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CYPLUS

CAPE YORK PENINSULA

LAND USE STRATEGY

LAND USE PROGRAM

# LAND DEGRADATION IN CAPE YORK PENINSULA

Australian Geological Survey Organisation
Bureau of Resource Science
Queensland Department of Primary Industries
1995

AGSO AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

DPI QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES

B R S

CYPLUS is a joint initiative of the Queensland and Commonwealth Governments

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(CYPLUS)

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Note:

Due to the timing of publication, reports on other CYPLUS projects may not be fully cited in the BIBLIOGRAPHY section. However, they should be able to be located by author, agency or subject.

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# CAPE YORK PENINSULA LAND USE STRATEGY
# STAGE I

## PREFACE TO PROJECT REPORTS

Cape York Peninsula Land Use Strategy (CYPLUS) is an initiative to provide a basis for public participation in planning for the ecologically sustainable development of Cape York Peninsula. It is jointly funded by the Queensland and Commonwealth Governments and is being carried out in three stages:

Stage I - information gathering;
Stage II - development of principles, policies and processes; and
Stage III - implementation and review.

The project dealt with in this report is a part of Stage I of CYPLUS. The main components of Stage I of CYPLUS consist of two data collection programs, the development of a Geographic Information System (GIS) and the establishment of processes for public participation.

The data collection and collation work was conducted within two broad programs, the Natural Resources Analysis Program (NRAP) and the Land Use Program (LUP). The project reported on here forms part of one of these programs.

The objectives of NRAP were to collect and interpret base data on the natural resources of Cape York Peninsula to provide input to:

evaluation of the potential of those resources for a range of activities related to the use and management of land in line with economic, environmental and social values; and
formulation of the land use policies, principles and processes of CYPLUS.

Projects examining both physical and biological resources were included in NRAP together with Geographic Information System (GIS) projects. NRAP projects are listed in the following Table.

| Physical Resource/GIS Projects | Biological Resource Projects |
|---|---|
| Bedrock geological data - digitising and integration (NR05) | Vegetation mapping (NR01) |
| Airborne geophysical survey (NR15) | Marine plant (seagrass/mangrove) distribution (NR06) |
| Coastal environment geoscience survey (NR14) | Insect fauna survey (NR17) |
| Mineral resource inventory (NR04) | Fish fauna survey (NR10) |
| Water resource investigation (groundwater) (NR16) | Terrestrial vertebrate fauna survey (NR03) |
| Regolith terrain mapping (NR12) | Wetland fauna survey (NR09) |
| Land resource inventory (NR02) | Flora data and modelling (NR18) |

| Physical Resource/GIS Projects | Biological Resource Projects |
|---|---|
| Environmental region analysis (NR11) | Fauna distribution modelling (NR19) |
| CYPLUS data into NRIC database FINDAR (NR20) | Golden-shouldered parrot conservation management (NR21) |
| Queensland GIS development and maintenance (NR08)* | |
| GIS creation/maintenance (NR07)* | |

* These projects are accumulating and storing all Stage I data that is submitted in GIS compatible formats.

Research priorities for the LUP were set through the public participation process with the objectives of:
collecting information on a wide range of social, cultural, economic and environmental issues relevant to Cape York Peninsula; and
highlighting interactions between people, land (resource use) and nature sectors.

Projects were undertaken within these sector areas and are listed in the following Table.

| People Projects | Land Projects | Nature Projects |
|---|---|---|
| Population | Current land use | Surface water resources |
| Transport services and infrastructure | Land tenure | Fire |
| Values, needs and aspirations | Indigenous management of land and sea | Feral and pest animals |
| Services and infrastructure | Pastoral industry | Weeds |
| Economic assessment | Primary industries (non-pastoral, non-forestry) | Land degradation and soil erosion |
| Secondary and tertiary industries | Forest resources | Conservation and natural heritage assessment |
| Traditional activities | Commercial and non commercial fisheries | Conservation and National Park management |
| Current administrative structures | Mineral resource potential and mining industry | |
| | Tourism industry | |

As a part of the public participation process, community and other groups associated with CYPLUS were invited to review all draft reports. These reviews were designed to correct any errors of fact (which were then modified in the final report) and to provide an opportunity for people to express their views of the information presented. The comments submitted to the CYPLUS process by various community groups and other interested persons in regards to this project report are situated within a final attachment to this report.

## TABLE OF CONTENTS

(Note: A detailed table of contents is located at the beginning of each Part)

## EXECUTIVE SUMMARY

The Land Use Program Land Degradation project has evaluated degradation in terms of soil erosion and soil salinity hazard. Soil erosion was examined in different ways by the Queensland Department of Primary Industries (QDPI) and the Australian Geological Survey Organisation (AGSO) with the Bureau of Resource Science (BRS).

The QDPI study used the data collected under the CYPLUS Natural Resources Analysis Program's (NRAP) Land Resource Inventory Project, NR02. This data was used to identify land where erosion has apparently been accelerated by human activity since European occupation and land with potential to develop accelerated erosion under current land use.

The study concluded that water and wind erosion are inherent features of the landscapes of Cape York Peninsula in areas such as the Mitchell Landscape, mostly located on alluvial plains of the south-west, and the Hodgkinson Landscape, located in the south-east. The latter area in particular contains a number of very erodible soils, particularly along major rivers, and human activities have increased levels of natural erosion. Past land management practices and disturbances of these soils via stock trampling or construction of roads has led to greatly increased levels of soil loss, and some areas of serious erosion have developed as a result.

The inherently unstable nature of most of the soils associated with the Hodgkinson Formation requires that land management planners formulate a landscape-based approach to prevent both on-site and off-site effects of accelerated erosion.

The clay soils of the south-western alluvial plains are naturally subject to sheet and rill erosion. The relatively flat nature of the landscape decreases the potential for erosion, but land use planning should take into account the erodibility of the soils, particularly with respect to watering points.

The AGSO/BRS erosion study used the Universal Soil Loss Equation (USLE) to predict soil losses from water erosion. The USLE is an empirical relationship developed in the United States of America to relate average annual soil loss to soil erodibility, slope length, slope steepness, cultivation method and vegetation cover. Inputs for the predictive equation came from the NR12 and NR02 projects, national maps predicting rainfall intensity and a national vegetation map cover.

The study resulted in a map of water erosion hazard for Cape York Peninsula (CYP). In general there is a gradient from high along the east coast to low along the west coast. This reflects the gradient of amount and intensity of rainfall, which is superimposed on other factors. The erosion hazard for most of the CYPLUS area is in the range very low to low, mainly because of the high permeability of the sandy soils which reduces the amount and rate of runoff. Additional factors are the generally low slope angles of the plains and rises that make up most of the area, and the woodland vegetation which reduces the erosivity of the high intensity rain which is characteristic of the seasonally wet tropics. The difference between very low and low potential soil loss appears to be related to slope angle and to surface soil texture.

The use of the USLE can be extended beyond its present application for assessing erosion hazard under present land conditions. For example, the technique could be used to evaluate and compare different land uses and management options in the region, because of its ability to make recommendations on ways to reduce erosion by changing land and crop management practices. This process of evaluation is critical for CYP where most soils have a low erodibility when undisturbed, but are highly susceptible to erosion under inappropriate management. Therefore, the prediction of a high water erosion hazard for an area does not preclude a particular land use. Rather, it indicates that a particular type and level of management is required for the sustainable use of the land.

Naturally occurring salinity and salinity hazard have been assessed by QDPI from the NR02 data. Naturally saline soils were identified from field and laboratory measurements and their distribution mapped. Areas of salinity hazard are those where changes to the soil's hydrological regime, such as those caused by clearing, may cause parts of the landscape to become salinised. Landscapes containing appreciable near surface salt levels were identified and associated soils and their distribution examined. However, more detailed study will be needed if the extent of the hazard is to be accurately defined.

Current information suggests that salinity hazard on Cape York Peninsula is restricted to the soils and/or sediments associated with the Rolling Downs Group and the Hodgkinson Formation. Significant areas of naturally saline soils are present on the coastline of the Peninsula, particularly in the central and south-west.

Soils associated with the Rolling Downs Group contain low levels of salts and have significant potential for man-made development. Unplanted development, including tree clearing an/or irrigation, could result in hydrological imbalance and mobilisation of salts held in the near surface sediments. Many of the soils formed on the Hodgkinson formation contain appreciable salt levels at depth. While this area is less likely to be intensively developed, unplanned tree clearing or irrigation may result in the mobilisation of these salts contained in the subsoils.

Some key issues for managing salinity in landscapes on the Peninsula are:

* Development of a better understanding of soil/geological relationships, and the source, nature and mobility of the salts in key areas

* Development of a better understanding of the hydrological balance within the landscape

* Utilisation of tree clearing guidelines

* Preparation of strategies for managing irrigation, in particular the removal of excess water by de-watering, drainage or other methods

Maps showing the areas described in this summary can be found at the end of each part of this report.

# PART 1

## EXISTING AND POTENTIAL EROSION HAZARD OF CAPE YORK PENINSULA

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**Queensland Department of Primary Industries**

**(Northern Region)**

## CONTENTS

## TABLES



## FIGURES



## PLATES

## 1.0 INTRODUCTION

Soil erosion caused by the action of water and wind is a natural process, but can be accelerated by human activities. Excessive soil erosion is an important land degradation issue, not only in terms of on-site loss of the soil resource itself, but also in relation to off-site effects such as changes in water quality and habitat integrity. This paper discusses the nature and risk of erosion with respect to Cape York Peninsula.

The NR02 soil survey was not a specific purpose erosion study and hence did not attempt to make a comprehensive assessment of erosion status across the Peninsula. The NR02 survey was primarily a soil mapping and agricultural suitability assessment exercise to supply land use planning information at a regional scale. With respect to erosion, NR02 is able to provide:

- a ranking of soil types in terms of their inherent potential to erode,
- an assessment of current erosion status, which is confined to lands through which traverses took place, and at which site information was collected at pre-determined points where soil profiles were described,
- indicative assessments of the degree of accelerated erosion for those areas where erosion was observed.

Distinguishing between **natural and accelerated** erosion in any study of erosion status is usually difficult. In specific purpose erosion assessment studies across large areas, conclusive information can be obtained on the extent of erosion but not on the relative amounts of natural and accelerated erosion. This is particularly so in the extensive, low intensity grazing lands of CYP where varying climatic influences prevail.

## 2.0 THE NATURE OF EROSION IN THE CONTEXT OF CYP

### 2.1 Natural processes

Erosion, both natural and accelerated takes a number of forms, as listed below:

- erosion of soil by wind,
- erosion of soil by rainfall or running water,
- mass movement, i.e landslides and slips,
- riverine erosion, and
- marine or foreshore erosion.

Of these, large scale mass movement and marine erosion are not deemed to be of major significance on CYP and will not be discussed any further.

#### 2.1.1 Factors affecting erosion

For any given intensity or duration of either rainfall or wind, soil erosion is a function of:

- surface cover
- land slope (in relation to water erosion)
- the soil's mechanical strength

**Surface cover** such as that provided by grasses and trees not only helps to bind the soil and hence increase its resistance to the power of water or wind, but also dissipates the erosive power of these elements.

**Soil erodibility increases with land slope** because water travelling downslope gains velocity and hence erosive power.

Soils vary in their **mechanical strength** - the ability of individual particles to resist being moved by wind or water. For surface soils, this strength is essentially a function of particle size (clay, silt and sand composition), organic matter level and moisture content. Chemical properties also play a role, particularly in the sub-soil where high levels of sodium or magnesium attached to clay particles can cause soils to disperse or disintegrate when in contact with water.

CYP includes soils that have poor physical (fine sands and silts) and chemical characteristics (high sodium and/or magnesium levels). There are also significant areas of steep land. These features in relation to particular CYP soils are discussed later. Additionally, climatic/seasonal variation in the region give rise to large variations in plant cover.

### 2.1.2 Wind erosion

Wind erosion is generally of significance in areas where ground cover is poor or winds are confined, hence greatly increasing their velocity (Chepil, 1958) The former will be discussed with relation to the south-western plains of the Peninsula.

### 2.1.3 Water erosion

Water erosion manifests itself in five general forms:

- raindrop erosion,
- sheet erosion,
- rill erosion,
- gully erosion, and
- solution erosion.

