mid-high open woodland to woodland of poplar gum, cabbage gum, carbeen and grey bloodwood with cocky apple associated with Tussock grassland of black spear grass, giant spear grass and brown sorghum
6Dbe	Db2.33 Db2.43 Db1 43 Db1.33	5 5-6.5 6 0-7 5 7 5-8 5 8.0-9.0 8.0-9.0 8 0-9 0	m m 0- 0.05- 0.1- 0.3- 0.55- 0.6- 0.9- 1.0- 1.2- 1.3- 1.5- A1 A2 B21t D1 D2k D3 D4 -0.15 -0.2 -0.7 -1.0 -1.25	Red-brown earth: Hard setting surface. A1: Dark to brown (7.5YR, 10YR 3/2, 3/3), 10-25% distinct brown mottles, loam to clay loam, massive to weak 5-20 mm subangular blocky, dry moderately firm. Abrupt to - A2. As above with sporadic to conspicuous bleach. Abrupt to - B21t: Brown (7 5YR, 10YR 3/4, 4/4, 4/6), frequently 10-25% distinct red mottles; medium to medium-heavy clay; strong 20-100 mm prismatic; dry moderately strong. Clear to - D1: As above but sandy clay to light medium clay, argillans always present. Clear to - D2k As above with few medium calcareous nodules. Clear to - D3. Brown to yellow-brown (7 5YR 4/4, 4/6, 5/6), loamy sand to clay loam; weak 10-20 mm subangular to angular blocky; dry very weak to moderately weak. Clear to - D4: Brown to grey (7.5YR, 10YR 3/3, 4/2, 4/3), light to light medium clay, strong 10-20 mm angular blocky, dry moderately firm. Very few to few fine to medium ferromanganiferous nodules and veins throughout B and D horizons Variations. Colour of B21t horizon yellow-brown (7 5YR, 10YR 5/4 5/6). Depth of A horizon to 0.25 m. B21t horizon continues to 1.5+m.	Miscellaneous alluvial landforms Levees, flood-outs and fans	Mid-high to tall open woodland to open forest of poplar gum, carbeen and red and grey bloodwood with beefwood and cocky apple associated with Tussock grassland of blue grasses, black spear grass and golden beard grass Occasionally open forest of tea-tree

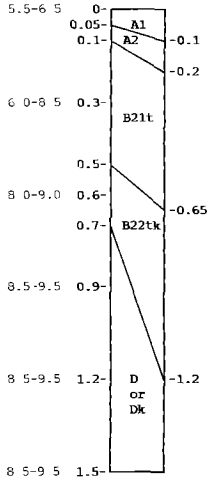
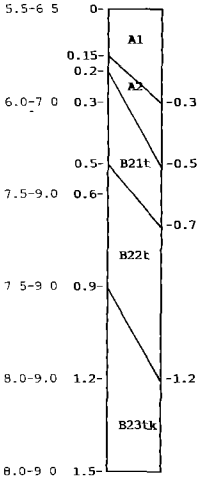
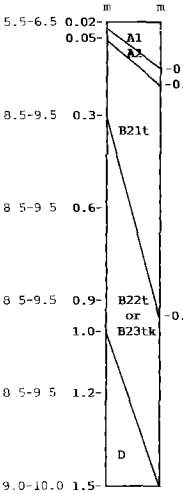
APPENDIX IV (continued)

Soil type	P P F.	pH	Profile diagram	Description of soil type	Landscape unit	Predominant natural vegetation
6Dbh	Db1 43 Db1 33 Db2.33	5.5-7.0 7.5-9.0 8 0-9 0 8 5-9 5 8 5-9 5 9 0-10 0	m m 0- 0.05- A1 0.1- A2 -0.15 -0.25 0.3- B21t 0.45- 0.6- B22t or B22tk 0.9- -0.9 -1.0 D or Dk 1.2- 1.5-	Brown solodic-solodized solonetz: Hard setting surface. A1 Dark to grey or brown (7.5YR, 10YR 3/2 to 4/3); occasionally 10-25% distinct brown mottles, loam to clay loam, massive to weak 2-5 mm platy, dry moderately weak. Abrupt to - A2: As above with sporadic or conspicuous bleach Abrupt to - B21t: Brown (7 5YR, 10YR 3/3, 4/3 to 4/6), occasionally 10-25% distinct brown mottles; light to medium clay, strong 20-100 mm angular blocky to columnar parting to 5-20 mm angular blocky to prismatic, dry moderately firm Clear to - B22t or B22tk: (Frequently present) as above with very few to few fine to coarse calcareous nodules and soft segregations. Clear to - D or Dk. Brown to yellow-brown or grey (7 5YR, 10YR 4/2, 4/3 to 6/4); clay loam to medium clay; moderate to strong 5-20 mm prismatic to angular blocky; dry moderately firm, very few to few fine to medium calcareous nodules and soft segregations. Very few to few fine to medium ferromanganiferous nodules throughout B and D horizons. Variations. Few fine to medium gypseous nodules in B22t. A2 horizon not bleached (Db1.23). Variant: 6Dbh2 - Texture of D horizon sandy loam to light sandy clay loam	Miscellaneous alluvial land-forms Levees, flood-outs and fans	Low open woodland to woodland of beefwood, false sandalwood and carbeen with cabbage gum and ironbark associated or Tall open shrubland of beefwood with Open tussock grassland of purple top Rhodes grass and blue grasses
6Dya	Dy3.41 Dy3.42 Gn3.85 Dy3.32	5.5-6.5 5.5-6.5 5 5-6.5 6.0-7 0 6.0-7.0 6 0-7.0	m m 0- 0.1- A1 0.3- -0.4 0.6- A2 0.9- 1.2- -1.2 B21t 1.5-	Yellow podzolic soil: Hard setting surface. A1. Dark to brown or grey (7.5YR, 10YR 3/1 to 4/2, 4/3), loamy sand to sandy loam, massive to weak 20-50 mm subangular blocky; dry moderately weak. Abrupt to - A2: Grey to yellow-brown (7 5YR, 10YR 5/3, 5/4 6/2, 6/3); frequently 10-25% distinct yellow mottles; loamy sand to sandy loam; massive, dry very weak, conspicuous or occasionally sporadic bleach. Abrupt to - B21t: Yellow to yellow-brown (7 5YR, 10YR 5/4, 5/6 5/8); 25-50% prominent grey or red mottles; sandy clay to light medium clay; strong 10-50 mm angular blocky, dry very firm. Few to many manganiferous nodules, soft segregations or veins throughout A2 or B21t horizons. Variation: D horizon of yellow (10YR, 2.5Y 7/4, 7/6) clayey sand with few small rounded pebbles present below 1.3 m. Variant: 6Dya5 - Colour of B horizon grey to yellow-brown (10YR 4/1, 6/4).	Miscellaneous alluvial landforms Levees, flood-outs and fans	Tall open forest to woodland of poplar gum and grey bloodwood with carbeen, pandanus, and cocky apple associated with Tussock grassland of black spear grass and giant spear grass
6Dyb	Dy3.32 Dy3 42 Dy3.31 Dy3.42	5.5-6 5 6.0-6.5 6.0-6 5 6 0-7 0 6 0-7 0 6 0-7.0	m m 0- A1 0.15- 0.3- A2 -0.3 0.6- -0.6 B21t 0.9- 1.2- -1.25 B22t 1.5-	Yellow soloth-solodic soil: Hard setting surface. A1. Dark to brown (10YR 2/1 to 4/2, 4/3); loamy sand, sandy loam or sandy clay loam, massive to weak 10-20 mm subangular blocky; dry moderately weak. Abrupt to - A2: Grey to yellow-brown (7.5YR, 10YR 5/2 to 6/3, 5/4); loamy sand to sandy loam, massive, dry moderately weak, sporadic or conspicuous bleach. Abrupt to - B21t- Yellow-brown to grey (7.5YR, 10YR, 2.5Y 5/2 to 6/4, 5/6, 5/8), 10-50% distinct yellow mottles, sandy clay to light medium clay, strong 20-100 mm angular blocky to prismatic, dry very firm. Gradual to diffuse to - B22t. As above but light medium to medium clay Few to many fine to medium manganiferous nodules, soft segregations or veins throughout A2 and B horizons Variant: 6Dyb2 - D horizon of sand to medium clay present below 0.6 m.	Miscellaneous alluvial landforms Levees, flood-outs and fans	Mid-high to tall open woodland of poplar gum and grey bloodwood with cocky apple and cabbage gum associated with Tussock grassland of blue grasses, black spear grass and giant spear grass

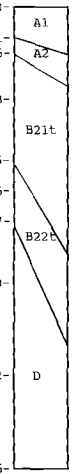
APPENDIX IV (continued)

Soil type	P P.F.	pH	Profile diagram	Description of soil type	Landscape unit	Predominant natural vegetation
6Dyc	Dy3.42 Dy3 32 Dy3 41 Db2 32	5 5-6 5 5 5-6.5 6 0-7.0 6 0-7 0 6 0-7 0	m m 0- 0.15- 0.3- 0.45- 0.6- 0.9- 1.2- 1.5- A1 A2 B21t D -0.4 -0.8	Yellow podzolic soil· Hard setting surface. A1: Dark to grey (7 5YR, 10YR 3/1 to 4/2); loam to clay loam; weak 10-20 mm subangular blocky; dry moderately weak. Abrupt to clear to - A2 As above but grey to brown (7 5YR, 10YR 4/3, 5/2, 6/2); sporadic or conspicuous bleach. Abrupt to - B21t: Yellow to brown (7 5YR, 10YR 4/4, 5/3 to 5/6), 10-25% distinct red mottles; light medium to medium heavy clay, strong 10-20 mm angular blocky, dry moderately firm to very firm. Clear to gradual to - D Red-brown (5YR 3/6, 4/6, 4/8), 10-25% distinct yellow or brown mottles, light to medium clay; strong 10-20 mm angular blocky, dry moderately firm to very firm. Few to many fine to medium ferromaniferous nodules, soft segregations or veins throughout A2, B21t and D horizons.	Miscellaneous alluvial landforms Levees, flood-outs and fans	Mid-high to tall woodland of grey bloodwood and poplar gum with cocky apple associated with Tussock grassland of black spear grass, giant spear grass and brown sorghum
6Dyd	Dy3 42 Dy3.41 Dy3.32 Dy3.31 Db2.32	5.5-6.5 6 0-6 5 6.0-6.5 6 0-6 5 6.0-7 0 6.0-7.0	m m 0- 0.1- 0.2- 0.3- 0.6- 0.9- 1.2- 1.5- A1 A2 B21t D -0.2 -0.4	Yellow podzolic soil. Hard setting surface. Few to many fine to medium ferromanganiferous nodules throughout profile. A1. Grey to dark (7 5YR, 10YR 3/1 to 4/2); frequently 10-20% distinct brown mottles, loam to clay loam, massive to weak 2-5 mm platy to 10-20 mm subangular blocky, dry moderately weak. Abrupt to - A2· As above with sporadic or conspicuous bleach. Abrupt to - B21t. Yellow-brown to brown (7.5YP, 10YR 4/4 to 5/6); 10-20% distinct red mottles; light medium to medium heavy clay, strong 10-20 mm subangular blocky; dry very firm. Gradual to - D· Red-brown to red (5YR, 2.5YR 3/6, 4/6, 4/8); 10-20% distinct yellow mottles; sandy clay to medium clay, strong 10-20 mm subangular blocky; dry very firm	Miscellaneous alluvial landforms Levees, flood-out and fans	Mid-high to tall woodland of grey bloodwood and poplar gum with Tussock grassland of black spear grass and giant spear grass
6Dyf	Dy3 43 Dy3.33 Db2.43 Db2.33	5.5-6 5 6 0-7.0 6 5-8.0 7 0-8 5 8 5-9 0 8 5-9 0	m m 0- 0.1- 0.25- 0.3- 0.6- 0.7- 0.9- 1.2- 1.5- A1 A2 B21t B22tk D -0.25 -0.5 -1.2	Yellow and brown solodic-solodized solonetz: Hard setting surface. A1· Grey to dark (10YR 3/1 to 4/2); frequently 10-25% distinct brown mottles, loam to clay loam, massive to weak 10-20 mm subangular blocky; dry moderately weak. Abrupt to - A2: As above but grey to yellow-brown (10YR 4/2, 5/2, 5/3, 6/3), sporadic or conspicuous bleach. Abrupt to - B21t: Yellow-brown to brown (7.5YR, 10YR 4/4, 4/6, 5/6, 5/3 to 6/4), 10-50% distinct red or brown mottles; light medium to medium heavy clay, strong 20-100 mm columnar to angular blocky parting to 10-20 mm prismatic to angular blocky; dry very firm to moderately strong. Clear to - B22tk: Brown to red-brown (5YR, 7 5YR 4/3 to 6/6); 10-25% distinct yellow mottles; light medium to medium clay, strong 10-20 mm angular blocky; dry very firm; few medium calcareous nodules. Clear to gradual to - D: As above but light to light medium clay and moderate 10-20 mm angular blocky. Few ferromanganiferous nodules throughout B and D horizons Variation· D horizon of yellow (10YR 6/6) clay loam. Variant. 6Dyf2-D horizon of brown to yellow-brown (7 5YR 4/4, 5/4, 6/6) sand to sandy clay loam present below 0.9 m.	Miscellaneous alluvial landforms Flood-outs, fans and levees	Tall to low woodland of poplar gum and grey bloodwood with cocky apple associated with Tussock grassland of black spear grass, giant spear grass and kangaroo grass