These tend to intergrade. Raindrop erosion is generally only of significance on soil surfaces with little or no vegetative cover. The impact of raindrops on the soil surface also aids in the breakdown of soil aggregates and the formation of surface seals.

Sheet erosion is the relatively uniform removal of soil from flat or sloping land. It can be significant on floodplains where large bodies of shallow water can move at speed, or alternatively it can develop on uniform surfaced hillslopes. In the case of floodplains, deposition of suspended material as waters recede may counteract any removal of soil by the water flow.

Rill erosion is a common form of erosion in which shallow overland flow (sheet erosion) becomes concentrated in small but well defined channels (<0.3 m deep). If the accumulation of water flow increases (as it generally will as one moves downslope) gullies may form. These are greater than 0.3 m deep (McDonald *et al.*, 1990) and distinguished by the three main formative processes:

- waterfall erosion at the gully head,
- channel erosion caused by water flowing through the gully, and
- localised slips or mass movement in the sides of the gully.

### 2.1.4 Aggradation

Inherently associated with erosion is deposition, or aggradation. If this aggradation occurs outside the catchment, the landscape will be at a net loss (assuming it hasn't received depositional material sourced from a higher catchment). In many cases, aggradation occurs within a localised area, e.g soil lost off a hillslope may be deposited at the footslope or on an associated colluvial fan or pediment. Many gullies with actively eroding heads also have actively aggrading partly stabilised lower elements, albeit lower in the land surface. The role of aggradation in the landscape is at times unclear, but should certainly not be underestimated.

## 2.2 Land management effects

The main impact of land management in relation to soil erosion potential is to reduce the soil's mechanical strength and resistance by:

- a reduction in plant cover
- the effect of animal hooves on the soil surface
- tillage

Except for very minor areas e.g Lakelands, **tillage** associated with cropping is not a significant factor on CYP. Any future tillage associated with the establishment of improved pasture will increase the significance of this factor in the short term.

**Grazing pressure or stocking rate** and its effect on plant cover and soil disturbance is the major factor in determining the level of accelerated erosion in CYP. Given that the impact of cattle and horse hooves is up to six times that of macropods such as the kangaroo (Table 1), it is the grazing management decisions of the beef industry in CYP that have a significant influence on the level of accelerated erosion.

**Table 1 Static foot pressures for a number of animals**

| Herbivore | Liveweight (kg) | Individual foot area bearing on soil surface ($cm^2$) | Static pressure per foot surface ($kg/cm^2$) |
|---|---|---|---|
| Kangaroo | 30-66 | 36 | 0.8-1.8 |
| Sheep | 40-55 | 21 | 1.9-2.6 |
| Camel | 450-650 | 411 | 1.1-1.6 |
| Horse | 400-700 | 184 | 2.2-3.8 |
| Cattle | 500-600 | 115 | 4.4-5.2 |

(Source: Noble and Tongway, 1986)

The reduction of plant cover from **clearing of vegetation** has not been significant on the Peninsula. Large areas were cleared at "Heathlands" in the early 1970's, and a planned clearing program is presently under way at "Kalinga".

A further impact of land management on soil erosion potential relates to **the effect of man made physical features** which alter the natural flow paths of run-off water. If features such as roads (farm and public) and fences are poorly designed, they will intercept large volumes of water and cause more concentrated run-off at particular points where previously much lower volumes flowed. These points are likely to experience accelerated erosion. This problem is Australia wide, and CYP is no exception.

## 3.0 ASSESSMENT

As previously mentioned, soil erosion assessment within NR02 was confined to:

- general observation during the course of the limited traverses selected to map and describe soils
- recorded site assessment as part of the soil description process.

The methodology used was that outlined in McDonald *et al.*, (1990). It involves the description of the degree, state, and type of erosion e.g moderate, partly stabilised, gully erosion. Depth of gully is also recorded.

As part of NR02, all soil types were given an erodibility index. It should be noted that this is based purely on field observations and interpretation of limited soil chemistry. The indices were:

- s - stable soils
- u - unstable soils
- v - very unstable soils

This index was linked to slope category and attempts to reflect natural erodibility only.

# 4.0 WATER EROSION ON CYP

Significant occurences of accelerated water erosion on CYP are confined to the soils related to the Hodgkinson Formation in the south-east and the alluvial clay plains of the south-west.

## 4.1 Hodgkinson Formation

### 4.1.1 General

The Hodgkinson Formation is a dissected landscape of highly folded and faulted sediments (greywacke, slate) and minor volcanics (Lucas and de Keyser, 1965). The sediments are of marine origin and hence would be expected to contain appreciable salts. The pattern of rolling to steep low hills or hills is heavily dissected by a fine network of streams. Valley incisions are often quite deep and steep sided. Considerable colluvial and alluvial deposits are associated with the hillslopes - in particular the deposits to the east of the north-south trending ridge on the east coast and north of the main unit in the south of the survey area. The soils associated with the colluvia and alluvia are amongst the most erodible soils on CYP. Figure 1 indicates the location of the formation and illustrates the relative positions of the dominant soils in the Hodgkinson landscape. Detailed descriptions are provided in Appendix 1.

### 4.1.2 Current erosion status

The nature and landform position of erosion with respect to the soils of the Hodgkinson Formation is summarised in Table 2.

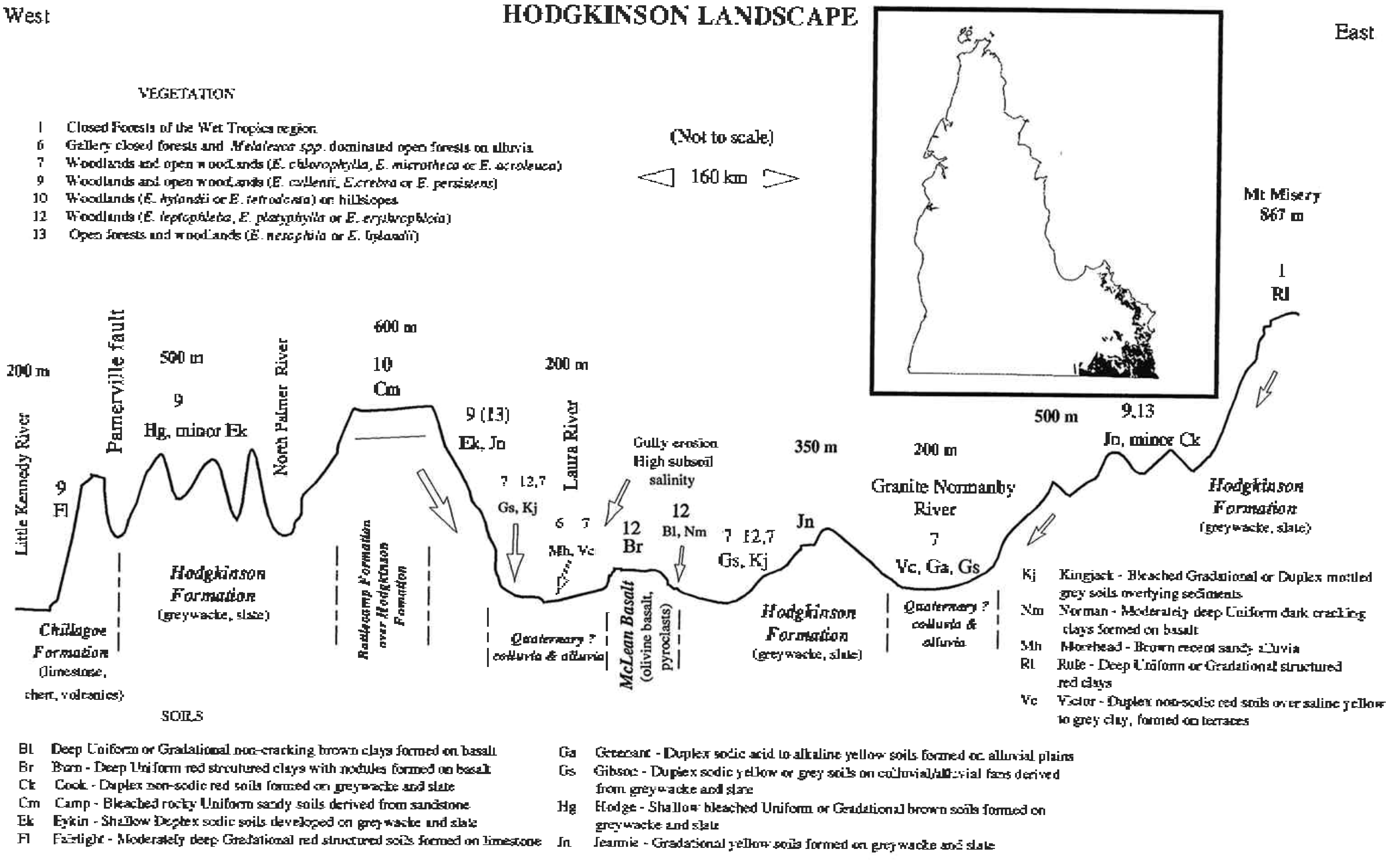



**Figure 1** Hodgkinson Formation

**Table 2** **Erosion categories and types of erosion observed for the soils of the Hodgkinson Formation**

| SPC | Landform | Erosion Category | Erosion Type |
|---|---|---|---|
| Hodge | hillcrests, hillslopes | unstable | rill |
| Eykin | hillcrests, hillslopes | unstable | rill, minor gully |
| Jeannie | hillslopes, hillcrests | stable | rill |
| Gibson | footslopes | unstable | gully, rill |
| Kingjack | footslopes | unstable | rill, sheet |
| Wakooka | alluvial plains | stable | minor sheet |
| Greenant | alluvial plains | unstable | sheet, gully |
| Victor | terraces | unstable | severe gully |

Erosion of the hillslope soils is generally restricted to rill erosion, with minor amounts of gully erosion associated with a Sodosol (*Eykin*) - a soil with high subsoil $Na^+$ levels. Vegetative cover on these hillslopes is poor, with *E. persistens*, *E. cullenii* and *E. hylandii* dominant. Basal areas of grass cover is generally quite low. The poor vegetation generally reflects the poor chemical and physical characteristics of the soil.

At the base of the hillslopes, a Yellow Sodosol (*Gibson*) and a Brown Dermosol (*Kingjack*) occur. Whilst the occurrence of these soils in this part of the landscape is predictable, it is difficult to predict where one will occur in place of the other. For this reason, it was decided to give *Kingjack* an unstable rating. Erosion of these soils in the footslopes would under natural circumstances be balanced to an extent by aggradation with material derived from the above hillslopes. The most common form of erosion of these soils is gullying, which is often initiated by poor roadway drainage structures.

The alluvial soils derived from Hodgkinson Formation have significant potential to erode if managed incorrectly. The level to very gently undulating nature of the plains reduces the effects of erosion associated with downslope movement of water and soil particles, but does increase the possibility of sheet erosion. Gullying is the most common form of erosion, and is invariably associated with rivers, streams and roads. The Normanby, Granite Normanby and Palmer Rivers have very significant amounts of gullying, and minor slumping along their banks. The causes are threefold.

- natural
- disturbance of river banks by stock
- incorrect construction of roads and associated drainage structures

Natural erosion probably represents a major portion of the erosion seen along the banks of the afore-mentioned rivers. These three rivers are very deeply incised in the landscape (up to 30 m), and hence will suffer from gullying as water naturally flows from the surrounding landscape down to the river bed. Minor slumping and slipping is undoubtedly associated with this process. These are also rivers which run very swiftly at their peak, with large flows. Erosion of the river bank edges will occur when the rivers flood i.e nearly every year.

It is clear however, that stock tracks down to the river beds have induced accelerated gully formation and increased loss of material from the river banks. This type of disturbance is in fact not restricted to the three rivers mentioned above but can be found on most rivers and creeks on the Peninsula.

The very large gullies associated with river crossings on the Lakeland-Cooktown road are clear evidence of road construction that has not taken the unstable nature of the alluvial soils into account. Soils such as *Greenant* and *Victor* in particular appear to be susceptible to accelerated erosion. Plate 1 illustrates typical erosion to be found on these soils. Both *Victor* and *Greenant* are present in intermittent patches along the Normanby, Granite Normanby, Palmer and Laura Rivers. The surface horizons of both soils are relatively stable, but at varying depths the lower horizons are unstable. In the case of *Victor*, a very unstable saline sodic D horizon exists. The trend in Exchangeable Sodium Percentage (ESP) with depth in a *Victor* is displayed in Figure 2. ESP is a measure of the dispersibility of the soil i.e the degree to which it erodes by solution. If the surface horizons are removed, the underlying horizons disperse and erode very rapidly. A good example is found on the Peninsula Developmental Road, south of Split Rock. The variability in depth to the D horizon, and the large difference in stability between it and the overlying surface horizons, makes *Victor* a difficult soil to manage.

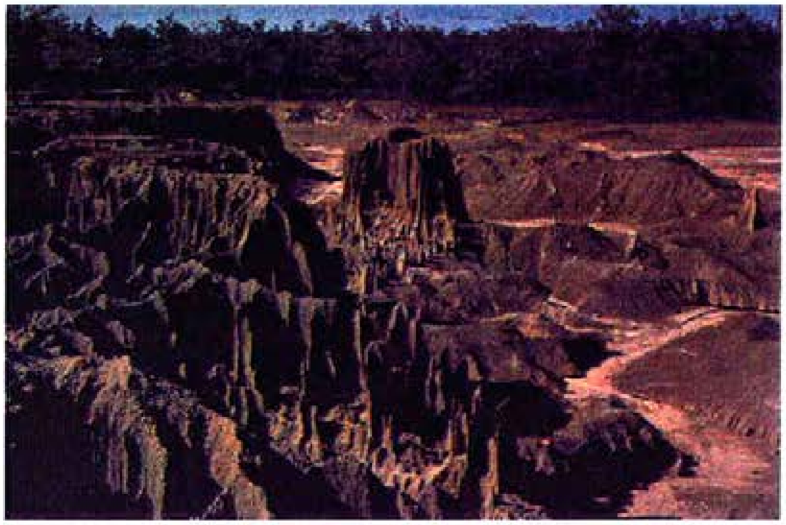


**Plate 1** Typical gully erosion located on alluvia derived from Hodgkinson Formation

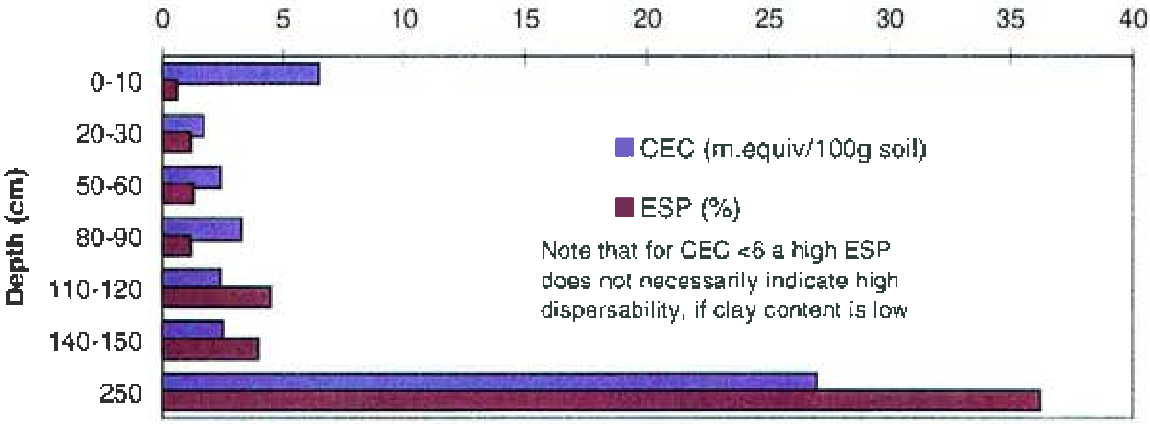



**Figure 2** **Trend in ESP with depth for *Victor***

### 4.1.3 Land use implications

The inherently unstable nature of most of the soils associated with the Hodgkinson Formation requires that land management planners formulate a landscape based approach to prevent both on-site and off-site effects of accelerated erosion.

Stocking rates and grazing practices should be adjusted to cater for the effects of stock on watering points, particularly rivers, and the role that grazing plays in reducing plant cover. Tree clearing, particularly on slopes greater than 10%, is not recommended.

Road construction practices need to be revised, especially with regards to river crossings. There is a often a lack of correctly constructed cross or side drainage structures. These provide safe passage of smaller volumes of water rather than allowing larger volumes to accumulate and travel rapidly downslope at a few vulnerable points.

The use of subsoil clay for the construction of roads and dams is not recommended, unless care is taken. The failure of a number of dams (as a result of solution erosion) constructed on soils derived from Hodgkinson Formation indicates the type of land use problem that can be associated with failure to acknowledge the nature of certain soils.

### 4.1.4 Summary

The soils associated with the Hodgkinson Formation are inherently unstable, some more so than others. Natural erosion levels, particularly along some rivers are quite significant, and although man's activities have increased these levels, it is very difficult to state by how much. Past land management practices, particularly road construction, have failed to acknowledge the natural instability of the soils, and some areas of serious erosion have developed as a result. It is suggested that future planning exercises consider this problem, and act accordingly.

## 4.2 The South-Western Plains

### 4.2.1 General

The level to very gently undulating floodplains of the south-western corner of the Peninsula are part of a larger system which extends south below the CYPLUS survey area. It is encompassed by Radnor, Cumbulla and Dunbar Land Systems of Galloway, *et al.* (1970). The location of the unit and the soils within it are displayed in Figure 4. Detailed descriptions are listed in Appendix 2. The plains are dominated by massive surfaced and cracking alkaline clays (*Kennedy*), supporting low open woodlands (*E. chlorophylla, E. microtheca*). The massive surface types are more dominant in the east, and are slightly higher in the landscape. The cracking clays, which are more common in the western half of the landscape are often lower in elevation and support dense grasslands, rather than low open woodlands. Closer to the Mitchell River, woodlands are present on levees, terraces and prior streams of sandier soils (*Mitchell, Morehead*).

### 4.2.2 Current erosion status

The clays which dominate the landscape are inherently unstable. Evidence suggests both wind and water erosion are present. Figure 3 illustrates the trend in ESP and pH with depth for the surface cracking type. It has been observed that the massive surfaced type is more unstable and alkaline and shows evidence of more erosion than the surface cracking type.

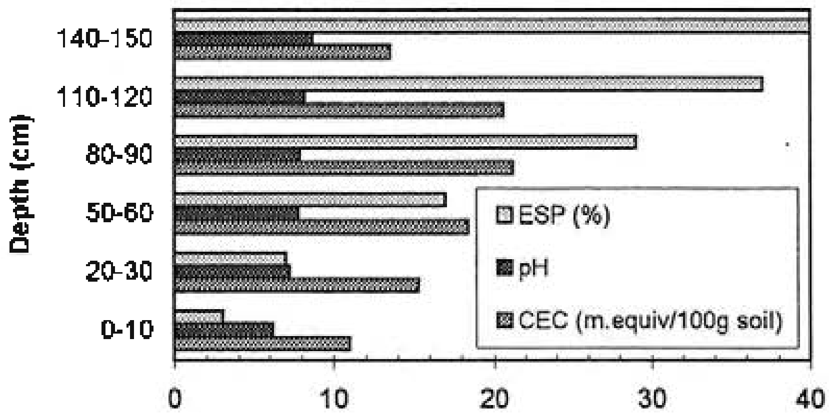
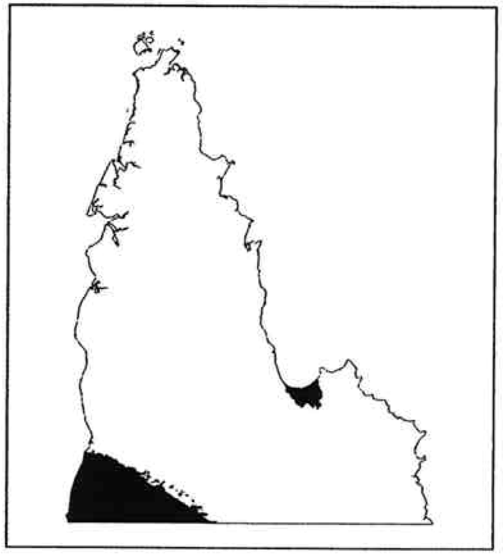



**Figure 3 Selected chemistry for *Kennedy***

# MITCHELL LANDSCAPE

West | East



SOILS

- Ab Aurbed - Sodic Gradational mottled grey soils formed on alluvial plains
- Bn Bend - Gradational or Uniform grey or yellow-brown soils formed on alluvial plains
- Cv Caravan - Coloured stratified Uniform sands formed in beach ridges on chenier plains
- Go George - Saline mottled clays developed in recent estuarine deposits (saltpans)
- Kd Kennedy - Uniform to Gradational massive surfaced or cracking grey clays formed on alluvial plains
- Mc Mitchell - Deep Uniform or Gradational yellow, brown or red soils on terraces
- Mh Morehead - Brown recent sandy alluvia
- Mn Marina - Uniform, frequently cracking, sodic grey clays formed on marine plains
- Ns Nassau - Saline Duplex mottled grey soils associated with playas
- Vy Vrilya - Uniform siliceous sands with minimal profile development, formed on foredunes

VEGETATION

- 6 Gallery closed forests and *Melaleuca spp.* dominated open forests on alluvia
- 7 Woodlands and open woodlands (*E. chlorophylla, E. microtheca* or *E. acroleuca*)
- 8 Woodlands and open woodlands (*E. clarksoniana, E. novoguinensis* or *E. polycarpa*)
- 18 Low open woodlands and low woodlands (*Melaleuca viridiflora*) on depositional plains
- 21 Tussock grasslands on marine plains
- 25 Woodlands and herblands on beach ridges and the littoral margin
- 29 Bare areas (saltpans)

(Not to scale)

< 120 km >

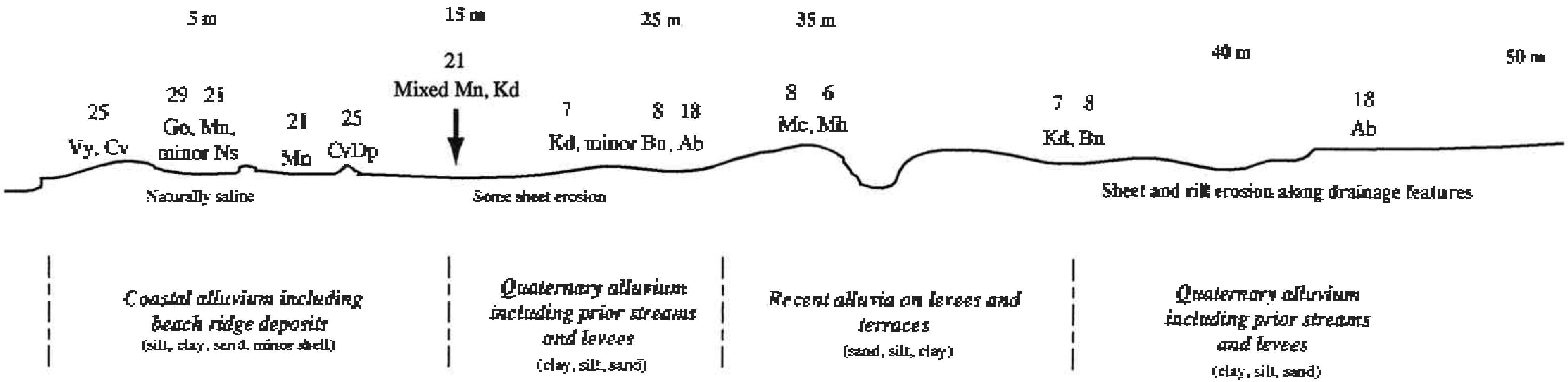



**Figure 4 Mitchell Landscape**

Sheet erosion appears to be the dominant form of erosion on the flats, particularly in the east. The development of sheet erosion is aided by the low plant cover on these clays and the relatively large areas of uniform slightly sloping (1%) land surface. Both tree stem density and Projective Foliage Cover on these flats is variable, but generally low (<120 trees/ha and <10% respectively).