APPENDIX IV (continued)

Soil type	P P.F	pH	Profile diagram	Description of soil type	Landscape unit	Predominant natural vegetation
6Dyg	Dy3.43 Dy2.43 Dy3.33 Dy2.33 Db2 43	5.5-6 5 6 0-8 5 8 0-9.0 8.5-9.5 8 5-9.5 8 5-9 5		Grey and brown solodic-solodized solonetz: Hard setting surface. Few fine to medium ferromanganiferous nodules throughout profile A1 Grey to brown or dark (7.5YR, 10YR 3/2 to 4/3, 4/1), frequently 10-25% distinct brown mottles, loam to clay loam, massive to weak 10-20 mm subangular blocky to 2-5 mm platy; dry moderately weak Abrupt to - A2· As above with conspicuous or sporadic bleach. Abrupt to - B21t Grey to yellow or brown (10YR, 2 5Y 4/1 to 4/3, 5/3 to 5/6), frequently 5-25% faint to distinct brown mottles, light medium to medium heavy clay; strong 20-100 mm columnar to angular blocky parting to 10-20 mm angular blocky to prismatic, dry moderately strong. Clear to - B22tk As above but strong 10-20 mm blocky with few medium calcareous nodules. Clear to - D or Dk· Yellow-brown to brown or grey (10YR 4/2 to 5/4, 4/6, 5/6), frequently 10-25% distinct brown mottles, clay loam to light medium clay, moderate 10-20 mm angular blocky to lenticular, dry very firm, frequently very few to few medium calcareous nodules. Variation: Colour of B21t horizon dark (10YR 2/2, 3/1, 3/2) (PPF Dd1.43, Dd2 43). Variant: 6Dyg2 - Texture of D horizon coarse sand to sandy clay loam.	Miscellaneous alluvial landforms Flood-outs, fans and levees	Low to mid-high open woodland of carbeen, cabbage gum, poplar gum, beefwood and false sandalwood with grey bloodwood and cocky apple associated with Open tussock grassland of black spear grass and purple top Rhodes grass
6Dyh	Dy3 43 Dy2 43 Dy3 33 Db2 43 Dd1 43	5.5-6 5 6.0-7 0 7.5-9.0 7 5-9 0 8.0-9.0 8.0-9 0		Grey solodic-solodized solonetz· Hard setting surface. A1· Dark to brown (7.5YR, 10YR 3/1, 3/2 to 4/3), occasionally 5-25% distinct brown mottles, sand to sandy loam; massive; dry very firm. Abrupt to - A2 As above but grey (7.5YR, 10YR 4/2 to 6/2); conspicuous or sporadic bleach. Abrupt to - B21t. Grey (10YR, 2 5Y 4/1, 4/2, 5/2), frequently 10-25% yellow mottles, light medium to medium clay; strong 10-100 mm columnar to prismatic to 20-50 mm angular blocky; dry moderately strong Gradual to diffuse to - B22t: As above but 10-20 mm prismatic to angular blocky. Gradual to diffuse to - B23tk· As above with few fine to medium calcareous nodules Variant· 6Dyh2 - D horizons of dark to grey (10YR 3/1, 4/1) light to medium clay or grey (10YR 4/2 to 6/2, 6/1) sand to sandy loam present below 0.7 m	Miscellaneous alluvial landforms Flood-outs, fans and levees	Low to mid-high open woodland of poplar gum, cabbage gum, carbeen and beef-wood with grey bloodwood, false sandalwood, dead finish, chinee apple and cocky apple associated with Tussock grassland of black spear grass and love grasses with blue grasses and purple top Rhodes grass associated
6Dyj	Dy3.43 Dy2.43 Dy3.33 Db2 43 Dd1 43	5.5-6.5 8.5-9.5 8 5-9 5 8 5-9.5 8 5-9 5 9.0-10.0		Grey, brown and dark solodic-solodized solonetz· Hard setting surface. A1: Dark to grey (7 5YR, 10YR 2/1, 3/2 to 4/2); sandy loam to clay loam; massive to weak 10-20 mm angular blocky; dry moderately weak. Abrupt to - A2 As above with sporadic or conspicuous bleach. Abrupt to - B21t: Grey to yellow-brown or dark (7.5YR, 10YR 3/2 to 4/3, 5/3, 5/4); frequently 10-25% distinct brown mottles; light medium to medium heavy clay, strong 20-100 mm columnar to 20-50 mm angular blocky parting to 5-20 mm angular blocky to prismatic, dry very firm; very few to few fine to medium calcareous nodules. Clear to - B22t or B22tk. As above but strong 5-20 mm angular blocky to prismatic; few to common medium calcareous nodules or soft segregations Clear to - D· Grey-brown to yellow-grey (7 5YR, 10YR, 2.5Y 5/2 to 6/4); frequently 10-25% distinct brown mottles, sand to medium clay; occasionally very few to few small pebbles; single grain to strong 10-20 mm angular blocky to lenticular; dry loose to moderately firm.	Miscellaneous alluvial landforms Flood-outs fans and levees	Low to mid-high open woodland of poplar gum, cabbage gum and false sandalwood with carbeen, grey bloodwood and corkwood associated with Open tussock grassland of blue grasses, giant spear grass, black spear grass and purple top Rhodes grass

APPENDIX IV (continued)

Soil type	P P.F.	pH	Profile diagram	Description of soil type	Landscape unit	Predominant natural vegetation
6Dda	Dd1.43 Dd1.33	5.5-6.5 6.5-8.0 8.0-9.0 8.5-9.0		Dark solodic-solodized solonetz· Hard setting surface. A1· Dark to brown (7 5YR, 10YR 2/1, 3/1 to 3/3, 4/3), occasionally 5-10% faint brown mottles; clay loam, massive to weak 5-20 mm angular blocky, dry moderately firm. Abrupt to - A2: As above with sporadic or conspicuous bleach. Abrupt to - B21t· Dark (7 5YR, 10YR 2/1 to 3/2), light medium to medium clay, strong 20-100 mm columnar to 20-50 mm angular blocky parting to 5-20 mm prismatic to angular blocky; dry very firm. Gradual to - B22t: Dark to grey (7.5YR, 10YR 2/1 to 4/2), light medium to medium clay; strong 5-20 mm angular blocky to lenticular, dry very firm; very few fine to medium calcareous nodules Gradual to - D· Dark to grey or brown (7.5YR, 10YR 3/1 to 5/2, 3/3, 4/3), occasionally 10-25% distinct yellow mottles; clay loam to light medium clay, moderate to strong 5-20 mm angular to subangular blocky, dry very firm Variant. 6Dda2 - Texture of D horizon sand to sandy loam	Miscellaneous alluvial landforms Closed and open depressions	Low to tall open woodland of poplar gum, carbeen, cabbage gum and beefwood with grey blood-wood associated with Tussock grassland of black spear grass, blue grasses and purple top Rhodes grass

SOIL TYPE: 2UGE
SITE NO: S1A
A.M.G. REFERENCE: 521 150 mE 7 805 330 mN ZONE 55

GREAT SOIL GROUP: Grey clay
PRINCIPAL PROFILE FORM: Ug3.2
SOIL TAXONOMY UNIT: Entic Chromustert
FAO UNESCO UNIT: Chromic Vertisol

TYPE OF MICRORELIEF: Normal gilgai
VERTICAL INTERVAL: .22 m
HORIZONTAL INTERVAL: 11 m
COMPONENT OF MICRORELIEF SAMPLED: Mound

SUBSTRATE MATERIAL:
CONFIDENCE SUBSTRATE IS PARENT MATERIAL:

SLOPE:
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

VEGETATION
STRUCTURAL FORM: Mid-high woodland
DOMINANT SPECIES: Eucalyptus alba, Melaleuca viridiflora, Bothriochloa species, Dichanthium species

ANNUAL RAINFALL:

PROFILE MORPHOLOGY:

CONDITION OF SURFACE SOIL WHEN DRY: Periodic cracking, hard setting

HORIZON	DEPTH	DESCRIPTION
ASb	0 to .05 m	Greyish yellow-brown (10YR5/2) moist, dull yellowish orange (10YR7/2) dry; few medium distinct orange mottles; light clay; weak 5-10mm subangular blocky; dry; very firm. Abrupt tongued to-
	.00 to .05 m	Dull yellowish orange (10YR7/2) dry.
B21	.05 to .18 m	Greyish yellow-brown (10YR4/2); few coarse faint yellow mottles; medium clay; strong 5-10mm subangular blocky; dry; very strong; very few fine manganiferous nodules. Clear smooth to-
B22	.18 to .35 m	Dark greyish yellow (2.5Y5/2); medium heavy clay; strong 5-10mm subangular blocky; dry; very strong; very few fine manganiferous nodules. Abrupt tongued to-
B23k	.35 to 1.00 m	Dark greyish yellow (2.5Y5/2); medium heavy clay; strong 10-20mm lenticular; many distinct other cutans; dry; very strong; few medium carbonate nodules, very few fine manganiferous nodules. Diffuse wavy to-
B24	1.00 to 1.90 m	Dull yellowish orange (10YR6/3); medium heavy clay; strong 200-500mm lenticular tertiary, parting to strong 10-20mm lenticular primary; many prominent other cutans; dry; very strong; very few fine manganiferous nodules.

Depth	1:5 Soil/Water			Particle Size				Exch. Cations					Total Elements			Moistures			Disp.Ratio		Exch	Exch	ECEC	pH
	pH	EC	Cl	CS	FS	S	C	CEC	Ca	Mg	Na	K	P	K	S	ADM	33*	1500*	R1	R2	Al	Acid		CaCl2
metres		dS/m	%	%				m.eq/100g					%			%					m.eq/100g			
	@ 40C		@105C	@ 105C				@ 105C					@ 80C			@ 105C			@ 40C		@ 105C			@ 40C
B 0.10	6.7	.04	.003	6	32	17	50									4.3	28	14	.50					
.0.05	6.7	.04	.003	7	29	18	47	23	5.4	9.5	1.3	.26				4.4	27	15	.51					
0.10	6.7	.06	.006	5	24	16	57	25	7.5	12	1.8	.13	0.01	0.45	0.01	5.3	30	17	.61					
0.30	7.7	.13	.015	4	21	16	59	29	10	15	3.0	.09	0.01	0.46	0.01	4.8	34	18	.87					
0.60	8.6	.46	.050	4	20	18	58	29	10	16	4.7	.10	0.01	0.47	0.01	4.9	34	19	.94					
0.90	9.0	.64	.078	3	28	20	52	24	6.6	10	5.1	.09	0.01	0.48	0.01	4.4	32	17	.97					
1.20	8.1	.86	.117	2	22	17	62	30	8.8	15	7.2	.13	0.01	0.43	0.01	6.6	40	21	.98					
1.50	8.0	.79	.101	2	24	15	58	28	7.8	14	6.5	.12	0.01	0.40	0.01	5.8								
1.70	6.7	.57	.083	3	27	22	52	22	6.2	10	4.6	.10				4.1								

Depth	Org.C	Tot.N	Extr. P		HCl	CaCl2 Extr		DTPA-extr.					Extractable			P		Alternative Cations				
	(W&B)		Acid	Bicarb.	K	K	P	Fe	Mn	Cu	Zn	B	SO4S	NO3N	NH4N	Buff Cap	Equil	CEC	Ca	Mg	Na	K
metres	%	%	mg/kg		meq%	mg/kg		mg/kg					mg/kg				ug/L	m.eq/100g				
	@ 105C	@ 105C	@ 105C		@105C	@ 105C		@ 105C					@ 105C			@ 40C		@ 105C				
B 0.10	0.9	.07	3	4	.31			83	86	1.9	0.7											
0.05	0.6	.05	1	2	.27			84	91	2.3	0.3											
0.10	0.6	.06	1	1	.19			48	76	2.1	0.4											

* -33kPa (-0.33bar) and -1500kPa (-15 bar) using pressure plate apparatus.