The cracking clays, being lower in the landscape, with slightly greater moisture supply, retain ground cover for longer in the year. The lack of ground cover at the end of the dry season greatly increases the effects of the first storms on the soil surface. Late season burning also reduces ground cover to virtually zero. The impact of raindrops on the bare soil surface, coupled with the dispersibility of the soil aggregates, leads to the formation of surface seals, greatly decreasing infiltration rates, and hence increasing surface run-off and the development of sheet erosion.

Slight rill and gully erosion is commonly associated with drainage depressions in the landscape, particularly in the east. This erosion is characterised by a small step (approx 0.3m) and then a partly stabilised, partly rilled area leading to the drainage line (Figure 5). It is certainly likely that cattle have played some role in either initiating or accelerating this erosion.

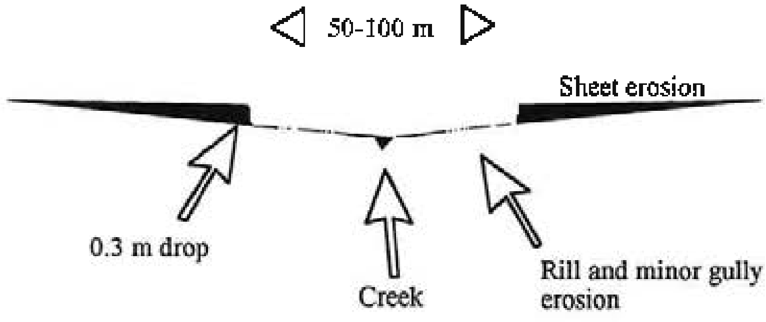



**Figure 5 Typical erosion pattern associated with drainage lines**

### 4.2.3 Land use implications

Due to the difficulty in gauging the natural levels of erosion on the south-western plains, it is not possible to state definitively whether man has induced significant quantities of accelerated erosion. It is possible however, based on the evidence seen in the field, to state that erosion is present in certain parts of the landscape, but provided management practices take this and the inherent instability of the soils into account, it should not be a significant problem.

### 4.2.4 Summary

The clay soils of the south-western alluvial plains are naturally subject to sheet and rill erosion. The activities of stock have increased erosion levels, but not significantly so. Disturbance of the soil surface around watering points, in particular creeks and rivers has resulted in some increase in rill and gully erosion. The relatively flat nature of the landscape decreases the potential for erosion, but land use planning should take into account the erodibility of the soils, particularly with respect to watering points.

## 5.0 WIND EROSION

The importance of wind erosion on CYP is very much unknown. Certainly it has had a major role in the formation of extensive dune fields on the east coast, at Cape Flattery, Cape Direction, Shelburne Bay and Orford Bay. These longitudinal dunes are orientated with a south-east, north-west trend, in line with the prevailing winds. The formation of these dunes is essentially a natural and ongoing process. Whether man has accelerated the formation of blowouts, through excessive use of fire, is unclear. Pye (1982) notes that there appears to be little evidence of disturbance to the stability of the Cape Direction dunefield by the presence of the old Lockhart River community.

The significance of wind erosion on open plains, particularly in the south-west of the study area, is also very difficult to quantify. It is suggested that wind erosion probably plays a small but not insignificant role on the south-western plains, although it is difficult to distinguish its relationship to sheet erosion. As indicated, the plains are relatively sparsely vegetated. Large open areas exist, although closer to the Mitchell River prior streams levees and terraces with denser vegetation become more common. These no doubt act as wind breaks. Wind run figures indicate that Kowanyama is not exceptionally windy in comparison to other centres on the Peninsula (Figure 5). However, the influence of the wind in the south-west is likely to be greater due to the lack of tree cover in comparison to centres such as Weipa and Aurukun. These latter

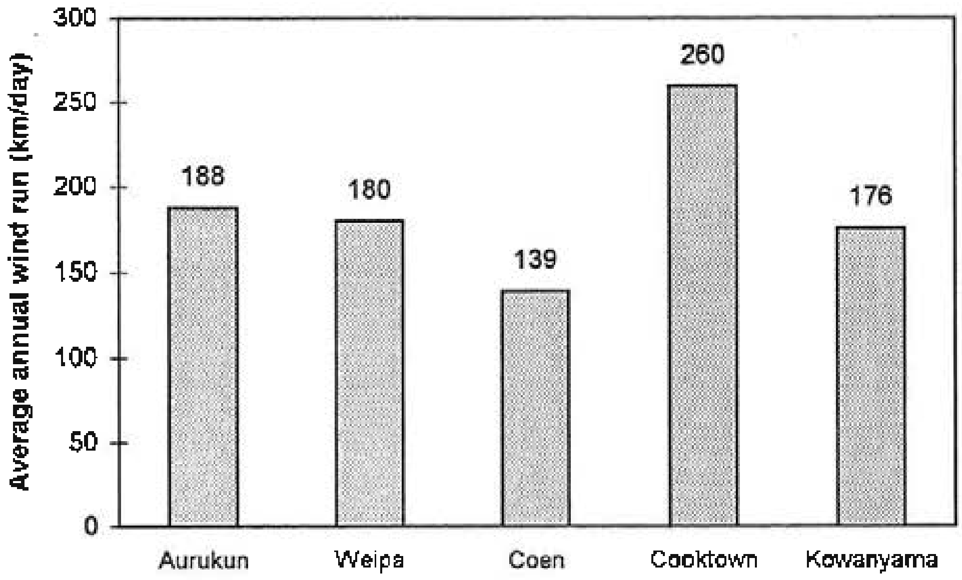



**Figure 6 Wind run for selected centres, CYP**

centres are densely wooded with *Eucalyptus tetrodonta*. Tree height average is 26 m, with a density of 203 trees/ha, in comparison to 11m and 100 trees/ha for the *E. microtheca* and *E. chlorophylla* communities in the south-west. Both Coen and Cooktown are areas with much greater relief than the western Peninsula.

Low tree and ground cover both increase the relative effect of wind on the plains. It is likely that surface fines produced from the impact of stock on the soil surface will be easily removed by wind. As with the sheet erosion, the massive surfaced clays in the east of this area are more likely to be susceptable to this form of erosion.

On its own, the level of erosion may not be significant, but when considered in conjunction with water erosion, it may be important. Management to prevent wind erosion is typically similar to that for prevention of water erosion, particularly with regards to maintaining surface cover.

## 6.0 CONCLUSION

Water and wind erosion are inherent features of the landscapes of Cape York Peninsula. Areas such as the Mitchell and Hodgkinson Landscapes also suffer from some degree of accelerated erosion. The latter area in particular contains a number of very erodible soils, particularly along major rivers. Disturbance of these soils via stock or construction of roads can lead to greatly increased levels of soil loss.

Areas containing erodible soils must be managed on a landscape basis, with both on-site and off-site consequences taken into account. Dam and road construction, as well as stocking rates and patterns need to acknowledge the inherent erodibility of certain soils on the Peninsula.

## 7.0 ACKNOWLEDGMENTS

The author wishes to express his gratitude to Seonaid Philip for providing assistance with the project and for producing the associated map. The assistance and advice of Doug Smith in the preparation of both report and map was invaluable.

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# APPENDIX 1

## Selected soils of the Hodgkinson Landscape

**Name:** Eykin (Ek)

**Concept:** Moderately deep Duplex sodic grey soils formed on greywacke and slate

**Classification:**

*Aust:* Eutrophic Mottled-Subnatric Grey Sodosol

*GSG:* Solodic Soil

*PPF:* Dy3.43, Dy3.42

**Landform:** Undulating rises to rolling hills

**Geology:** Hodgkinson Formation (D-Ch)

**Vegetation:** *E. cullenii*, *E.crebra* or *E. persistens* woodlands and open woodlands

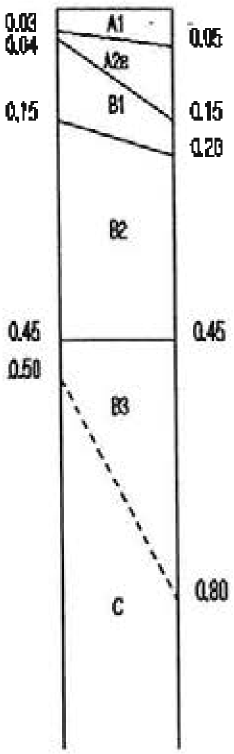
**Microrelief:** None

**Surface condition:** Hardsetting

**Surface coarse fragments:** Abundant 6-60 mm angular greywacke and slate

| Land Use Limitations | |
|---|---|
| **Climate:** | <35°C, <1500 mm (C1) |
| **Moisture Supply:** | 40 - 60 mm/m (M5) |
| **Fertility:** | <3 ppm P, >4 ppm $SO_4$ S (N7) |
| **Wetness:** | Imperfectly to poorly drained, slowly permeable (W6s, W5s) |
| **Flooding frequency:** | No flooding (F0) |
| **Rockiness:** | 6-20 mm, 20-50 % (Rm4) |
| **Topography:** | No microrelief (T0) |
| **Soil physical condition:** | Slightly to moderately adhesive soils, moderate moisture range, moderately hardsetting (P1) |
| **Vegetation factor:** | Regrowth poses a problem, existing vegetation no problem (Vo2e1) |
| **Erodibility:** | 3-10%, unstable (E3u) |
| **Landscape complexity:** | Unit size > 20 ha (X0) |
| **Salinity:** | High risk outflow zone (So3) |

**Soil Description:**




**A1** 0 - 0.04 Dark or brown (10YR 3/2 or 7.5YR 4/3); Loamy sand to sandy loam; Few to many 2-6 mm angular metamorphic or sub-rounded quartz coarse fragments; Massive; Dry, firm; Field pH 5.5 to 7.0; Abrupt or clear boundary to;

**A2e** 0.04 - 0.15 Conspicuously bleached - brown or yellow-brown (10YR 4-5/4 or 5/3); Loamy sand to sandy loam; Common to many 6-20 mm angular metamorphic coarse fragments; Massive; Dry, firm; Field pH 5.5 to 6.5; Abrupt boundary to;

**B1** 0.15 - 0.20 Yellow-brown (10YR 5-6/4 or 7.5YR 5/4); Sandy clay to light medium clay; Common 6-20 mm angular platy metamorphic or sub-rounded quartz coarse fragments; Massive to weak 2-5 mm sub-angular blocky; Dry, very firm; Field pH 6.0; Clear or gradual boundary to;

**B2** 0.20 - 0.45 Yellow-grey (2.5Y 5-6/3-4); Common to many fine faint red or yellow mottles; Light medium clay to medium heavy clay; Many to very many 2-20 mm angular metamorphic or quartz coarse fragments; Moderate to strong 2-50 mm sub-angular to angular blocky; Dry, very firm to strong; Field pH 6.0 to 9.0; Clear or gradual boundary to;

**B3** 0.45 - 0.60 Yellow-grey or pale (2.5Y 6-7/3); Few to common fine faint grey to distinct red and yellow mottles; Light clay; Many 2-6 mm angular platy metamorphic coarse fragments; Moderate 2-5 mm sub-angular blocky; Dry, firm to very strong; Field pH 6.5 to 7.5; Diffuse boundary to;

**C** Rock

**Number of sites:** 4

**Name:** Gibson (Gs)

**Concept:** Deep Duplex sodic yellow or grey soils on colluvial and pediments from greywacke and slate

**Classification:**

*Aust:* Eutrophic Mottled-Subnatric Yellow Sodosol; Sodic Sodosolic Redoxic Hydrosol

*GSG:* Soloth/Solodic Soil

*PPF:* Dy3.41, Dy3.42, Dy3.43

**Landform:** Footslopes of rises and and hillslopes

**Geology:** Pleistocene? and recent colluvia (Czx)

**Vegetation:** *E. chlorophylla, E. microtheca* or *E. acroleuca* woodlands and open woodlands

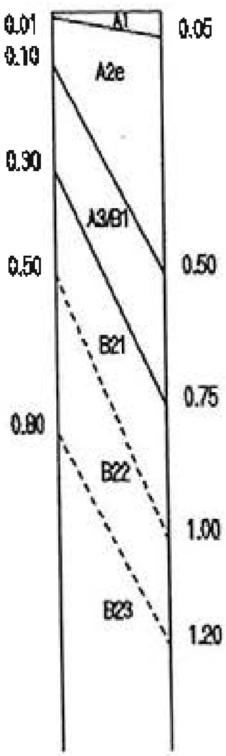
**Microrelief:** None

**Surface condition:** Hardsetting

**Surface coarse fragments:** None

| Land Use Limitations | |
|---|---|
| **Climate:** | <35°C, <1500 mm (C1), <35°C, >1500 mm (C2) |
| **Moisture Supply:** | 40 - 60 mm/m (M5) |
| **Fertility:** | 8-20 ppm P, >4 ppm $SO_4$ S (N3) |
| **Wetness:** | Poorly drained, slowly permeable (W5s) |
| **Flooding frequency:** | No flooding (F0) |
| **Rockiness:** | No rock (R0) |
| **Topography:** | No microrelief (T0) |
| **Soil physical condition:** | Slightly to moderately adhesive soils, moderate moisture range, moderately hardsetting (P1) |
| **Vegetation factor:** | Regrowth poses a problem, existing vegetation no problem (Vc2e1) |
| **Erodibility:** | 3-10%, unstable (E3u) |
| **Landscape complexity:** | Unit size > 20 ha (X0) |
| **Salinity:** | High risk outflow zone (So3) |

**Soil Description:**




**A1** 0 - 0.03 Dark, grey or grey-brown (7.5YR 3-4/2 or 10YR 4-5/2 or 2.5Y 4/1-2); Loamy sand to loam; Massive; Dry, weak to firm; Field pH 6.0 to 7.0; Abrupt or clear boundary to;

**A2e** 0.03 - 0.25 Conspicuously bleached - grey or yellow-brown or yellow-grey (10YR 5/2-4 or 6/3 or 2.5Y 6/2-4); Loamy sand to sandy loam; Few to common 2-20 mm sub-angular quartz; Massive; Dry, weak to very firm; Field pH 5.5 to 6.5; Abrupt or gradual boundary to;

**A3/B1** 0.25 - 0.50 Grey or yellow-grey or yellow-brown or pale (2.5Y 5/2-3 or 10YR 6-7/4); Few to common fine distinct yellow to orange motles; Sandy clay loam to sandy light clay; Massive to strong angular blocky; Few to many 2-5mm manganiferous nodules occasionally present; Field pH 6.0; Clear or gradual boundary to;

**B21** 0.50 - 0.80 Grey or yellow-brown or yellow-grey or yellow (10YR 6/2-5 or 2.5Y 5/1 or 5/4); Few to many fine distinct yellow, orange or red mottles; Sandy light medium clay to medium heavy clay; Strong 2-20 mm sub-angular blocky to prismatic; Moderately moist, firm to very strong; Field pH 5.0 to 8.0; Gradual or diffuse boundary to;

**B22** 0.80 - 1.00 Yellow-brown or grey (10YR 6/3-5 or 5Y 5/2); Few to many fine distinct yellow, orange or red mottles; Sandy medium clay to medium clay; Strong 2-5 mm angular blocky to 5-10 mm prismatic; Moderately moist, strong; Field pH 8.0 to 10.0; Diffuse boundary to;

**B23** 1.00 - 1.20 Yellow-grey or pale or grey (2.5Y 6/4 or 7/2 or 5Y 6/1); Few to many fine faint to distinct yellow, orange or red motles; Light medium clay silty to medium clay; Strong 2-5 mm angular blocky to 10-20 mm prismatic; Moderately moist, strong; Many 2-6 mm calcareous nodules occasionally present; Field pH 9.0 to 10.0

Limit of augering

**Number of sites:** 10

**Name:** Greenant (Ga)

**Concept:** Deep Duplex sodic acid to alkaline yellow soils formed on alluvial plains

**Classification:**

*Aust:* Mesotrophic Mottled-Subnatric Yellow Grey or Brown Sodosol; Bleached-Manganic Sodosolic Redoxic Hydrosol

*GSG:* Solodic Soil/Soloth

*PPF:* Dy3.41, Dy3.42, Dy3.43, Dg2.41, Db2.41

**Landform:** Alluvial plains/fans

**Geology:** Quaternary alluvia (Qa) and Pleistocene? colluvia (Czx)

**Vegetation:** *E. chlorophylla*, *E. microtheca* or *E. acroleuca* woodlands and open woodlands

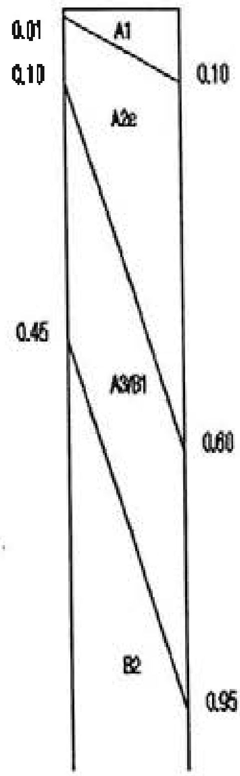
**Microrelief:** None

| Land Use Limitations | |
|---|---|
| Climate: | <35°C, <1500 mm (C1) |
| Moisture Supply: | 40 - 60 mm/m (M5) |
| Fertility: | 3-8 ppm P, >4 ppm $SO_4$ S (N5) |
| Wetness: | Poorly drained, slowly permeable (W5s) |
| Flooding frequency: | 1 in 2-10 years (F2) |
| Rockiness: | No rock (R0) |
| Topography: | No microrelief (T0) |
| Soil physical condition: | Slightly to moderately adhesive soils, moderate moisture range, moderately hardsetting (P1) |
| Vegetation factor: | Regrowth control no problem, existing vegetation no problem (Vc1e1) |
| Erodibility: | 1-3%, very unstable (E2v) |
| Landscape complexity: | Unit size > 20 ha (X0) |
| Salinity: | Medium risk outflow zone (So2) |

**Surface condition:** Hardsetting

**Surface coarse fragments:** None

**Soil Description:**




**A1** 0 - 0.05 Dark or grey or grey-brown (10YR 3-5/2 or 7.5YR 4/2); Few fine faint brown or orange mottles occasionally present; Loamy sand to fine sandy clay loam; Massive; Dry, firm to strong; Field pH 6.0 to 7.0; Abrupt or gradual boundary to;

**A2e** 0.05 - 0.40 Conspicuously bleached - grey or yellow-brown or brown or pale (10YR 5-6/2-4 or 7.5YR 5-7/3); Loamy sand to fine sandy clay loam; Massive; Dry, firm to strong; Field pH 5.5 to 6.5; Clear or gradual boundary to;

**A3/B1** 0.40 - 0.85 Yellow-brown or yellow or pale (10YR 5/3-5 or 6/4-6 or 7/1-3); Few to common fine distinct orange or red mottles; Sandy clay loam to medium clay; Massive to moderate 2-5 mm sub-angular blocky; Dry, firm to strong; Field pH 5.5 to 6.0; Clear or gradual boundary to;

**B2** 0.85 - 1.20 Brown or yellow-brown or yellow or yellow-grey or pale (10YR 4-6/4 or 10YR 6/5 or 2.5Y 4/2 or 8/1); Few to many fine distinct yellow, orange or red mottles; Light clay to medium heavy clay; Moderate to strong 2-50 mm angular or sub-angular blocky, or prismatic; Dry to moderately moist, very firm to very strong; Field pH 5.5 to 9.0;

Limit of augering

**Number of sites:** 14

**Name:** Hodge (Hg)

**Concept:** Very shallow to shallow bleached Uniform or Gradational brown soils formed on greywacke and slate

**Classification:**

*Aust:* Haplic Paralithic Bleached-Leptic Tenosol; Bleached Dystrophic Brown Kandosol

*GSG:* Lithosol

*PPF:* Uc2.12, Um2.12, Gn2.81

**Landform:** Undulating rises to steep hills

**Geology:** Hodgkinson Formation (D-Ch), Chillagoe Formation (S-Dh), Little River Coal Measures (Pur)

**Vegetation:** *E. cullenii, E.crebra* or *E. persistens* woodlands and open woodlands

**Land Use Limitations**

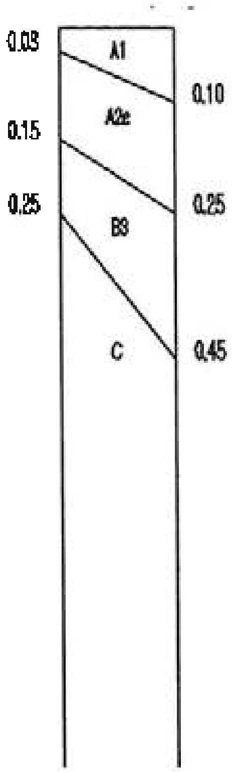
| | |
|---|---|
| **Climate:** | <35°C, <1500 mm (C1) |
| **Moisture Supply:** | < 40 mm/m (M6) |
| **Fertility:** | <3 ppm P, <4 ppm $SO_4$ S (N8) |
| **Wetness:** | Well drained, highly permeable (W2h) |
| **Flooding frequency:** | No flooding (F0) |
| **Rockiness:** | 20-60 mm, 20-50% (Rg4) |
| **Topography:** | No microrelief (T0) |
| **Soil physical condition:** | No restriction (P0) |
| **Vegetation factor:** | Regrowth control no problem, existing vegetation no problem (Vc1e1) |
| **Erodibility:** | 10-32%, unstable (E4u) |
| **Landscape complexity:** | Unit size > 20 ha (X0) |
| **Salinity:** | Moderate risk intake zone (Si2) |

**Microrelief:** None

**Surface condition:** Hardsetting, occasionally soft

**Surface coarse fragments:** Very many 6-200 mm angular greywacke, slate or quartz

**Soil Description:**




**A1** 0 - 0.05 Dark or grey (7.5YR 3-4/2); Sand to loam; Many 6-20 mm to very many 20-60 mm angular metamorphic; Massive; Dry, weak to firm; Field pH 5.5 to 6.5; Sharp or clear boundary to;

**A2e** 0.05 - 0.20 Brown (7.5YR 5/3-4); Sand to sandy clay loam; Many 6-20 mm to very many 20-60 mm angular metamorphic; Massive; Dry, weak to firm; Field pH 5.5 to 6.5; Clear or diffuse boundary to;

**B3** (frequently present) 0.20 - 0.30 Brown (7.5YR 6/4); Sandy loam to clay loam sandy; Many 6-20 mm to very many 20-60 mm angular metamorphic; Massive; Dry, weak to firm; Field pH 5.5; Clear or gradual boundary to;

**C** Rock

**Number of sites:** 4

**Name:** Jeannie (Jn)

**Concept:** Moderately deep Gradational or Uniform yellow soils formed on greywacke and slate

**Classification:**

*Aust:* Mottled or Bleached-Mottled Mesotrophic Yellow Dermosol Haplic Mesotrophic Brown Kandosol;

*GSG:* Yellow Earth/Yellow Podzolic Soil

*PPF:* Gn3.71, Gn3.74, Gn3.84, Um4.23, Uf6.51

**Landform:** Undulating rises to steep hills

**Geology:** Hodgkinson Formation (D-Ch)

**Vegetation:** *E. cullenii, E. crebra, E. persistens,* or *E. hylandii* woodlands and open woodlands

**Microrelief:** None

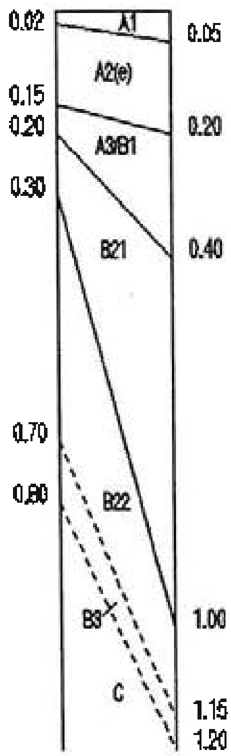
**Surface condition:** Hardsetting

**Surface coarse fragments:** Common to many 6-20 mm greywacke, slate or quartz

**Land Use Limitations**

| | |
|---|---|
| Climate: | <35°C, >1500 mm (C2), <35°C, <1500 mm (C1) |
| Moisture Supply: | 60 - 80 mm/m (M4) |
| Fertility: | <3 ppm P, <4 ppm $SO_4$ S (N8) |
| Wetness: | Imperfectly drained, moderately permeable (W4m) |
| Flooding frequency: | No flooding (F0) |
| Rockiness: | 6-20 mm, 20-50 % (Rm4) |
| Topography: | No microrelief (T0) |
| Soil physical condition: | Slightly to moderately adhesive soils, moderate moisture range, moderately hardsetting (P1) |
| Vegetation factor: | Regrowth control no problem, existing vegetation no problem (Vc1e1) |
| Erodibility: | 10-32%, stable (E4s) |
| Landscape complexity: | Unit size > 20 ha (X0) |
| Salinity: | Moderate risk inflow zone (Si2), Transmission zone (St2) |