Cation method: ?
CEC methods: ?
Alternative cation method: ?
Alternative CEC method: ?
ECEC METHOD: ?

SOIL TYPE: 2UGE
SITE NO: S1B
A.M.G. REFERENCE: 521 150 mE 7 805 330 mN ZONE 55

GREAT SOIL GROUP: No suitable group
PRINCIPAL PROFILE FORM: Ug3.2
SOIL TAXONOMY UNIT: Entic Chromustert
FAO UNESCO UNIT: Pellic Vertisol

TYPE OF MICRORELIEF: Normal gilgai
VERTICAL INTERVAL: .22 m
HORIZONTAL INTERVAL: 11 m
COMPONENT OF MICRORELIEF SAMPLED: Depression

SUBSTRATE MATERIAL:
CONFIDENCE SUBSTRATE IS PARENT MATERIAL:

SLOPE:
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

VEGETATION
STRUCTURAL FORM: Mid-high woodland
DOMINANT SPECIES: Eucalyptus alba, Melaleuca viridiflora, Bothriochloa species, Dichanthium species

ANNUAL RAINFALL:

PROFILE MORPHOLOGY:

CONDITION OF SURFACE SOIL WHEN DRY: Periodic cracking, hard setting

HORIZON	DEPTH	DESCRIPTION
ASb	0 to .15 m	Dark greyish yellow (2.5Y5/2) moist, light grey (2.5Y8/2) dry; common coarse distinct orange mottles; light clay; weak 2-5mm subangular blocky; dry; moderately strong. Abrupt tongued to-
B21	.15 to .30 m	Yellowish grey (2.5Y5/1); common coarse distinct brown mottles; medium heavy clay; strong 5-10mm subangular blocky; dry; very strong; very few fine manganiferous nodules. Clear wavy to-
B22	.30 to .60 m	Dark greyish yellow (2.5Y5/2); very few medium faint brown mottles; medium heavy clay; strong 10-20mm subangular blocky; dry; very strong; very few fine manganiferous nodules. Clear wavy to-
B23	.60 to 1.30 m	Dark greyish yellow (2.5Y5/2); medium heavy clay; strong 10-20mm lenticular; common distinct other cutans; dry; very strong; very few fine manganiferous nodules. Gradual wavy to-
B24	1.30 to 1.80 m	Greyish yellow (2.5Y6/2); medium clay; strong 200-500mm lenticular tertiary, parting to strong 10-20mm lenticular primary; many prominent other cutans; dry; very strong; very few fine manganiferous nodules.

Depth	1:5 Soil/Water pH @ 40C	EC dS/m @ 40C	Cl % @105C	Particle Size CS %	FS %	S %	C % @ 105C	Exch. Cations CEC m.eq/100g @ 105C	Ca m.eq/100g @ 105C	Mg m.eq/100g @ 105C	Na m.eq/100g @ 105C	K m.eq/100g @ 105C	Total Elements P % @ 80C	K % @ 80C	S % @ 80C	Moistures ADM	33* % @ 105C	1500* % @ 105C	Disp.Ratio R1 @ 40C	R2	Exch Exch ECEC Al m.eq/100g @ 105C	Acid m.eq/100g @ 105C	pH CaCl2 @ 40C
metres																							
0.10	6.1	.03	.002	7	38	20	39	17	2.4	4.6	.47	.39	0.02	0.46	0.01	2.8	25	11	.50				
0.30	6.2	.10	.013	5	30	18	53	22	6.1	9.6	1.8	.11	0.01	0.44	0.01	6.6	27	16	.76				
0.60	6.1	.47	.067	4	29	21	50	21	5.7	9.2	3.3	.08	0.01	0.47	0.01	3.7	30	16	.96				
0.90	8.3	.71	.091	3	20	17	61	29	9.5	15	5.8	.11	0.01	0.50	0.01	6.6	38	20	1.0				
1.20	7.4	.68	.063	2	24	21	53	25	7.5	13	5.7	.12	0.01	0.38	0.01	5.1	38	20	1.0				
1.50	7.5	.54	.070	3	25	15	56	27	7.3	14	5.9	.14	0.01	0.33	0.01	4.9	35	19	1.0				
1.80	7.5	.52	.067	3	25	15	56	25	7.4	13	5.9	.11				5.6	36	19	1.0				

Depth	Org.C (W&B) % @ 105C	Tot.N % @ 105C	Extr. P Acid mg/kg @ 105C	Bicarb. mg/kg	HCl K meq% @105C	CaCl2 Extr K mg/kg @ 105C	P mg/kg	DTPA-extr. Fe mg/kg @ 105C	Mn mg/kg	Cu mg/kg	Zn mg/kg	B mg/kg	Extractable SO4S mg/kg @ 105C	NO3N mg/kg	NH4N mg/kg	P Buff Cap @ 40C	Equil ug/L	Alternative Cations CEC m.eq/100g @ 105C	Ca m.eq/100g @ 105C	Mg m.eq/100g @ 105C	Na m.eq/100g @ 105C	K m.eq/100g @ 105C
metres																						
0.10	1.0	.08	3	6	.34			186	119	3.1	1.5											

* -33kPa (-0.33bar) and -1500kPa (-15 bar) using pressure plate apparatus.
Cation method: ?
Alternative cation method: ?
ECEC METHOD: ?
CEC methods: ?
Alternative CEC method: ?

SOIL TYPE: 2UGC
SITE NO: S2A
A.M.G. REFERENCE: 520 760 mE 7 806 280 mN ZONE 55

GREAT SOIL GROUP: Grey clay
PRINCIPAL PROFILE FORM: Ug3.2
SOIL TAXONOMY UNIT: Entic Chromustert
FAO UNESCO UNIT: Chromic Vertisol

TYPE OF MICRORELIEF: Normal gilgai
VERTICAL INTERVAL: .20 m
HORIZONTAL INTERVAL: 12 m
COMPONENT OF MICRORELIEF SAMPLED: Mound

SUBSTRATE MATERIAL:
CONFIDENCE SUBSTRATE IS PARENT MATERIAL:

SLOPE:
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

VEGETATION
STRUCTURAL FORM: Mid-high woodland
DOMINANT SPECIES: Eucalyptus tessellaris, Eucalyptus alba, Melaleuca viridiflora, Bothriochloa species, Dichanthium species

ANNUAL RAINFALL:

PROFILE MORPHOLOGY:

CONDITION OF SURFACE SOIL WHEN DRY: Hard setting, periodic cracking

HORIZON	DEPTH	DESCRIPTION
ASb	0 to .10 m	Greyish yellow-brown (10YR5/2) moist, dull yellowish orange (10YR7/2) dry; few medium distinct brown mottles; light medium clay; weak 5-10mm subangular blocky; dry; very firm. Abrupt wavy to-
B21	.10 to .40 m	Dark greyish yellow (2.5Y5/2); few medium faint brown mottles; medium clay; strong 5-10mm subangular blocky; dry; very strong; very few medium manganiferous veins. Clear wavy to-
B22n	.40 to .60 m	Dark greyish yellow (2.5Y5/2); few medium faint brown mottles; medium clay; strong 10-20mm lenticular; common faint other cutans; dry; very strong; few medium manganiferous nodules. Clear wavy to-
B23	.60 to 1.50 m	Dark greyish yellow (2.5Y5/2); medium clay; strong 50-100mm lenticular secondary, parting to strong 10-20mm lenticular primary; many prominent other cutans; dry; very strong; very few medium manganiferous nodules. Diffuse smooth to-
B24	1.50 to 1.80 m	Dull yellowish orange (10YR6/3); medium clay; strong 50-100mm lenticular secondary, parting to strong 10-20mm lenticular primary; many prominent other cutans; dry; moderately strong; very few medium manganiferous nodules.

Depth	1:5 Soil/Water pH	EC	Cl	Particle Size CS	FS	S	C	Exch. Cations CEC	Ca	Mg	Na	K	Total Elements P	K	S	Moistures ADM	33*	1500*	Disp.Ratio R1	R2	Exch Al	Exch Acid	ECEC	pH CaCl2
metres	@ 40C	dS/m @105C	% @105C	% @ 105C				m.eq/100g @ 105C					% @ 80C			% @ 105C			@ 40C		m.eq/100g @ 105C			@ 40C
B 0.10	6.5	.04	.004	6	24	16	55									3.5	29	16	.51					
0.10	6.3	.02	.001	4	18	19	65	88	5.4	8.8	1.0	.40	0.01	0.37	0.01	4.3	29	17	.47					
0.30	6.8	.06	.006	3	16	18	64	24	7.4	11	1.7	.09	0.01	0.35	0.01	7.1	33	19	.85					
0.60	7.0	.24	.035	3	16	17	63	26	7.5	12	3.5	.10	0.01	0.36	0.01	4.6	38	20	1.0					
0.90	7.0	.50	.078	2	16	23	62	26	7.3	12	4.6	.09	0.01	0.37	0.01	5.4	37	20	.95					
1.20	7.0	.68	.089	1	15	20	62	26	7.0	12	5.8	.12	0.01	0.38	0.01	4.7	36	20	1.0					
1.50	6.9	.93	.133	2	15	18	66	28	7.1	12	6.2	.12	0.01	0.35	0.01	6.2			.94					
1.80	6.8	.94	.126	1	15	17	69	28	7.2	13	6.6	.14				5.3			.96					

Depth	Org.C (W&B)	Tot.N	Extr. P Acid	Bicarb.	HCl K	CaCl2 Extr K	P	DTPA-extr. Fe	Mn	Cu	Zn	B	Extractable SO4S	NO3N	NH4N	P Buff Cap	Equil ug/L	Alternative Cations CEC	Ca	Mg	Na	K
metres	% @ 105C	% @ 105C	mg/kg @ 105C		meq% @105C	mg/kg @ 105C		mg/kg @ 105C					mg/kg @ 105C				@ 40C	m.eq/100g @ 105C				
B 0.10	0.8	.06	1	4	.23			83	76	2.5	0.7											
0.10	0.9	.06	1	3	.32			107	117	2.9	0.6											

* -33kPa (~0.33bar) and -1500kPa (~15 bar) using pressure plate apparatus.
Cation method: ?
Alternative cation method: ?
ECEC METHOD: ?
CEC methods: ?
Alternative CEC method: ?

SOIL TYPE: 2UGC
SITE NO: S2B
A.M.G. REFERENCE: 520 760 mE 7 806 280 mN ZONE 55

GREAT SOIL GROUP: Grey clay
PRINCIPAL PROFILE FORM: Ug3.2
SOIL TAXONOMY UNIT: Entic Chromustert
FAO UNESCO UNIT: Chromic Vertisol

TYPE OF MICRORELIEF: Normal gilgai
VERTICAL INTERVAL: .20 m
HORIZONTAL INTERVAL: 12 m
COMPONENT OF MICRORELIEF SAMPLED: Depression

SUBSTRATE MATERIAL:
CONFIDENCE SUBSTRATE IS PARENT MATERIAL:

SLOPE:
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

VEGETATION
STRUCTURAL FORM: Mid-high woodland
DOMINANT SPECIES: Eucalyptus tessellaris, Eucalyptus alba, Melaleuca viridiflora, Bothriochloa species, Dichanthium species

ANNUAL RAINFALL:

PROFILE MORPHOLOGY:

CONDITION OF SURFACE SOIL WHEN DRY: Hard setting, periodic cracking

HORIZON	DEPTH	DESCRIPTION
ASb	0 to .10 m	Greyish yellow-brown (10YR5/2) moist, dull yellowish orange (10YR7/2) dry; common coarse prominent brown mottles; silty clay; massive; dry; moderately weak. Abrupt tongued to-
B21	.10 to .40 m	Greyish yellow-brown (10YR5/2); few medium distinct brown mottles; medium clay; strong 5-10mm subangular blocky; dry; very strong; few medium ferromanganiferous nodules. Clear smooth to-
B22	.40 to .80 m	Greyish yellow-brown (10YR5/2); medium clay; strong 5-10mm subangular blocky; dry; very strong; few medium ferromanganiferous nodules. Clear smooth to-
B23	.80 to 1.40 m	Greyish yellow-brown (10YR5/2); medium clay; strong 20-50mm lenticular secondary, parting to strong 5-10mm lenticular primary; common faint other cutans; dry; very strong; few medium ferromanganiferous nodules. Diffuse smooth to-
B24	1.40 to 1.80 m	Dull yellowish orange (10YR6/3); medium clay; strong 50-100mm lenticular secondary, parting to strong 5-10mm lenticular primary; many prominent other cutans; moderately moist; moderately strong; few medium ferromanganiferous veins.

Depth	1:5 Soil/Water			Particle Size				Exch. Cations					Total Elements			Moistures			Disp.Ratio		Exch	Exch	ECEC	pH
	pH	EC	Cl	CS	FS	S	C	CEC	Ca	Mg	Na	K	P	K	S	ADM	33*	1500*	R1	R2	Al	Acid		CaCl2
metres		dS/m	%	%				m.eq/100g					%			%					m.eq/100g			
	@ 40C		@105C	@ 105C				@ 105C					@ 80C			@ 105C			@ 40C		@ 105C			@ 40C
0.10	5.9	.03	.003	6	26	21	47	21	3.1	4.3	.51	.35	0.03	0.44	0.01	3.2	27	15	.30					
0.30	6.4	.02	.002	3	18	15	66	24	6.4	7.8	1.2	.15	0.01	0.37	0.01	5.0	30	18	.44					
0.60	6.0	.24	.036	6	27	18	50	19	7.1	7.3	2.2	.07	0.01	0.39	0.01	3.8	29	16	.92					
0.90	6.0	.44	.065	5	26	20	51	20	5.0	7.9	3.3	.08	0.01	0.39	0.01	3.5	29	17	.96					
1.20	5.9	.67	.089	3	22	21	56	24	5.8	9.8	4.8	.13	0.01	0.36	0.01	4.7	34	19	.98					
1.50	5.9	.83	.121	2	17	14	64	24	5.7	10	5.5	.14	0.01	0.33	0.01	5.6								
1.80	5.8	.90	.132	2	16	16	63	29	6.1	12	5.9	.14				5.8								

Depth	Org.C	Tot.N	Extr. P		HCl	CaCl2 Extr		DTPA-extr.					Extractable			P		Alternative Cations				
	(W&B)		Acid	Bicarb.	K	K	P	Fe	Mn	Cu	Zn	B	SO4S	NO3N	NH4N	Buff Cap	Equil	CEC	Ca	Mg	Na	K
metres	%	%	mg/kg		meq%	mg/kg		mg/kg					mg/kg				ug/L	m.eq/100g				
	@ 105C	@ 105C	@ 105C		@105C	@ 105C		@ 105C					@ 105C			@ 40C		@ 105C				
0.10	1.0	.11	4	13	.29			209	151	3.7	1.7											

* -33kPa (-0.33bar) and -1500kPa (-15 bar) using pressure plate apparatus.
Cation method: ?
CEC methods: ?
Alternative cation method: ?
Alternative CEC method: ?
ECEC METHOD: ?

SOIL TYPE: 2UGD2
SITE NO: S3A
A.M.G. REFERENCE: 518 710 mE 7 806 390 mN ZONE 55

GREAT SOIL GROUP: Grey clay
PRINCIPAL PROFILE FORM: Ug3.2
SOIL TAXONOMY UNIT: Entic Chromustert
FAO UNESCO UNIT: Chromic Vertisol

TYPE OF MICRORELIEF: Normal gilgai
VERTICAL INTERVAL: .22 m
HORIZONTAL INTERVAL: 12 m
COMPONENT OF MICRORELIEF SAMPLED: Mound

SUBSTRATE MATERIAL:
CONFIDENCE SUBSTRATE IS PARENT MATERIAL:

SLOPE:
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

VEGETATION
STRUCTURAL FORM: Mid-high woodland
DOMINANT SPECIES: Eucalyptus alba, Bothriochloa species, Dichanthium species

ANNUAL RAINFALL:

PROFILE MORPHOLOGY:

CONDITION OF SURFACE SOIL WHEN DRY: Periodic cracking, hard setting

HORIZON	DEPTH	DESCRIPTION
ASb	0 to .10 m	Greyish yellow-brown (10YR5/2) moist, dull yellowish orange (10YR7/2) dry; common fine prominent orange mottles; light medium clay; weak 5-10mm subangular blocky; dry; very firm; very few fine ferromanganiferous nodules. Clear wavy to-
B21	.10 to .40 m	Greyish yellow-brown (10YR5/2); few medium faint yellow mottles; light medium clay; strong 10-20mm subangular blocky; dry; moderately strong; very few medium ferromanganiferous nodules. Clear tongued to-
B22	.40 to 1.00 m	Dark greyish yellow (2.5Y4/2); light medium clay; strong 20-50mm lenticular secondary, parting to strong 5-10mm lenticular primary; common distinct other cutans; dry; very strong; very few medium ferromanganiferous nodules. Clear wavy to-
B23k	1.00 to 1.10 m	Dull yellowish brown (10YR5/3); few medium faint yellow mottles; light medium clay; strong 20-50mm subangular blocky parting to strong 5-10mm subangular blocky; dry; moderately strong; few medium carbonate nodules, very few medium ferromanganiferous nodules. Clear smooth to-
B3?	1.10 to 1.30 m	Dull yellowish orange (10YR6/4); sandy clay; moderate 20-50mm subangular blocky; dry; very firm. Sharp smooth to-
D1cb	1.30 to 1.40 m	Orange (7.5YR6/6) moist, light yellowish orange (7.5YR8/4) dry; sand; single grain; dry; loose. Sharp smooth to-
D2	1.40 to 1.60 m	Bright reddish brown (5YR5/6); loamy sand; massive; dry; moderately firm; very few medium manganiferous soft segregations, very few fine manganiferous nodules. Sharp wavy to-
D3	1.60 to 1.80 m	Fine sandy light medium clay; strong 20-50mm subangular blocky; dry; moderately strong. Sharp wavy to-
D4n	1.80 to 2.00 m	Fine sandy clay; strong 5-10mm subangular blocky; dry; moderately strong; few fine manganiferous soft segregations.

Depth	1:5 Soil/Water pH @ 40C	EC dS/m @ 40C	Cl % @105C	Particle Size CS FS S C % @ 105C	Exch. Cations CEC Ca Mg Na K m.eq/100g @ 105C	Total Elements P K S % @ 80C	Moistures ADM 33* 1500* % @ 105C	Disp.Ratio R1 R2 @ 40C	Exch Exch ECEC Al Acid m.eq/100g @ 105C	pH CaCl2 @ 40C
B 0.10	6.2	.03	.003	11 19 19 51			4.9 29 16	.44		
0.10	6.1	.03	.002	18 18 15 48	25 6.3 6.2 .48 .67	0.02 1.50 0.02	4.8 30 16	.48		
0.30	6.5	.02	.002	10 14 14 64	29 9.7 8.9 .90 .41	0.01 1.37 0.01	5.2 32 20	.48		
0.60	7.3	.14	.017	10 15 18 57	28 12 12 2.4 .20	0.01 1.37 0.01	5.4 33 18	.84		
0.90	8.3	.17	.018	10 13 16 60	30 13 13 3.2 .18	0.01 1.31 0.01	6.2			
1.20	9.0	.22	.011	42 15 7 33	18 7.3 7.0 1.7 .08	0.01 1.81 0.01	3.3			
1.40	8.4	.05	.005							
1.50	8.1	.14	.018			0.01 2.26 0.01				
1.60	8.2	.12	.013	53 26 3 16			2.4			
1.70	8.1	.15	.023							
1.80	7.8	.26	.033							
1.90	7.9	.25	.033	3 40 28 35			4.4			

Depth	Org.C (W&B) % @ 105C	Tot.N % @ 105C	Extr. P Acid Bicarb. mg/kg @ 105C	HCl K meq% @105C	CaCl2 Extr K mg/kg @ 105C	P mg/kg	DTPA-extr. Fe Mn Cu Zn mg/kg @ 105C	B	Extractable SO4S NO3N NH4N mg/kg @ 105C	P Buff Cap @ 40C Equil ug/L	Alternative Cations CEC Ca Mg Na K m.eq/100g @ 105C
B 0.10	0.7	.06	3 6	.55		108	71 2.6 1.0				
0.10	1.4	.12	5 8	.59		183	67 2.2 1.4				

* -33kPa (-0.33bar) and -1500kPa (-15 bar) using pressure plate apparatus.
Cation method: ?
Alternative cation method: ?
ECEC METHOD: ?
CEC methods: ?
Alternative CEC method: ?

SOIL TYPE: 2UGD2
SITE NO: S3B
A.M.G. REFERENCE: 518 710 mE 7 806 390 mN ZONE 55

GREAT SOIL GROUP: No suitable group
PRINCIPAL PROFILE FORM: Ug2.
SOIL TAXONOMY UNIT: Entic Chromustert
FAO UNESCO UNIT: Chromic Vertisol

TYPE OF MICRORELIEF: Normal gilgai
VERTICAL INTERVAL: .22 m
HORIZONTAL INTERVAL: 12 m
COMPONENT OF MICRORELIEF SAMPLED: Depression

SUBSTRATE MATERIAL:
CONFIDENCE SUBSTRATE IS PARENT MATERIAL:

SLOPE:
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

VEGETATION
STRUCTURAL FORM: Mid-high woodland
DOMINANT SPECIES: Eucalyptus alba, Bothriochloa species, Dichanthium species

ANNUAL RAINFALL:

PROFILE MORPHOLOGY:

CONDITION OF SURFACE SOIL WHEN DRY: Periodic cracking, hard setting

HORIZON	DEPTH	DESCRIPTION
ACb	0 to .12 m	Greyish yellow-brown (10YR6/2) moist, dull yellowish orange (10YR7/2) dry; few fine prominent orange mottles; light clay; massive; many fine macropores; dry; very firm. Clear tongued to-
B21	.12 to .40 m	Greyish yellow-brown (10YR4/2); few medium distinct yellow mottles; light medium clay; strong 10-20mm subangular blocky; dry; very strong. Clear wavy to-
B22	.40 to .80 m	Dull yellowish brown (10YR5/3); light medium clay; strong 5-10mm subangular blocky; dry; very strong. Clear tongued to-
B23k	.80 to 1.10 m	Dull yellowish brown (10YR5/3); medium clay; strong 20-50mm subangular blocky; dry; moderately strong; few medium carbonate nodules. Abrupt wavy to-
D1	1.10 to 1.25 m	Bright brown (7.5YR5/6); clayey sand; very few coarse pebbles, subrounded gravel; massive; dry; very firm. Clear smooth to-
D2	1.25 to 1.50 m	Orange (7.5YR6/6); sandy loam; massive; dry; very firm. Sharp smooth to-
D3n	1.50 to 1.80 m	Dull yellowish brown (10YR4/3); few medium faint brown mottles; sandy clay; strong 10-20mm subangular blocky; dry; moderately strong; few medium manganiferous soft segregations.