**Soil Description:**




**A1** 0 - 0.03 Dark or grey-brown or brown (10YR 3/2 or 7.5YR 3/2 or 4/2-3); Sandy loam to light clay; Few to many 2-20 mm sub-angular to angular platy metamorphic coarse fragments; Massive; Dry, firm to very firm; Field pH 5.5 to 6.5; Clear or abrupt boundary to;

**A2(e)** 0.03 - 0.15 Occasionally conspicuously bleached - yellow-brown or brown (10YR or 7.5YR 5/3); Sandy loam to light clay; Common to many 2-60 mm sub-angular to angular platy metamorphic coarse fragments; Massive; Dry, firm to very fine; Field pH 5.5 to 6.0; Clear or gradual boundary to;

**A3/B1** 0.15 - 0.30 Yellow-brown, brown or grey (10YR 4-5/3 or 10YR 5-6/4 or 2.5Y 5/2); Few fine distinct red mottles occasionally present; Sandy loam to light medium clay. Few to many 2-60 mm sub-angular to angular platy metamorphic coarse fragments; Massive to moderate 2-5 mm sub-angular blocky to polyhedral; Dry, firm to very firm; Field pH 5.5 to 6.0; Clear boundary to;

**B21** 0.30 - 0.50 Yellow-brown or yellow (7.5YR or 10YR 5-6/5-6); Few to common fine distinct red mottles; Clay loam heavy to light medium clay; Massive to strong 2-5 mm angular blocky to polyhedral; Few to many 2-60 mm sub-angular to angular platy metamorphic coarse fragments; Dry, weak to firm; Field pH 5.5 to 6.0; Clear or gradual boundary to;

**B22** 0.50 - 0.70 Yellow (10YR 5/6 or 6/5); Common fine distinct red mottles; Light medium clay to medium clay; Massive to strong 2-5 mm angular blocky to polyhedral; Many 2-6 mm angular metamorphic coarse fragments; Dry to moderately moist, weak to firm; Field pH 5.0 to 6.0; Diffuse boundary to;

**B3** 0.70 - 90 Red-brown or yellow (5YR 5-6/6 or 10YR 5/6); Light clay to silty light medium clay; Many 2-6 mm angular platy metamorphic coarse fragments; Massive; Dry, firm; Field pH 6.0; Diffuse boundary to;

**C** Rock

**Number of sites:** 14

**Name:** Kingjack (Kj)

**Concept:** Moderately deep Gradational non-sodic yellow soils on colluvia and pediments from greywacke and slate

**Classification:**

*Aust:* Bleached-Mottled Mesotrophic Brown Dermosol

*GSG:* Yellow Podzolic Soil

*PPF:* Gn3.84, Gn3.04, Gn3.05, Dy5.41

**Landform:** Gently undulating plains, to undulating rises

**Geology:** Pleistocene? and recent colluvia (Czx)

**Vegetation:** *E. leptophleba*, *E. platyphylla* or *E. erythrophloia* woodlands

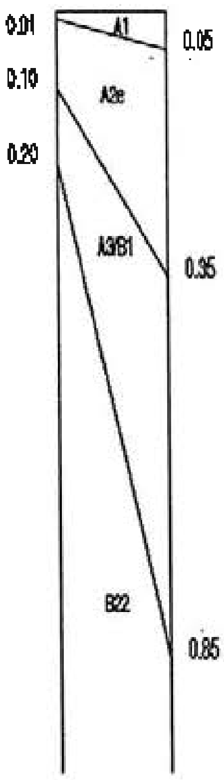
**Microrelief:** None

**Surface condition:** Hardsetting

**Surface coarse fragments:** None

| Land Use Limitations | |
|---|---|
| Climate: | <35°C, >1500 mm (C2) |
| Moisture Supply: | 80 - 100 mm/m (M3) |
| Fertility: | 8-20 ppm P, >4 ppm $SO_4$ S (N3) |
| Wetness: | Imperfectly drained, slowly permeable (W4s) |
| Flooding frequency: | Less than 1 in 10 years (F1) |
| Rockiness: | No rock (R0) |
| Topography: | No microrelief (T0) |
| Soil physical condition: | Slightly to moderately adhesive soils, moderate moisture range, moderately hardsetting (P1) |
| Vegetation factor: | Regrowth poses a problem, existing vegetation no problem (Ve2e1) |
| Erodibility: | 1-3%, unstable (E2u) |
| Landscape complexity: | Unit size > 20 ha (X0) |
| Salinity: | Moderate risk outflow zone (So2) |

**Soil Description:**




**A1** 0 - 0.03 Dark or grey (10YR 3-5/1-2); Few fine distinct orange mottles occasionally present; Fine sandy loam to silty clay loam; Massive; Dry, weak to very firm; Field pH 6.0 to 7.0; Abrupt or clear boundary to;

**A2e** 0.03 - 0.15 Conspicuously bleached - grey or yellow-brown (10YR 4/2 or 5-6/2-3); Few fine faint to distinct orange mottles occasionally present; Fine sandy loam to silty clay loam; Massive; Dry, firm to very firm; Field pH 5.5 to 6.5; Abrupt or clear boundary to;

**A3/B1** 0.15 - 0.40 Yellow-brown or yellow-grey or yellow (10YR 5/4 or 6/6 or 2.5Y 5/3 or 6/6); Few to common fine faint to distinct yellow to red mottles; Fine sandy clay loam to light clay; Weak to moderate 2-5 mm sub-angular blocky; Dry, firm to very firm; Field pH 5.5 to 6.5; Clear or gradual boundary to;

**B22** 0.40 - 1.00 Yellow or yellow-grey (10YR 5-6/6-8 or 2.5Y 5-6/4); Few to many fine distinct to prominent brown, yellow, orange, red or grey mottles; Fine sandy light clay to medium clay; Many to abundant angular to sub-rounded quartz to metamorphic coarse fragments occasionally present; Moderate to strong 2-10 mm angular to sub-angular blocky; Dry to moderately moist, firm to strong; Few to many < 2-20 mm ferruginous nodules occasionally present; Field pH 5.5 to 7.0.

Limit of augering

**Number of sites:** 15

**Name:** Victor (Vc)

**Concept:** Very deep Duplex non-sodic red soils over saline horizons, formed on terraces of major streams and rivers associated with Hodgkinson Formation

**Classification:**

*Aust:* Haplic Eutrophic Red Chromosol

*GSG:* Red Brown Earth

*PPF:* Dr2.22, Dr3.43, Dr3.42

**Landform:** Terraced land

**Geology:** Quaternary alluvia (Qa)

**Vegetation:** *E. chlorophylla*, *E. microtheca* or *E. acroleuca* woodlands and open woodlands, *E. tetrodonta* woodlands

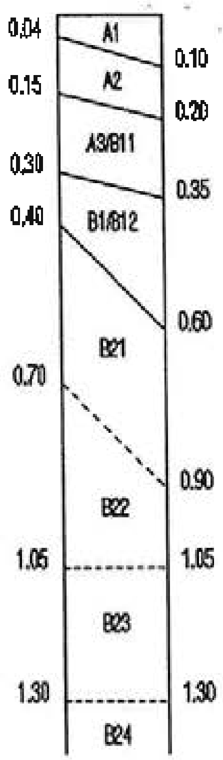
**Microrelief:** None

**Surface condition:** Hardsetting

**Surface coarse fragments:** None

| Land Use Limitations | |
|---|---|
| Climate: | $<35°C$, $<1500$ mm (C1), $>35°C$, $<1500$ mm (C3) |
| Moisture Supply: | 100 - 140 mm/m (M2) |
| Fertility: | $<3$ ppm P, $>4$ ppm $SO_4$ S (N7) |
| Wetness: | Well drained, moderately permeable (W2m) |
| Flooding frequency: | Less than 1 in 10 years (F1) |
| Rockiness: | No rock (R0) |
| Topography: | No microrelief (T0) |
| Soil physical condition: | Slightly to moderately adhesive soils, moderate moisture range, moderately hardsetting (P1) |
| Vegetation factor: | Regrowth control no problem, existing vegetation no problem (Vc1e1) |
| Erodibility: | 1-3%, unstable (E2u) |
| Landscape complexity: | Unit size > 20 ha (X0) |
| Salinity: | Naturally saline (Ss) |

**Soil Description:**




**A1** 0 - 0.04 Dark or occasionally grey (7.5YR or 10YR 3/2 or 4/1); Fine sandy loam to clay loam fine sandy; Massive; Dry, firm to moist, weak; Field pH 7.0 to 8.0; Abrupt or clear boundary to;

**A2** 0.04 - 0.15 Red-brown or yellow-brown (5YR 4/3-6 or 10YR 6/4); Fine sandy loam to fine sandy clay loam; Massive; Dry firm to moist weak; Field pH 6.0 to 7.5; Clear boundary to;

**A3/B11** 0.15 - 0.30 Red-brown or brown or occasionally yellow (5YR 3/4 or 4/5-6 or 7.5YR 4/3 or 10YR 6/5); Common fine faint yellow mottles occasionally present; Fine sandy loam heavy to light clay; Massive or weak 2-5 mm sub-angular blocky; Dry to moderately moist, firm to very firm; Field pH 6.0 to 7.5; Clear or gradual to ;

**B1/B12** 0.30 - 0.50 Red or red-brown or yellow (2.5YR 4/5 or 5YR 3/5 or 4/4 or 10YR 6/5); Common fine faint red mottles; Clay loam fine sandy heavy to light medium clay; Massive to moderate < 2 mm angular blocky; Moderately moist, firm to very firm; Field pH 6.5 to 7.5; Clear or gradual boundary to;

**B21** 0.50 - 0.85 Red or red-brown (2.5YR 3-4/7 or 5YR 3/6 or 4/4); Many fine distinct yellow mottles; Fine sandy light medium clay to medium heavy clay; Strong 2-5 mm sub-angular to angular blocky; Moderately moist, very firm; Field pH 6.5 to 7.0; Gradual boundary to;

**B22** 0.85 - 1.05 Red (2.5YR 3/5 or 4/7); Fine sandy light clay to light medium clay silty; Moderate 5-10 mm angular blocky to strong 2-5 mm angular blocky; Dry, strong to moderately moist, very firm; Field pH 7.0; Gradual boundary to;

**B23** 1.05 - 1.30 Red (2.5YR 4/6 or 5/7); Fine sandy light clay to light medium clay silty; Moderate 5-10 mm angular blocky to strong 2-5 mm angular blocky; Dry, strong to moderately moist, very firm; Field pH 7.0; Gradual boundary to;

**B24** 1.30 - 1.50 Red or red-brown (2.5YR 5/7 or 5YR 4/6); Fine sandy light clay to medium clay silty; Moderate 2-10 mm angular blocky; Dry, strong to moderately moist, very firm; Field pH 7.0;

Limit of augering

Silcrete and saline D horizons at depth

**Number of sites:** 6

**Name:** Wakooka (Wk)

**Concept:** Deep bleached Gradational non-sodic yellow soils formed on alluvial plains derived from greywacke and slate

**Classification:**

*Aust:* Bleached-Mottled or Bleached-Manganic or Bleached or Mottled Mesotrophic Yellow Dermosol