Depth	1:5 Soil/Water pH	EC	Cl	Particle Size CS	FS	S	C	Exch. Cations CEC	Ca	Mg	Na	K	Total Elements P	K	S	Moistures ADM	33*	1500*	Disp.Ratio R1	R2	Exch Al	Exch Acid	ECEC	pH CaCl2
metres	@ 40C	dS/m	@105C	% @ 105C				m.eq/100g @ 105C					% @ 80C			% @ 105C			@ 40C		m.eq/100g @ 105C			@ 40C
0.12	5.9	.05	.004	12	31	31	33	18	3.8	3.4	.28	.49	0.02	1.57	0.02	2.4								
0.30	6.6	.07	.008	11	27	21	42	21	7.5	6.3	1.2	.19	0.02	1.41	0.01	3.9	27	15	.85					
0.60	6.8	.18	.034	13	31	23	39	19	6.8	6.6	2.6	.11	0.01	1.43	0.01	2.9	25	14	.90					
0.90	8.7	.41	.040	14	24	20	44	23	9.7	9.2	4.0	.21	0.01	1.53	0.01	4.0	28		.83					
1.20	8.5	.17	.019					10	4.2	4.1	2.3	.10	0.02	2.07	0.01									
1.40	8.5	.14	.015	76	7	1	14	8	3.5	3.8	1.9	.10				1.8	13	07	1.0					
1.50	8.4	.12	.015					6	2.7	3.1	1.2	.08	0.02	2.10	0.01									
1.60	8.3	.27	.034					21	7.9	8.8	3.4	.11												
1.70	8.3	.27	.032	15	31	23	32	21	7.7	8.3	3.5	.18				3.2								
1.80	8.5	.20	.035	34	23	17	27	15	5.7	6.4	2.7	.08				4.4								

Depth	Org.C (W&B)	Tot.N	Extr. P Acid	Bicarb.	HCl K	CaCl2 Extr K	P	DTPA-extr. Fe	Mn	Cu	Zn	B	Extractable SO4S	NO3N	NH4N	P Buff Cap	Equil ug/L	Alternative Cations CEC	Ca	Mg	Na	K
metres	% @ 105C	% @ 105C	mg/kg @ 105C		meq% @105C	mg/kg @ 105C		mg/kg @ 105C					mg/kg @ 105C			@ 40C		m.eq/100g @ 105C				
0.12	1.5	.13	8	11	.54			287	54	3.0	1.8											

* -33kPa (-0.33bar) and -1500kPa (-15 bar) using pressure plate apparatus.
Cation method: ?
CEC methods: ?
Alternative cation method: ?
Alternative CEC method: ?
ECEC METHOD: ?

SOIL TYPE: 2DDB
SITE NO: S4
A.M.G. REFERENCE: 518 240 mE 7 806 440 mN ZONE 55

GREAT SOIL GROUP: Solodic soil
PRINCIPAL PROFILE FORM: Dy2.33
SOIL TAXONOMY UNIT: Typic Natrustalf
FAO UNESCO UNIT: Solodic Planosol

SUBSTRATE MATERIAL:
CONFIDENCE SUBSTRATE IS PARENT MATERIAL:

SLOPE:
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

VEGETATION
STRUCTURAL FORM: Mid-high isolated trees
DOMINANT SPECIES: Eucalyptus alba, Grevillea striata, Eucalyptus tessellaris, Acacia bidwillii, Grevillea striata, Bothriochloa species

ANNUAL RAINFALL:

PROFILE MORPHOLOGY:

CONDITION OF SURFACE SOIL WHEN DRY: Hard setting

HORIZON	DEPTH	DESCRIPTION
ASb	0 to .08 m	Dull yellowish brown (10YR5/3) moist, dull yellowish orange (10YR7/3) dry; few medium distinct brown mottles; clay loam,fine sandy; massive; many fine macropores; dry; very firm. Clear wavy to-
B21t	.08 to .30 m	Dark greyish yellow (2.5Y4/2); medium heavy clay; strong 20-50mm subangular blocky parting to strong 2-5mm subangular blocky; dry; very strong. Clear wavy to-
B22tk	.30 to .90 m	Dark greyish yellow (2.5Y4/2); medium heavy clay; strong 20-50mm subangular blocky parting to strong 2-5mm subangular blocky; dry; very strong; few medium carbonate nodules. Diffuse smooth to-
D	.90 to 1.80 m	Dull brown (7.5YR5/4); light clay; strong 10-20mm subangular blocky; dry; very firm.

Depth	1:5 Soil/Water pH	EC	Cl	Particle Size CS	FS	S	C	Exch. Cations CEC	Ca	Mg	Na	K	Total Elements P	K	S	Moistures ADM	33*	1500*	Disp.Ratio R1	R2	Exch Al	Exch Acid	ECEC	pH CaCl2
metres	@ 40C	dS/m @105C	%	% @ 105C				m.eq/100g @ 105C					% @ 80C			% @ 105C			@ 40C		m.eq/100g @ 105C			@ 40C
B 0.10	6.9	.03	.001	14	27	21	41									3.6	25	12	.59					
0.08	6.9	.03	.002	17	35	23	30	14	2.3	3.4	1.1	.44	0.02	1.50	0.01	2.0	23	10	.63					
0.30	8.3	.16	.019	6	13	15	66	28	10	12	4.7	.24	0.03	1.26	0.01	4.8	36	20	.84					
0.60	9.0	.71	.070	7	14	21	57	27	9.1	10	7.7	.16	0.01	1.30	0.02	4.8	34	18	.96					
0.90	9.2	.85	.088	7	17	24	54	27	8.4	10	9.2	.14	0.01	1.42	0.02	9.5	37	19	1.0					
1.20	9.1	.62	.066	17	20	24	39	23	6.9	9.2	9.0	.18	0.02	1.78	0.01	3.4	32	16	.90					
1.50	8.8	.48	.059	13	22	27	41						0.04	1.82	0.01	4.2								

Depth	Org.C (W&B)	Tot.N	Extr. P Acid	Bicarb.	HCl K	CaCl2 Extr K	P	DTPA-extr. Fe	Mn	Cu	Zn	B	Extractable SO4S	NO3N	NH4N	P Buff Cap	Equil ug/L	Alternative Cations CEC	Ca	Mg	Na	K
metres	% @ 105C	% @ 105C	mg/kg @ 105C		meq% @105C	mg/kg @ 105C		mg/kg @ 105C					mg/kg @ 105C			@ 40C		m.eq/100g @ 105C				
B 0.10	1.0	.09	2	4	.37			86	55	1.8	0.7											
0.08	1.1	.08	2	4	.43			102	60	1.9	1.1											

* -33kPa (-0.33bar) and -1500kPa (-15 bar) using pressure plate apparatus.
Cation method: ?
CEC methods: ?
Alternative cation method: ?
Alternative CEC method: ?
ECEC METHOD: ?

SOIL TYPE: 6DDA
SITE NO: S5
A.M.G. REFERENCE: 517 620 mE 7 804 440 mN ZONE 55

GREAT SOIL GROUP: Solodic soil
PRINCIPAL PROFILE FORM: Dd1.43
SOIL TAXONOMY UNIT: Typic Natrustalf
FAO UNESCO UNIT: Solodic Planosol

SUBSTRATE MATERIAL:
CONFIDENCE SUBSTRATE IS PARENT MATERIAL:

SLOPE:
LANDFORM ELEMENT TYPE: Prior stream
LANDFORM PATTERN TYPE:

VEGETATION
STRUCTURAL FORM: Dwarf trees
DOMINANT SPECIES: Eucalyptus papuana, Grevillea striata, Bothriochloa species, Dichanthium species

ANNUAL RAINFALL:

PROFILE MORPHOLOGY:

CONDITION OF SURFACE SOIL WHEN DRY: Hard setting

HORIZON	DEPTH	DESCRIPTION
A1sb	0 to .15 m	Greyish yellow-brown (10YR6/2) moist, light grey (10YR8/1) dry, dry sporadically bleached; few fine faint brown mottles; loam, fine sandy; massive; dry; moderately weak. Abrupt wavy to-
A2cb	.15 to .18 m	Greyish yellow-brown (10YR6/2) moist, light grey (10YR8/1) dry; few fine faint brown mottles; loam, fine sandy; massive; dry; moderately weak. Abrupt wavy to-
B21t	.18 to .50 m	Brownish black (10YR3/1); medium clay; strong 10-20mm subangular blocky; dry; moderately strong; very few fine ferromanganiferous nodules. Clear tongued to-
B22tk	.50 to .70 m	Greyish yellow-brown (10YR5/2); medium clay; strong 10-20mm subangular blocky; dry; very firm; few medium carbonate nodules, few medium manganiferous nodules. Clear wavy to-
D1	.70 to 1.00 m	Dull yellowish brown (10YR5/3); light medium clay; strong 10-20mm prismatic secondary, parting to strong 2-5mm subangular blocky primary; dry; moderately strong; very few medium carbonate nodules, very few fine ferromanganiferous nodules. Clear wavy to-
D2	1.00 to 1.80 m	Dull yellowish brown (10YR5/3); few fine distinct brown mottles; light medium clay; strong 10-20mm prismatic secondary, parting to strong 2-5mm subangular blocky primary; few faint clay skins; many fine macropores; dry; moderately strong; very few medium manganiferous veins.

Depth (metres)	1:5 Soil/Water pH @ 40C	EC dS/m @105C	Cl % @105C	Particle Size CS FS S C % @ 105C	Exch. Cations CEC Ca Mg Na K m.eq/100g @ 105C	Total Elements P K S % @ 80C	Moistures ADM 33* 1500* % @ 105C	Disp.Ratio R1 R2 @ 40C	Exch Exch ECEC Al Acid m.eq/100g @ 105C	pH CaCl2 @ 40C
B 0.10	6.8	.04	.003	7 45 29 23			2.7 29 10	.68		
0.10	6.3	.03	.003	5 42 37 20	16 3.4 3.1 .48 .28	0.02 1.42 0.01	1.9 32 10	.68		
0.30	7.6	.15	.016	3 20 27 53	34 15 12 4.5 .10	0.01 1.34 0.01	6.7 38 19	.83		
0.60	8.9	.42	.036	3 18 25 53	32 18 13 6.8 .12	0.04 1.52 0.02	5.7 40 20	.84		
0.90	8.5	.39	.040	2 25 29 46	30 15 11 5.6 .21	0.07 1.78 0.01	5.4 35 18	.74		
1.20	8.1	.28	.034	2 33 28 28	25 12 9.0 4.8 .26	0.05 1.83 0.01	4.0 34 17	.79		
1.50	8.1	.21	.026	2 44 19 34		0.03 1.87 0.01	3.5			

Depth (metres)	Org.C (W&B) % @ 105C	Tot.N % @ 105C	Extr. P Acid mg/kg @ 105C	Extr. P Bicarb. mg/kg @ 105C	HCl K meq% @105C	CaCl2 Extr K mg/kg @ 105C	CaCl2 Extr P mg/kg @ 105C	DTPA-extr. Fe mg/kg @ 105C	DTPA-extr. Mn mg/kg @ 105C	DTPA-extr. Cu mg/kg @ 105C	DTPA-extr. Zn mg/kg @ 105C	DTPA-extr. B mg/kg @ 105C	Extractable SO4S mg/kg @ 105C	Extractable NO3N mg/kg @ 105C	Extractable NH4N mg/kg @ 105C	P Buff Cap @ 40C	P Equil ug/L	Alternative Cations CEC m.eq/100g @ 105C	Alternative Cations Ca m.eq/100g @ 105C	Alternative Cations Mg m.eq/100g @ 105C	Alternative Cations Na m.eq/100g @ 105C	Alternative Cations K m.eq/100g @ 105C
B 0.10	1.3	.09	6	7	.63			83	82	1.7	1.7											
0.10	1.2	.08	2	5	.31			124	121	1.5	1.7											

* -33kPa (-0.33bar) and -1500kPa (-15 bar) using pressure plate apparatus.
Cation method: ?
Alternative cation method: ?
ECEC METHOD: ?
CEC methods: ?
Alternative CEC method: ?

SOIL TYPE: 2DDB
SITE NO: S7
A.M.G. REFERENCE: 514 600 mE 7 805 020 mN ZONE 55

GREAT SOIL GROUP: Solodic soil
PRINCIPAL PROFILE FORM: Dy2.33
SOIL TAXONOMY UNIT: Typic Natrustalf
FAO UNESCO UNIT: Solodic Planosol

SUBSTRATE MATERIAL:
CONFIDENCE SUBSTRATE IS PARENT MATERIAL:

SLOPE:
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

VEGETATION
STRUCTURAL FORM: Mid-high trees
DOMINANT SPECIES: Eucalyptus papuana, Grevillea striata, Cryptostegia grandiflora, Acacia farnesiana, Chloris species, Bothriochloa species

ANNUAL RAINFALL:

PROFILE MORPHOLOGY:

CONDITION OF SURFACE SOIL WHEN DRY: Hard setting

HORIZON	DEPTH	DESCRIPTION
ASb	0 to .08 m	Dull yellowish orange (10YR6/3) moist, dull yellowish orange (10YR7/2) dry; few medium faint orange mottles; clay loam,fine sandy; massive; dry; moderately firm. Sharp wavy to-
B21t	.08 to .30 m	Dark greyish yellow (2.5Y4/2); medium clay; strong 20-50mm prismatic tertiary, parting to 5-10mm subangular blocky primary; dry; very strong; very few medium ferromanganiferous nodules. Clear smooth to-
B22t	.30 to .80 m	Dull yellowish brown (10YR5/3); medium clay; strong 20-50mm prismatic secondary, parting to 5-10mm subangular blocky primary; dry; very strong; few medium carbonate nodules, very few medium ferromanganiferous nodules. Clear smooth to-
D1	.80 to 1.30 m	Dull brown (7.5YR5/4); fine sandy light medium clay; strong 20-50mm subangular blocky secondary, parting to 2-5mm subangular blocky primary; dry; moderately strong; few medium carbonate nodules, very few fine manganiferous nodules. Gradual wavy to-
D2	1.30 to 1.50 m	Dull yellowish orange (10YR6/3); common coarse distinct brown mottles; fine sandy clay; strong 5-10mm prismatic secondary, parting to 2-5mm subangular blocky primary; few faint clay skins; dry; moderately strong; few medium carbonate tubules, few medium manganiferous soft segregations. Gradual wavy to-
D3	1.50 to 1.90 m	Light yellow (2.5Y7/3); fine sandy clay; moderate 20-50mm subangular blocky; common distinct clay skins; dry; very strong; few medium carbonate nodules, few medium manganiferous veins.

Depth	1:5 Soil/Water pH	EC	Cl	Particle Size CS	FS	S	C	Exch. Cations CEC	Ca	Mg	Na	K	Total Elements P	K	S	Moistures ADM	33*	1500*	Disp.Ratio R1	R2	Exch Al	Exch Acid	ECEC	pH CaCl2
metres	@ 40C	dS/m @105C	% @105C	% @ 105C				m.eq/100g @ 105C					% @ 80C			% @ 105C			@ 40C		m.eq/100g @ 105C			@ 40C
B 0.10	6.7	.11	.013	8	39	20	34									3.8	26	12	.77					
0.08	6.2	.05	.005	9	51	22	21	12	2.2	3.5	.71	.14	0.01	1.13	0.01	1.6	20	07	.74					
0.30	8.8	.68	.079	6	39	19	45	25	8.7	10	6.9	.08	0.01	1.10	0.02	4.9	30	16	.98					
0.60	9.0	1.1	.137	4	24	22	52	30	8.5	12	12	.14	0.01	1.28	0.01	5.4	36	19	.99					
0.90	9.0	1.1	.137	23	34	13	30	28	8.4	12	12	.19	0.02	1.55	0.01	5.1	37	19	1.0					
1.20	8.9	.63	.076	23	40	8	27	15	4.1	5.6	5.8	.10	0.01	1.02	0.01	2.8	24	11	.98					
1.50	8.9	.47	.056	53	26	3	16	14	3.7	5.5	5.3	.07	0.01	0.67	0.01	3.1								
1.80	9.0	.51	.056	20	38	21	20	19	4.7	6.8	6.4	.09				3.4								

Depth	Org.C (W&B) % @ 105C	Tot.N % @ 105C	Extr. P Acid mg/kg @ 105C	Bicarb.	HCl K meq% @105C	CaCl2 Extr K mg/kg @ 105C	P	DTPA-extr. Fe	Mn	Cu	Zn	B mg/kg @ 105C	Extractable SO4S	NO3N	NH4N mg/kg @ 105C	P Buff Cap @ 40C	Equil ug/L	Alternative Cations CEC	Ca	Mg	Na	K m.eq/100g @ 105C
metres																						
B 0.10	0.6	.08	1	2	.11			67	91	2.4	0.5											
0.08	0.6	.06	3	4	.17			112	62	1.8	0.6											

* -33kPa (-0.33bar) and -1500kPa (-15 bar) using pressure plate apparatus.
Cation method: ?
CEC methods: ?
Alternative cation method: ?
Alternative CEC method: ?
ECEC METHOD: ?

SOIL TYPE: 5DYC
SITE NO: S9
A.M.G. REFERENCE: 520 880 mE 7 802 750 mN ZONE 55

GREAT SOIL GROUP: Solodic soil
PRINCIPAL PROFILE FORM: Dy2.43
SOIL TAXONOMY UNIT: Mollic Natrustalf
FAO UNESCO UNIT: Solodic Planosol

SURFACE COARSE FRAGMENTS: Very few coarse pebbles, angular unspecified coarse fragments

SUBSTRATE MATERIAL:
CONFIDENCE SUBSTRATE IS PARENT MATERIAL: Almost certain or certain

SLOPE: 01 %
LANDFORM ELEMENT TYPE: Lower slope
LANDFORM PATTERN TYPE:

VEGETATION
STRUCTURAL FORM: Mid-high woodland
DOMINANT SPECIES: *Eucalyptus alba, Eucalyptus papuana, Dichanthium* species, Bothriochloa species

ANNUAL RAINFALL:

PROFILE MORPHOLOGY:

CONDITION OF SURFACE SOIL WHEN DRY: Hard setting

HORIZON	DEPTH	DESCRIPTION
A1	0 to .22 m	Brownish black (10YR3/1); clay loam; very few small pebbles, subrounded; moderate 2-5mm subangular blocky; dry; very firm; few fine ferromanganiferous nodules; common very fine roots.
A2cb	.22 to .25 m	Light grey (10YR7/1) dry; clay loam; very few small pebbles, subrounded; weak <2mm subangular blocky dry; *very firm; few fine ferromanganiferous nodules;* common very fine roots. Sharp to-
B21	.25 to .45 m	Greyish yellow-brown (10YR4/2); medium clay; very few small pebbles, subrounded; strong 50-100mm prismatic tertiary, parting to 5-10mm prismatic primary; *dry; very strong; few fine* ferromanganiferous nodules; few very fine roots. Sharp to-
B22	.45 to .75 m	Brown (7.5YR4/3); medium clay; very few small pebbles, subrounded; strong 5-10mm subangular blocky primary; few faint clay skins; dry; very strong; common medium carbonate nodules, very few fine *carbonate nodules;* few very fine roots. Clear to-
B23	.75 to .90 m	Brown (7.5YR4/4); light medium clay; strong 5-10mm subangular blocky primary; few faint clay skins; dry; very strong; common medium *ferromanganiferous nodules,* very few fine carbonate nodules. Clear to-
BC	.90 to 1.00 m	Clay loam; common medium pebbles, subrounded altered substrate materials; moderate 5-10mm subangular blocky primary; few faint clay skins; dry; moderately strong; few medium ferromanganiferous nodules, very few fine carbonate nodules. Clear to-
C	1.00 to 1.40 m	Abundant coarse pebbles, subrounded altered substrate materials; few medium carbonate soft *segregations.*

Depth	1:5 Soil/Water pH	EC	Cl	Particle Size CS	FS	S	C	Exch. Cations CEC	Ca	Mg	Na	K	Total Elements P	K	S	Moistures ADM 33*	1500*	Disp.Ratio R1	R2	Exch Al	Exch Acid	ECEC	pH CaCl2
metres	@ 40C	dS/m	@105C	% @ 105C				m.eq/100g @ 105C					% @ 80C			% @ 105C		@ 40C		m.eq/100g @ 105C			@ 40C
B 0.10	6.7	.03	.001	19	40	13	28									2.7	27	10	.62				
0.10	6.4	.02	.001	25	43	17	16	19	6.9	4.8	.20	.17	0.03	0.35	0.02	2.2	21	09	.63				
0.25	7.0	.03	.002	26	46	15	15	13	5.1	3.8	.41	.05				1.8	17	07					
0.30	7.3	.10	.009	20	31	15	35	25	10	9.3	2.4	.08	0.01	0.26	0.01	3.8	28	15	.71				
0.60	8.4	.58	.053	14	28	17	41	31	12	14	5.5	.12	0.01	0.23	0.02	4.9	34	18	.72				
1.00	9.0	.82	.087	16	31	16	38	31	11	14	6.5	.07	0.05	0.33	0.02	6.3	36	18	.77				
1.20	9.3	.65	.062	25	32	14	29	29	9.8	13	6.6	.03	0.10	0.47	0.02	5.1	32	15	.63				
1.40	9.3	.67	.061										0.10	0.19	0.01								

Depth	Org.C (W&B)	Tot.N	Extr. P Acid	Bicarb.	HCl K	CaCl2 Extr K	P	DTPA-extr. Fe	Mn	Cu	Zn	B	Extractable SO4S	NO3N	NH4N	P Buff	Equil	Alternative Cations CEC	Ca	Mg	Na	K
metres	% @ 105C	% @ 105C	mg/kg @ 105C		meq% @105C	mg/kg @ 105C		mg/kg @ 105C					mg/kg @ 105C			Cap @ 40C	ug/L	m.eq/100g @ 105C				
B 0.10	1.1	.09	17	9	.46			85	81	1.0	0.9											
0.10	1.1	.08	8	4	.20			76	61	1.3	1.3											

* -33kPa (-0.33bar) and -1500kPa (-15 bar) using pressure plate apparatus.
Cation method: ?
CEC methods: ?
Alternative cation method: ?
Alternative CEC method: ?
ECEC METHOD: ?

SOIL TYPE: 6DBH
SITE NO: S10
A.M.G. REFERENCE: 516 225 mE 7 804 950 mN ZONE 55

GREAT SOIL GROUP: Solodic soil
PRINCIPAL PROFILE FORM: Db1.33
SOIL TAXONOMY UNIT: Typic Natrustalf
FAO UNESCO UNIT: Solodic Planosol

SUBSTRATE MATERIAL:
CONFIDENCE SUBSTRATE IS PARENT MATERIAL:

SLOPE:
LANDFORM ELEMENT TYPE: Prior stream
LANDFORM PATTERN TYPE:

VEGETATION
STRUCTURAL FORM: Mid-high isolated trees
DOMINANT SPECIES: Grevillea striata, Grevillea striata, Heteropogon contortus, Dichanthium species

ANNUAL RAINFALL:

PROFILE MORPHOLOGY:

CONDITION OF SURFACE SOIL WHEN DRY: Hard setting

HORIZON	DEPTH	DESCRIPTION
A1	0 to .12 m	Brown (7.5YR4/3); few fine faint orange mottles; loamy fine sand; weak <2mm platy primary; dry; very firm; common very fine roots.
A2sb	.12 to .15 m	Brown (7.5YR4/3) moist, dry sporadically bleached; few fine faint orange mottles; loamy fine sand; weak <2mm platy primary; dry; moderately firm; common very fine roots. Sharp to-
B21t	.15 to .32 m	Dull yellowish brown (10YR4/3); light medium clay; strong 50-100mm prismatic tertiary, parting to 2-5mm angular blocky primary; dry; very strong; common very fine roots. Sharp to-
B22tk	.32 to .55 m	Brown (7.5YR4/3); light medium clay; strong 2-5mm angular blocky primary; dry; very strong; common medium carbonate nodules; few very fine roots. Clear to-
D1	.55 to .65 m	Brown (7.5YR4/4); light clay; strong 2-5mm angular blocky primary; dry; moderately strong; few medium carbonate nodules; few very fine roots. Clear to-
D2	.65 to .80 m	Dull reddish brown (5YR4/4); fine sandy clay; strong 5-10mm prismatic tertiary; many very fine macropores; dry; moderately strong; few medium carbonate nodules. Clear to-
D3	.80 to 1.20 m	Brown (7.5YR4/4); fine sandy clay; strong 5-10mm prismatic tertiary; many very fine macropores; dry; moderately strong; few medium carbonate nodules. Clear to-
D4	1.20 to 1.50 m	Dull reddish brown (5YR4/4); fine sandy clay; strong 5-10mm prismatic tertiary, parting to 2-5mm angular blocky primary; many very fine macropores; dry; moderately strong; few medium carbonate nodules. Clear to-