*GSG:* Yellow Podzolic

*PPF:* Gn3.84, Gn3.04

**Landform:** Gently undulating alluvial plains

**Geology:** Quaternary alluvia (Qa) and Pleistocene? and recent colluvia (Czx)

**Vegetation:** *E. clarksoniana, E. novoguinensis* or *E. polycarpa* woodlands and open woodlands

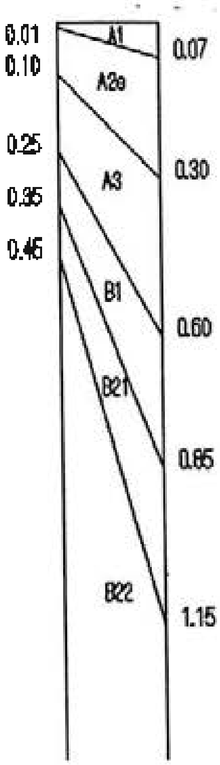
**Microrelief:** None

**Surface condition:** Hardsetting

**Surface coarse fragments:** None

| Land Use Limitations | |
|---|---|
| **Climate:** | <35°C, >1500 mm (C1), <35°C, <1500 mm (C2) |
| **Moisture Supply:** | 80 - 100 mm/m (M3) |
| **Fertility:** | <3 ppm P, >4 ppm $SO_4$ S (N7) |
| **Wetness:** | Imperfectly drained, slowly to moderately permeable (W4s, W4m) |
| **Flooding frequency:** | Every year to 1 in 2-10 years (F3, F2) |
| **Rockiness:** | No rock (R0) |
| **Topography:** | No microrelief (T0) |
| **Soil physical condition:** | Slightly to moderately adhesive soils, moderate moisture range, moderately hardsetting (P1) |
| **Vegetation factor:** | Regrowth control no problem, existing vegetation no problem (Vc1e1) |
| **Erodibility:** | 0-1%, stable (E1s) |
| **Landscape complexity:** | Unit size > 20 ha (X0) |
| **Salinity:** | Non-saline (Sn) |

**Soil Description:**




**A1** 0 - 0.03 Dark or grey or brown (10YR 3-5/1-2 or 4/3); Fine sandy loam to fine sandy clay loam; Massive; Dry, weak to very firm; Field pH 5.5 to 6.5; Abrupt boundary to;

**A2e** 0.03 - 0.15 Conspicuously bleached - grey or yellow-brown (10YR 5-6/2-3); Few to common fine faint yellow to orange mottles; Fine sandy loam to fine sandy clay loam; Massive; Dry, firm to strong; Field pH 6.0 to 6.5; Clear boundary to;

**A3** 0.15 - 0.30 Yellow-brown or yellow (10YR 5-6/4-5); Common fine faint to distinct yellow to orange mottles; Fine sandy clay loam to clay loam heavy; Massive; Dry, firm to strong; Very few < 2 mm ferruginous or ferro-manganiferous manganiferous nodules occasionally present; Field pH 6.0; Clear boundary to;

**B1** 0.30 - 0.40 Yellow-brown or brown or yellow (10YR or 7.5YR 5/4 or 6/6); Common to many fine faint to distinct yellow to red mottles; Clay loam heavy to light clay; Weak to moderate 2-5 mm angular to sub-angular blocky; Dry, firm to strong; Very few < 2-6 mm ferruginous or ferro-manganiferous or manganiferous nodules occasionally present; Field pH 5.5 to 6.5; Clear or diffuse boundary to;

**B21** 0.40 - 0.55 Yellow or yellow-brown or yellow-grey (10YR 5/5-6 or 6/4-6 or 2.5Y 6/4-6); Common to many fine faint to distinct red or grey mottles; Light clay; Moderate to strong 2-5 mm subangular blocky; Dry, firm to very firm; Very few < 2-6 mm ferruginous or ferro-manganiferous or manganiferous nodules occasionally present; Field pH 5.5 to 6.5; Clear or diffuse boundary to;

**B22** 0.55 - 1.10 Grey or yellow-brown or yellow or yellow-grey (10YR 5/2-4 or 6/5-6 or 2.5Y 6/3); Common to many fine to medium distinct to prominent red or grey mottles; Light clay to medium clay; Moderate to strong 2-10 mm sub-angular blocky to polyhedral; Moderately moist firm to very firm; Very few to common < 2-6 mm ferruginous or ferro-manganiferous or manganiferous nodules occasionally present; Field pH 6.0;

Limit of augering

**Number of sites:** 19

## APPENDIX 2

### Selected soils of the Mitchell Landscape

**Name:** Kennedy (Kd)

**Concept:** Very deep Uniform or occasionally Gradational massive surfaced or cracking grey clays formed on alluvial plains

**Classification:**

*Aust:* Sodic or Vertic Dermosolic Oxyaquic Hydrosol; Mottled or Epihypersodic or Endohypersodic or Sodic-Acidic Massive Grey or Aquic Vertosol

*GSG:* Grey Clay/No suitable group

*PPF:* Uf6.33, Uf6.51, Ug5.24, Gn3.91, Gn3.92

**Landform:** Drainage depressions to plains on alluvial plains

**Geology:** Quaternary alluvia (Qa)

**Vegetation:** *E. chlorophylla*, *E. microtheca* or *E. acroleura* woodlands and open woodlands

**Microrelief:** Normal gilgai occasionally present; vertical interval 0.30 m; horizontal interval 4-8 m

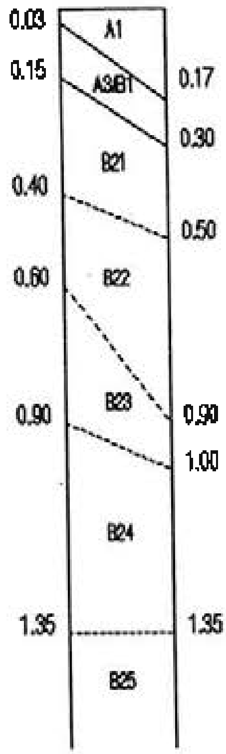
**Land Use Limitations**

| | |
|---|---|
| Climate: | >35°C, <1500 mm (C3), <35°C, <1500mm (C1) |
| Moisture Supply: | 80 - 100 mm/m (M3) |
| Fertility: | 3-8 ppm P, <4 ppm $SO_4$ S (N6) |
| Wetness: | Poorly drained, very slowly permeable (W5v) |
| Flooding frequency: | Every year (F3) |
| Rockiness: | No rock (R0) |
| Topography: | Microrelief vertical interval 0.1 - 0.3 m (T2) |
| Soil physical condition: | Strongly adhesive soils, narrow moisture range, hardsetting (including large aggregates) (P8) |
| Vegetation factor: | Regrowth control no problem, existing vegetation no problem (Vc1e1) |
| Erodibility: | 0-1%, very unstable (E1v) |
| Landscape complexity: | Unit size > 20 ha (X0) |
| Salinity: | Low risk outflow zone (So1) |

**Surface condition:** Hardsetting, frequently cracking

**Surface coarse fragments:** None

**Soil Description:**




**A1** 0 - 0.10 Grey or yellow-brown (10YR 4/1-2 or 5/1-3); Few to many fine distinct orange mottles; Silty clay loam to light medium clay; Massive; Dry, firm to strong; Field pH 6.0 to 6.5; Abrupt or gradual boundary to;

**A3/B1** 0.10 - 0.20 Grey or brown (10YR 4/1-3 or 5/2); Few to many fine distinct orange to brown mottles; Silty light medium clay to medium clay; Massive to moderate 2-5 mm sub-angular to angular blocky; Dry to moderately moist, firm to very firm; Field pH 6.0 to 6.5; Clear or gradual boundary to;

**B21** 0.20 - 0.45 Grey or olive-brown or brown or dark (10YR or 2.5Y 4/2-3 or 10YR 3/2-3); Few to common fine distinct orange mottles; Silty medium clay to medium clay; Moderate to strong 2-5 mm angular to sub-angular blocky; Moderately moist, firm to very firm; Field pH 6.0 to 7.0; Gradual boundary to;

**B22** 0.45 - 0.85 Grey or olive-brown or brown (10YR or 2.5Y 4/2-3); Few to common fine distinct orange mottles; Medium clay silty to medium heavy clay; Strong 2-5 mm angular blocky to lenticular; Moderately moist, firm to very firm; Very few to few 2-6 mm manganiferous nodules may be present; Field pH 4.5 to 7.0; Gradual or diffuse boundary to;

**B23** 0.85 - 1.00 Grey (10YR, 2.5Y or 5Y 4/1); Common fine distinct orange or brown mottles; Medium clay silty to medium heavy clay; Moderate 5-10 mm angular blocky to 2-5 mm lenticular; Moderately moist, very firm; Very few to few 2-6 mm manganiferous nodules; Field pH 7.0 to 10.0; Gradual boundary to;

**B24** 1.00 - 1.35 Grey (2.5Y 4/2); Heavy clay; Strong 5-10 mm lenticular; Moderately moist, very firm; Few 2-6 mm manganiferous nodules; Field pH 10.0; Gradual boundary to;

**B25** 1.35 - 1.50 Grey (10YR 4/2); Few fine distinct yellow mottles; Medium heavy clay; Strong 2-5 mm lenticular; Moderately moist, very firm; Field pH 10.0;

Limit of augering

**Number of sites:** 16

CYPLUS
CAPE YORK PENINSULA
LAND USE STRATEGY

DEPARTMENT OF PRIMARY INDUSTRIES
QUEENSLAND
NORTH REGION

CYPLUS is a joint initiative between the Queensland and Commonwealth Governments.

# DEGRADATION STATUS

## Existing and Potential Soil Erosion

**LAND USE PROGRAM**

**CYPLUS NR02**

**Information shown on this map is derived from 'Soil Survey and Agricultural Land Suitability of Cape York Peninsula' (Biggs, A.J.W. & Philip, S.R. 1994.)**

**Further information is available in the report: 'Existing and Potential Erosion Hazard, Cape York Peninsula' (Biggs A.J.W. 1994)**

**REFERENCE**

- Soils with a high potential[1] to develop accelerated[2] erosion
- Soils with a moderate potential to develop accelerated erosion
- Soils with existing accelerated erosion

NOTES

1. Potential erosion assessment is based on examination of soil morphological properties and slope.
2. Accelerated erosion is soil loss that occurs at a rate greater than that which naturally occurs and is induced by mans activities.

This map is based on reconnaissance soil survey data gathered during NR02 involving air photo interpretation and ground observations to the order of one observation per 82 km². Hence it is not a comprehensive statement about all areas of existing erosion on Cape York Peninsula.

The information shown on the map has been supplied by the Queensland Department of Primary Industries. Initial enquires regarding the information should be directed to Land Use and Fisheries, Mareeba.