Depth	1:5 Soil/Water pH @ 40C	EC dS/m @105C	Cl % @105C	Particle Size CS FS S % @ 105C	C	Exch. Cations CEC Ca Mg Na K m.eq/100g @ 105C	Total Elements P K S % @ 80C	Moistures ADM 33* 1500* % @ 105C	Disp.Ratio R1 R2 @ 40C	Exch Exch ECEC Al Acid m.eq/100g @ 105C	pH CaCl2 @ 40C
B 0.10	6.3	.03	.001	5 49 29	21			1.8 22 08	.61		
0.10	5.7	.13	.011	5 46 31	21	14 2.4 2.7 .33 .62	0.03 1.45 0.02	1.5 24 08	.65		
0.30	8.1	.33	.036	2 25 23	52	27 9.9 9.0 5.4 .12	0.02 1.31 0.01	5.0 31 17	.87		
0.55	9.0	.62	.060	3 27 30	42	25 8.4 8.8 8.1 .20	0.03 1.84 0.01	3.9 33 16	.78		
0.90	8.9	.61	.068	2 38 23	39	24 7.9 8.3 7.5 .20	0.04 1.91 0.01	4.7 31 16	.94		
1.20	9.0	.53	.056	3 49 17	31	18 6.6 6.3 6.1 .17	0.03 1.95 0.01	3.2 26 13	.98		
1.50	8.7	.48	.057	2 28 33	37	22 8.8 7.5 7.4 .19	0.03 1.97 0.01	3.9			
1.70	8.6	.38	.049	4 40 24	32	19 7.2 5.9 6.1 .14		3.3			

Depth	Org.C (W&B) % @ 105C	Tot.N % @ 105C	Extr. P Acid Bicarb. mg/kg @ 105C	HCl K meq% @105C	CaCl2 Extr K mg/kg @ 105C	P	DTPA-extr. Fe Mn Cu Zn B mg/kg @ 105C	Extractable SO4S NO3N NH4N mg/kg @ 105C	P Buff Equil Cap ug/L @ 40C	Alternative Cations CEC Ca Mg Na K m.eq/100g @ 105C
B 0.10	1.1	.08	5 5	.39			72 56 1.4 0.3			
0.10	1.1	.08	7 7	.65			73 122 1.4 0.8			.

* -33kPa (-0.33bar) and -1500kPa (-15 bar) using pressure plate apparatus.
Cation method: ?
Alternative cation method: ?
ECEC METHOD: ?
CEC methods: ?
Alternative CEC method: ?

SOIL TYPE: 2DYA
SITE NO: S11A
A.M.G. REFERENCE: 515 520 mE 7 804 900 mN ZONE 55

GREAT SOIL GROUP: Solodic soil
PRINCIPAL PROFILE FORM: Dy2.33
SOIL TAXONOMY UNIT: Typic Natrustalf
FAO UNESCO UNIT: Solodic Planosol

TYPE OF MICRORELIEF: Normal gilgai
VERTICAL INTERVAL: .10 m
HORIZONTAL INTERVAL: 10 m
COMPONENT OF MICRORELIEF SAMPLED: Mound

SUBSTRATE MATERIAL:
CONFIDENCE SUBSTRATE IS PARENT MATERIAL:

SLOPE:
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

VEGETATION
STRUCTURAL FORM: Mid-high woodland
DOMINANT SPECIES: Eucalyptus alba, Grevillea striata, Eucalyptus tessellaris, Grevillea striata, Dichanthium species, Bothriochloa species

ANNUAL RAINFALL:

PROFILE MORPHOLOGY:

CONDITION OF SURFACE SOIL WHEN DRY: Hard setting

HORIZON	DEPTH	DESCRIPTION
A1sb	0 to .10 m	Dull yellowish brown (10YR5/3), dry sporadically bleached; very few fine faint brown mottles; clay loam; massive; dry; moderately firm; common fine roots.
B21	.10 to .20 m	Brown (7.5YR4/3); very few fine faint brown mottles; medium clay; strong 50-100mm angular blocky; dry; very firm; common fine roots.
B22	.20 to .50 m	Greyish yellow-brown (10YR4/2); heavy clay; strong 50-100mm lenticular parting to strong 10-20mm angular blocky; dry; very strong; very few medium manganiferous concretions; common very fine roots.
B23	.50 to .85 m	Dull yellowish brown (10YR4/3); heavy clay; strong 50-100mm lenticular parting to strong 10-20mm lenticular; dry; very strong; very few coarse carbonate nodules; few very fine roots.
2B24	.85 to 1.20 m	Brown (7.5YR4/3); medium heavy clay; strong 20-50mm subangular blocky; dry; moderately strong; few medium carbonate nodules; few coarse roots.
2B25	1.20 to 1.60 m	Brown (7.5YR4/3); light medium clay; moderate 20-50mm prismatic parting to moderate 20-50mm angular blocky; common distinct clay skins; dry; moderately strong; few extremely coarse carbonate tubules; few coarse roots.
2B26	1.60 to 2.10 m	Dull brown (7.5YR5/4); light clay; moderate 10-20mm prismatic parting to moderate 10-20mm subangular blocky; dry; moderately strong; few extremely coarse carbonate tubules; few coarse roots.

Depth	1:5 Soil/Water pH	EC	Cl	Particle Size CS	FS	S	C	Exch. Cations CEC	Ca	Mg	Na	K	Total Elements P	K	S	Moistures ADM	33*	1500*	Disp.Ratio R1	R2	Exch Al	Exch Acid	ECEC	pH CaCl2
metres	@ 40C	dS/m @105C	%	% @ 105C				m.eq/100g @ 105C					% @ 80C			% @ 105C			@ 40C		m.eq/100g @ 105C			@ 40C
B 0.10	6.3	.17	.015	5	35	29	34									2.8	26	12	.59					
0.10	6.1	.15	.016	5	41	24	35	17	3.7	5.2	.94	.49	0.02	1.52	0.02	2.6	25	11	.58					
0.30	7.4	.28	.040	3	22	19	58	26	9.0	10	4.0	.16	0.01	1.46	0.01	5.8	33	19	.89					
0.60	8.7	.78	.090	2	17	21	62	31	9.8	12	7.9	.18	0.01	1.53	0.02	6.3	38	20	1.0					
0.85	8.9	1.0	.109	4	14	25	60	29	9.2	11	8.9	.22	0.01	1.57	0.03	3.8	39	20	.97					
1.20	9.0	.91	.107	1	22	26	51	28	7.6	9.3	7.3	.16	0.03	1.77	0.01	7.4	38	18	.98					
1.50	8.8	.69	.078	1	23	29	49	28	8.6	10	9.5	.22	0.04	1.79	0.01	4.0								
1.70	8.6	.46	.061	1	34	26	39	25	7.7	9.3	8.3	.16				4.6								

Depth	Org.C (W&B)	Tot.N	Extr. P Acid	Bicarb.	HCl K	CaCl2 Extr K	P	DTPA-extr. Fe	Mn	Cu	Zn	B	Extractable SO4S	NO3N	NH4N	P Buff Cap	Equil ug/L	Alternative Cations CEC	Ca	Mg	Na	K
metres	% @ 105C	% @ 105C	mg/kg @ 105C		meq% @105C	mg/kg @ 105C		mg/kg @ 105C					mg/kg @ 105C			@ 40C		m.eq/100g @ 105C				
B 0.10	1.2	.09	3	5	.48			112	89	2.8	0.8											
0.10	1.0	.08	3	5	.52			85	55	2.3	1.0											

* -33kPa (-0.33bar) and -1500kPa (-15 bar) using pressure plate apparatus.
Cation method: ?
Alternative cation method: ?
ECEC METHOD: ?
CEC methods: ?
Alternative CEC method: ?

SOIL TYPE: 2DYA
SITE NO: S11B
A.M.G. REFERENCE: 515 520 mE 7 804 900 mN ZONE 55

GREAT SOIL GROUP: Solodic soil
PRINCIPAL PROFILE FORM: Dy2.33
SOIL TAXONOMY UNIT: Typic Natrustalf
FAO UNESCO UNIT: Solodic Planosol

TYPE OF MICRORELIEF: Normal gilgai
VERTICAL INTERVAL: .10 m
HORIZONTAL INTERVAL: 10 m
COMPONENT OF MICRORELIEF SAMPLED: Mound

SUBSTRATE MATERIAL:
CONFIDENCE SUBSTRATE IS PARENT MATERIAL:

SLOPE:
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

VEGETATION
STRUCTURAL FORM: Mid-high woodland
DOMINANT SPECIES: Eucalyptus alba, Grevillea striata, Eucalyptus tessellaris, Grevillea striata

ANNUAL RAINFALL:

PROFILE MORPHOLOGY:

CONDITION OF SURFACE SOIL WHEN DRY: Hard setting

HORIZON	DEPTH	DESCRIPTION
A1sb	0 to .05 m	*Greyish yellow-brown* (10YR4/2), dry sporadically bleached; very few fine faint brown mottles; clay loam,fine sandy; weak 5-10mm platy; dry; moderately firm; common very fine roots. Abrupt to-
B1	.05 to .10 m	*Greyish yellow-brown* (10YR4/2), brown (7.5YR4/3); medium clay; strong 20-50mm prismatic; dry; very firm; common very fine roots. Clear to-
B21	.10 to .70 m	*Greyish yellow-brown* (10YR4/2); heavy clay; strong 50-100mm lenticular parting to 10-20mm angular blocky; dry; very strong; very few fine manganiferous concretions; common very fine roots. Gradual to-
B22	.70 to .90 m	Brown (7.5YR4/3); medium clay; strong 50-100mm lenticular parting to 10-20mm angular blocky; dry; moderately strong; few coarse carbonate nodules; few medium roots. Gradual to-
2B23	.90 to 1.20 m	Brown (7.5YR4/3); medium clay; strong 10-20mm angular blocky; common distinct clay skins; dry; very firm; common medium carbonate nodules; few medium roots. Diffuse to-
2B24	1.20 to 2.00 m	Dull brown (7.5YR5/4); clay loam,fine sandy; strong 20-50mm prismatic parting to moderate 10-20mm angular blocky; dry; moderately strong; very few very coarse carbonate tubules.

Depth	1:5 Soil/Water pH	EC	Cl	Particle Size CS	FS	S	C	Exch. Cations CEC	Ca	Mg	Na	K	Total Elements P	K	S	Moistures ADM	33*	1500*	Disp.Ratio R1	R2	Exch Al	Exch Acid	ECEC	pH CaCl2
metres	@ 40C	dS/m	% @105C	% @ 105C				m.eq/100g @ 105C					% @ 80C			% @ 105C			@ 40C		m.eq/100g @ 105C			@ 40C
B 0.10	6.1	.03	.002	3	33	28	38									5.0	30	13	.63					
0.05	5.6	.05	.003	3	38	29	35	19	3.3	4.0	.66	.39				2.3	26	11	.55					
0.10	6.0	.04	.003	2	27	26	52	27	7.1	6.8	1.7	.31	0.02	1.32	0.01	3.7	29	17	.53					
0.30	6.3	.17	.021	1	24	26	53	29	10	8.4	2.8	.15	0.01	1.33	0.01	4.1	31	18	.86					
0.60	7.8	.42	.054	1	20	27	55	32	12	10	5.6	.13	0.01	1.40	0.02	5.5	33	19	.94					
0.85	8.9	.73	.075	2	22	25	54	30	12	10	7.0	.16	0.02	1.62	0.02	5.8	36	19	.98					
1.20	8.4	.64	.082	1	24	26	51	30	12	11	7.5	.19	0.04	1.82	0.01	5.4	32	19	.91					
1.50	8.4	.53	.070	1	34	23	43	25	9.7	9.2	6.6	.18	0.04	1.75	0.01	3.8								
1.80	8.4	.47	.065	1	33	26	41	26	9.3	8.8	6.8	.19				3.2								

Depth	Org.C (W&B)	Tot.N	Extr. P Acid	Bicarb.	HCl K	CaCl2 Extr K	P	DTPA-extr. Fe	Mn	Cu	Zn	B	Extractable SO4S	NO3N	NH4N	P Buff Cap	Equil ug/L	Alternative Cations CEC	Ca	Mg	Na	K
metres	% @ 105C	% @ 105C	mg/kg @ 105C		meq% @105C	mg/kg @ 105C		mg/kg @ 105C					mg/kg @ 105C			@ 40C		m.eq/100g @ 105C				
B 0.10	0.9	.08	3	6	.40			215	127	3.1	1.8											
0.05	0.9	.09	3	6	.41			216	94	3.3	1.4											
0.10	0.5	.06	1	2	.32			113	77	3.7	0.9											

* -33kPa (-0.33bar) and -1500kPa (-15 bar) using pressure plate apparatus.
Cation method: ?
CEC methods: ?
Alternative cation method: ?
Alternative CEC method: ?
ECEC METHOD: ?

APPENDIX VI IRRIGATION LAND SUITABILITY CLASSES, BURDEKIN RIVER IRRIGATION AREA

Land suitability classification is the evaluation of current knowledge of land properties based on the requirements of a specified land use. **Current technology and management are assumed and the land was assessed as it was found at the time of the survey**. Levelling and drainage will therefore improve the land suitability in some cases. The objective is sustained production with minimal land degradation. Socioeconomic factors are considered in general terms only, either at the start of the study or in the definition of the level of inputs required to overcome each limitation. The approach is qualitative in that the land suitability classes do not equate to actual costs and benefits.

Five land suitability classes have been defined with suitability decreasing progressively from Class 1 to Class 5 as follows:

Class 1 Suitable land with negligible limitations. This is highly productive land requiring only simple management practices to maintain economic production.

Class 2 Suitable land with minor limitations which either reduce production or require more than the simple management practices* of class 1 land to maintain economic production.

Class 3 Suitable land with moderate limitations which either further lower production or require more than those management practices of class 2 land to maintain economic production.

Class 4 Marginal land which is presently considered unsuitable due to severe limitations. The precise effects of these limitations on the proposed land use are unknown. The use of this land is dependent upon either undertaking additional studies to determine its suitability for sustained production or reducing the effects of the limitation(s) to achieve production.

Class 5 Unsuitable land with extreme limitations that preclude its use.

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* Where more than simple management practices are required, this may involve changes in land preparation, irrigation management, the addition of soil ameliorants and the use of additional measures to prevent land degradation.

APPENDIX VII (a) LAND SUITABILITY CLASSIFICATION FOR CROPS OTHER THAN RICE, BURDEKIN RIVER IRRIGATION AREA

Limitation	Nature of degree of limitation	Land suitability subclasses
Soil depth	Refers to rock, pan or readily observable restriction which will affect root development and plant available water. Does not refer to effective rooting depth as suggested by salinity, sodicity or bulk density.	
	0.6 - 1.0 m	d2
	0.45 - 0.6 m	d3
	0.25 - 0.45 m	d4
	<0.25 m	d5
Depth to hard/slowly permeable subsoils	Hard subsoils reduce water entry, available water capacity and restrict root development.	
	Depth to B horizon of duplex soils with dry moderately strong, very strong or rigid consistence:	
	0.2 - 0.4 m	pb2
	0.1 - 0.2 m	pb3
	<0.1 m	pb4
Nature of surface soils	Crop emergence is limited if soils have large aggregates at the surface or set too hard.	
	(a) Cracking clay soils	
	* Percentage of peds or fragments >5 mm diameter on surface is:	
	25 - 45%	ps2
	>45%	ps3
	(b) Other soils	
	Surface may set hard if overworked and there may be difficulties in achieving satisfactory germination.	ps2
	Surface soils set hard. Some difficulty in achieving satisifactory germination.	ps3
	Surface soils set very hard; may seal on wetting, forming dense crusts drying; very difficult to establish and maintain tilth and achieve satisfactory germination.	ps4

* Based on data reported in Gardner and Coughlan (1982)

APPENDIX VII (a) (Continued)

Limitation	Nature of degree of limitation	Land suitability subclasses
Distribution of soils	Where two or more soils occur in a 300 m traverse, (300 m is regarded as minimum run length for furrow irrigation) and differ in depth or texture of the surface, and/or internal drainage characteristics such that even under good management, crop yields may differ markedly. Criteria are:	
	B horizon permeability is similar but A horizon depths differ by a factor of 1.5 -2+ where A horizon depth of one soil is greater than 0.2 m and/or A horizon field textures differ by >2 field texture groups. ++	pd3
	B horizon permeability differ markedly and/or A horizon depths differ by a factor of >2 where A horizon depth of one soil is greater than 0.2 m and/or A horizon field textures differ by >2 field texture groups.	pd4
+ Depth difference determined by multiplication ++ Northcote (1979)		
Texture of surface soils	Method of irrigation is dependent on surface texture. Furrow irrigation is more difficult with deeper sand; spray irrigation becomes essential.	
	Surface textures of sands to sandy loams to depth of:	
	0.45 - 0.6 m	pt2
	0.6 - 0.9 m	pt3
	>0.9 m	pt4
Salinity	Salts in the upper part of the soil affect crop growth.	
	Electrical conductivity of 1:5 suspension at 25°C is >1.0 dsm^{-1} at:	
	0.3 - 0.9 m	sa3
	<0.3 m	sa4

APPENDIX VII (a) (Continued)

Limitation	Nature of degree of limitation	Land suitability subclasses
Sodicity	High sodicity causes soil dispersion, loss of pore space, restricted rooting depth and plant available water capacity.	
	EITHER	
	ESP at 0.2 - 0.3 m is:	
	6 - 14	so3
	>14	so4
	OR (where no ESP data or ESP know to have a wide range)*	
	Field pH at 0.2 - 0.3 m is:	
	(a) For cracking clays	
	8.0 - 9.5	so3
	>9.5	so4
	(b) For solodic soils and solodized-solonetz	
	6.5 - 8.0	so3
	>8.0	so4
* Relationship from Baker, Rayment and Reid (1983)		
Topography	Slope influences water management, ease of development, layout and erosion control. (Angled layout not considered).	
	Even slopes of:	
	0.25 - 1.0%	t2
	1.0 - 2.0%	t3
	<0.03 or 2.0 - 6.0%	t4
	>6.0%	t5
Fertility	Fertility can be very low in some soils. This alters the economic basis of development.	
	From soil analyses described in Bruce and Rayment (1982), the following combination can be determined for plant nutrients:	
	1 - 2 nutrients are very low	n2
	>2 nutrients are very low	n3

APPENDIX VII (a) (Continued)

Limitation	Nature of degree of limitation	Land suitability subclasses
Rockiness and stoniness	The presence of rocks on the surface and in surface soil affects cultivation and other cultural operations.	
	Some picking of cobbles for certain management requirements (e.g. harvesting soybeans).	r2
	Tillage restricted, picking of cobbles and stones required.	r3
	Tillage difficult, picking of cobbles and stones required.	r4
	Tillage impractical, stones and boulders too numerous to warrant removal, or rockland.	r5
Microrelief	Uneven surfaces create the need for careful levelling. Costs increase with depth of levelling required. Soil chemical and physical problems with exposed subsoils are often associated.	
	Vertical interval of gilgai, or of other regular microrelief is:	
	0.1 - 0.25 m	g2
	0.25 - 0.6 m	g3
	>0.6 m	g4
Wetness	Areas which remain wet after rainfall, cannot be used until drainage has taken place. (Includes both internal (soil) and external (site) aspects of drainage).	
	Areas which are wet for some time; require levelling including some cut and fill.	w3
	Areas which are wet for many months after wet season; considerable filling, or special drainage, or other considerable reclamation necessary.	w4
	Areas which are wet for most of the year and are uneconomical to reclaim	w5
Water erosion	Soils susceptible to erosion need to be protected to maintain productivity.	
	Susceptible to erosion, control measures required are:	
	Simple practices, for example maintenance of cover.	e2
	Intensive practices, for example graded banks.	e3
	Pasture phase or permanent pasture.	e4
	Gully erosion so severe that measures to rehabiliate these areas would be uneconomical.	e5

APPENDIX VII (a) (Continued)

Limitation	Nature of degree of limitation	Land suitability subclasses
Flooding	Areas susceptible to flooding at critical stages of crop growth pose limitations to development because of yield reduction or total loss of crops.	
	Areas subjected to local flooding at different frequencies. Crop losses or damage may occur.	
	Frequency of flooding <1 in 10 years. Minor wet season crop losses or damage can be expected.	f2
	Frequency of flooding 1 in 5-10 years.	f3
	Frequency of flooding >1 in 5 years. Cropping during wet season months is not recommended due to frequency of flooding. Low lying areas adjacent to creeks and their outlets.	f4
	Areas subjected to erosive flooding.	f5
Intake or recharge attributes	Refers to intake areas where excessive amounts of irrigation and rain water losses to the groundwater can cause off-site seepage and salinisation.	
	Intake to groundwater is such that it can be minimized with:	
	Simple management and design	i2
	Special management and design e.g. use of sprinkler irrigation.	i3
	Restricted cropping management and design e.g. trickle irrigation of deep rooted tree crops.	i4
	Where accessions to groundwater are excessive and cannot be prevented.	i5
Outflow or discharge attributes, susceptibility to rise to groundwater.	Areas which have a history of seepage or secondary salinisation or are suspected of same, will not be productive or will be very risky to develop. Lower slopes of the gently undulating rises are susceptible. Edges of the Burdekin River levee may also be susceptible.	
	Know/suspected secondary salinisation	o4

APPENDIX VII (b) LAND SUITABILITY CLASSIFICATION FOR FLOOD IRRIGATION OF RICE, BURDEKIN RIVER IRRIGATION AREA

Limitation	Nature of degree of limitation	Land suitability subclasses
Topography	Simple slopes of 0.03 to 0.25% are regarded as the most suitable.	
	0.03 to 0.25% complex slopes	t2
	<0.03 or 0.25 to 0.5% simple or complex slope	t3
	0.5 to 0.75% simple slope	t4
	Any slope >0.75% and/or complex slopes of 0.5-0.75%	t5
Microrelief	Vertical interval of gilgai or other regular microrelief is:	
	0.1 to 0.25 m	g2
	0.25 to 0.6 m	g3
	>0.6 m	g4
Flooding	Areas subjected to local flooding more than 1 in 10 years but less often than 1 in 5 years.	f2
	Areas subject to local flooding more often than 1 in 5 years.	f3
	Areas subject to erosive flooding.	f5
Profile permeability	Duplex soils with A horzion of >0.2 m, moderately strong, very strong or rigid upper B horizon and textures in the clay range from the base of the A horizon to >1.5 m, and strongly alkaline (or with ESP >14) by 0.6 m are considered the least permeable.	
	Cracking clay soils with alkaline soil reaction trend and/or ESP at some point in the profile >14 and texture in the clay range extending to >1.5 m.	p2
	Duplex soils with A horizons >0.2 m deep, moderately strong, very strong or rigid upper B horizons and textures in the clay range from the base of the A horizon to >1.5 m. Alkaline soil reaction trend and/or ESP at some point in the profile >14.	p3
	As for p3 but upper B horizon not moderately strong, very strong or rigid.	p4
	All uniform, duplex and gradational soils with acid and neutral soil reaction trends with ESP <14 throughout profile and/or with some material with texture coarser than sandy clay between 0.4 and 1.5 m.	p5
Fertility	Significant fertiliser inputs are required to achieve satisfactory crop growth.	n3
Soil salinity	Electrical conductivity of 1:5 extract at 25°C is greater than 1.0 dsm^{-1} at:	
	0.1 to 0.3 m	sa4
	<0.1 m	sa5

APPENDIX VII (b) (Continued)

Limitation	Nature of degree of limitation	Land suitability subclasses
*Distribution of soil types	Distribution of soil types is such that when two or more soils types occur within a 300 m traverse:	
	Soil types are of similar suitability for rice.	pd2
	Soil types are all suitable for rice but are of different suitabilities.	pd3
	One or more soil types is not suitable for rice.	pd4

* Not applicable if UMA has a land suitability subclass of 4 or 5 (that is unsuitable), for any previous limiting factor.