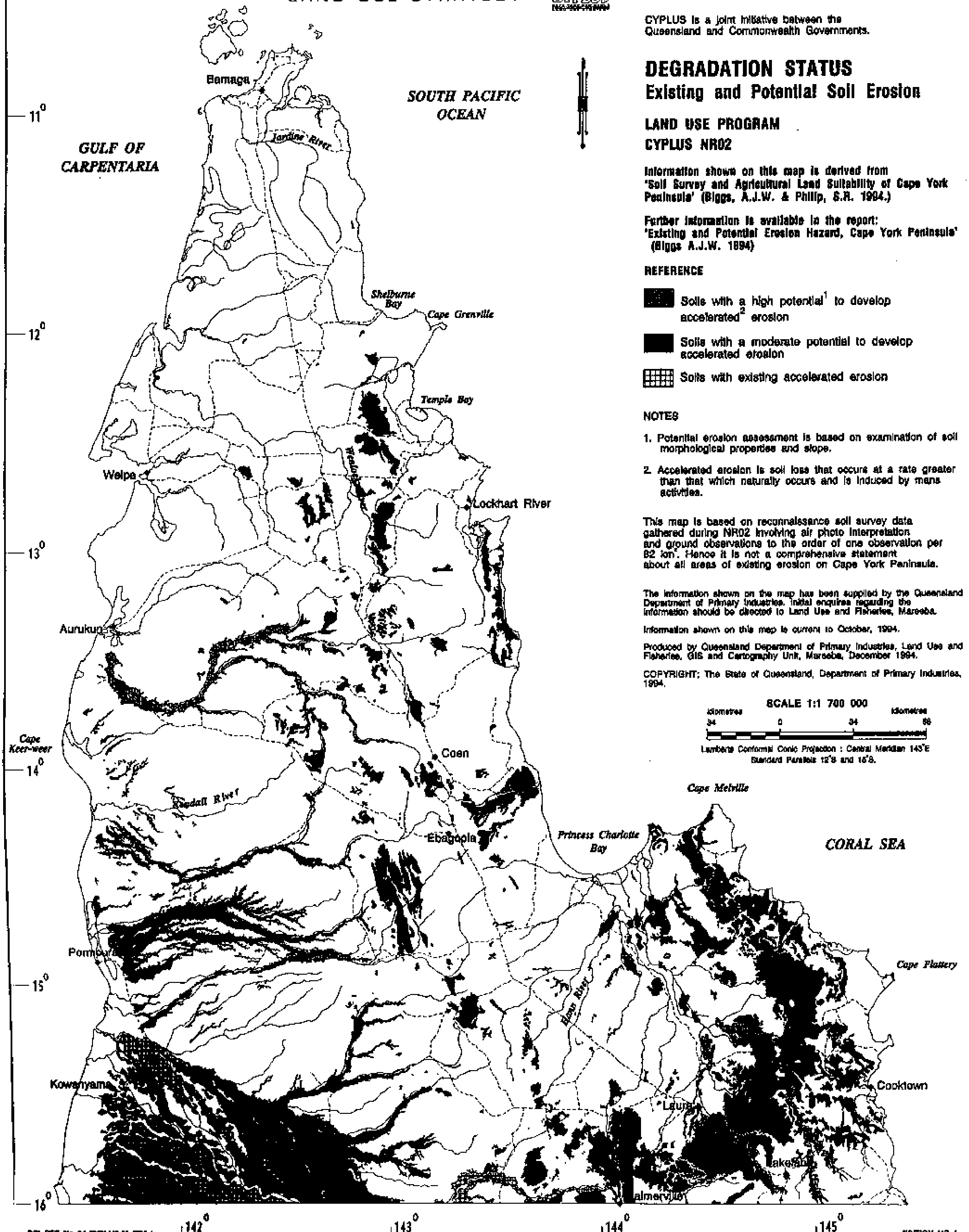
Information shown on this map is current to October, 1994.

Produced by Queensland Department of Primary Industries, Land Use and Fisheries, GIS and Cartography Unit, Mareeba, December 1994.



SCALE 1:1 700 000

Lamberts Conformal Conic Projection : Central Meridian 143°E
Standard Parallels 12°S and 16°S.




DPI REF No 94-CYPLUS-NRJ735.1

EDITION NO 1

# PART 2

## POTENTIAL SOIL LOSS BY WATER EROSION

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## TABLE OF CONTENTS

## SUMMARY

This report presents a map of water erosion hazard for Cape York Peninsula assessed from the predicted soil loss using the Universal Soil Loss Equation (USLE). The erosion hazard for most of the CYPLUS area is in the range very low to low, mainly because of the high permeability of the sandy soils which reduces the amount and rate of runoff. The distribution of mapped erosion potential is consistent with the locations and severity of occurrences of sheet, rill and gully erosion observed in the field. The natural woodland and grass vegetation assists in reducing erosion hazard. Predicted soil losses increase greatly where the vegetation cover is depleted or removed, as would be the case following dry season fires. The prediction of a high water erosion hazard for an area does not preclude a particular land use. Rather, it indicates that a particular type and level of management is required for the sustainable use of the land.

## 1. INTRODUCTION

Erosion hazard is the potential for land to undergo accelerated erosion (erosion which, because of human activities, operates at rates higher than natural rates) when subject to inappropriate land uses. The assessment of erosion hazard is an especially important component of land evaluation in the seasonally wet tropics of northern Australia where there is the potential for high rates of erosion on disturbed or unprotected ground (East 1994). This report is concerned with water erosion, which involves the detachment of soil particles by raindrop impact or flowing water, their transport, and subsequent deposition. Water erosion takes a number of forms, including sheet, rill, gully, tunnel and stream bank erosion. This report is concerned mainly with the prediction of soil loss by sheet and rill erosion that takes place on slopes, outside natural water ways. Soil loss is determined here using the Universal Soil Loss Equation (USLE).

The report of the Land Degradation and Soil Erosion Project forms part of the Cape York Peninsula Land Use Strategy (CYPLUS), Land Use Project. It provides a brief statement of methodology, results and significance. The work was carried out over the period 1992-1994 by the Australian Geological Survey Organisation (AGSO) and the Bureau of Resource Sciences (BRS).

## 2. THE UNIVERSAL SOIL LOSS EQUATION

The USLE was developed in the United States (Wischmeier and Smith 1978). It predicts the average annual soil loss in storm runoff from specified land units under specified management practices. The version used in this study is SOILOSS, a computer program developed by the New South Wales Department of Conservation and Land Management (Rosewell and Edwards 1988).

Soil loss (A) is determined by multiplying six factor values together:

$$A\ (t/ha/y) = R \cdot K \cdot L \cdot S \cdot P \cdot C$$

*Rainfall erosivity (R), soil erodibility (K), slope length (L), slope steepness (S), cultivation method (P) and vegetation cover (C).*

A is the predicted long term average soil loss (t/ha/yr).

R is a measure of the ability of rainfall to cause erosion. The numerical value used for R is the average annual total of Erosion Index (EI) at a location where EI is the product of runoff energy and maximum 30 minute intensity for each storm.

K is a measure of the erodibility of the regolith or its susceptibility to erosion. K is normally determined experimentally but can be estimated using five regolith attributes - texture (per cent sand, silt and clay), per cent gravel, organic matter content, soil structure, and permeability (Goldman and Jackson 1986).

Slope length (L) is the distance, measured parallel to the ground surface, from the origin of overland flow to the point where either the slope gradient decreases enough so that deposition begins or where runoff becomes concentrated in a defined channel. Slope steepness (S) is measured as the per cent gradient of the slope segment.

C is a cover management factor, and measures the combined effect of all the interrelated crop cover and management variables. Values for C for rangelands are given in Wischmeier and Smith (1978, Table 10).

The support factor P accounts for the direction of cultivation and the size of the furrows created by tillage; P is unity for rangelands.

In its original form the USLE was developed for relatively small areas and detailed soil and topographic information, and was calibrated against measurements of actual soil loss (Wischmeier and Smith 1978). However, it has subsequently been adopted for use at more regional scales, and the factors can be estimated from surrogate data rather from measured data.

The USLE was chosen to assess the erosion hazard of the regolith of Cape York Peninsula (CYP) because it lends itself to use for large areas at reconnaissance map scales (<1:250 000) for which there are little or no existing erosion data. There are two caveats on the results:

1. The data put into the USLE for this study were variable in scale, and based on surrogates rather than real measurements.

2. There are no published measurements of soil loss for the CYPLUS area, so the results are uncalibrated.

For these reasons, the results must be regarded as relative only, and no absolute reliability should be placed on the numerical results. The mapped distribution of predicted soil loss was checked for consistency with extensive field observations of erosion and their associated regolith and landforms in CYP.

## 3. METHODS

### 3.1 Data Sources

Data were required for each factor in the USLE - climate, landforms, vegetation and soils. All data, with the exception of climate, were available as digital coverages, captured at a variety of scales. Data were input into the AGSO Geographic Information System, ESRI's ARC/INFO. They were converted to a raster format, or grid, for use in the USLE.

#### 3.1.1 Rainfall Erosivity (R)

The R factor was derived from the following climatic maps obtained from Institution of Engineers (1987).

Average Regional Rainfall Skewness

2yr average recurrence interval / 1hr duration (mm/hr)
2yr average recurrence interval / 12hr duration (mm/hr)
50yr average recurrence interval / 1hr duration (mm/hr)
50yr average recurrence interval / 12hr duration (mm/hr)

These maps, showing isolines at a scale of 1:5 000 000 were scanned, imported into ARC and converted to grid cells. The final R factor map was produced using an aml in ARC. The aml reproduces a procedure developed by C. Rosewell (NSW CALM, pers. comm.).

### 3.1.2 Soil Erodibility (K)

K is estimated here from the soil texture (per cent sand, silt, clay) using the texture nomograph in Goldman and Jackson (1986 fig. 5.6) and corrected for gravel content (percent by volume of soil particles greater than 2mm), organic matter content, soil structure and permeability. The uncorrected values for the K factor for a range of soil textures are given in Table 1.

**Table 1. Uncorrected K factor values for a range of soil textures**

| Soil Texture | K Factor |
|---|---|
| Clay | 0.16 |
| Clay loam | 0.17 |
| Sandy clay | 0.05 |
| Sandy clay loam | 0.10 |
| Sandy loam | 0.12 |
| Sand | 0.09 |
| Loamy sand | 0.19 |
| Silty clay | 0.26 |
| Silty clay loam | 0.35 |
| Silty loam | 0.47 |
| Loam | 0.19 |
| Fine sandy loam | 0.24 |
| Fine sandy clay loam | 0.22 |

The K factor for the CYPLUS area was estimated using the CYPLUS Soil map (Biggs *et al.* 1994), which includes information about soil surface texture and rock content. Each soil map polygon was given a value for the K factor and was then gridded.

### 3.1.3 Slope Length (L) and Slope Steepness (S)

Slope length and slope steepness were obtained from the regolith landform map of the CYPLUS area (Pain *et al.* 1994) using the diagnostic range of values for a classification of landforms in Speight (1990). The slope length factor ranges from 20 m in mountains to 300 m on plains. The slope steepness factor ranges from 1% for plains to 50% for mountains. These two values were combined into one (LS) using SOILOSS, a computer program developed by the New South Wales Department of Conservation and Land Management (Rosewell and Edwards 1988).

### 3.1.4 Cultivation Method (P)

The P factor was set to unity.

### 3.1.5 Vegetation Cover (C)

The vegetation cover C is determined from canopy type and percent cover, and percent cover that contacts the soil surface. This information was obtained from the map of present vegetation of Australia compiled by Carnahan (1989). C factor values were allocated to classes of vegetation following Wischmeier and Smith (1978 table 10).

## 3.2 Calculation of Soil Loss

Predicted soil loss was obtained by multiplying R . K . LS . C. These calculations were performed on grid files of each factor in ARC/INFO.

Because the USLE has not been validated for CYP conditions, and there are no measurements of actual soil loss, a conservative approach was used and predicted values of soil loss were assigned to five classes of erosion hazard:

| | |
|---|---|
| 0 - 1 t/ha/yr | Very low |
| 1 - 5 | Low |
| 5 - 10 | Moderate |
| 10 - 100 | High |
| >100 | Very high |

The validity of applying the USLE to CYP and the mapping of five classes of erosion hazard rather than the computed values was considered by national and international authorities on the USLE to be a conservative application of the model (C Rosewell, NSW CALM; K Renard, United States Department of Agriculture, Agriculture Research Service, Tucson Arizona USA. pers comm).

### 3.3 Field checking

As an additional check on the use of the model, detailed regolith, topographic and vegetation data were collected in the field in the area of the 1:250 000 Ebagoola map sheet (about 18 000 $km^2$ ) during the 1992 and 1993 northern dry seasons. These data were input to the USLE and predicted soil loss mapped using the five classes of erosion hazard. Erosion hazard was calculated for the worst case situation - at the end of the dry season (Sept-Oct) when the grass cover is most reduced and the risk of erosion greatest. The predicted values would be expected to be somewhat higher than those calculated using Carnahan's (1989) vegetation classification.

A comparison of the Ebagoola map (Figure 1) with the map for the whole CYPLUS area shows general agreement in the extent and level of erosion hazard. The steep slopes of the Great Escarpment and some areas of higher relief and fine sandy soils to the east and west are shown in both maps as high erosion hazard. The plains to the west of the uplands are predicted as very low in both maps. Erosion hazard of regolith on hilly terrain between the escarpment and the plains is intermediate between the two extremes; it is classified as low on the map for the whole CYPLUS area, and as moderate in the dry season vegetation situation on the 1:250 000 Ebagoola Sheet (Figure 1).

The distribution of mapped erosion potential is consistent with the locations and severity of occurrences of sheet, rill and gully erosion observed in the field during the 1992 and 1993 AGSO CYP field seasons. For example, intensive but localised erosion systems occur in fine grained sediments on the floodplain of the Palmer River (Figure 2) and are mapped as moderate erosion hazard, whereas the surrounding more stable lowlands are mapped as low and very low hazard.

Figure 1

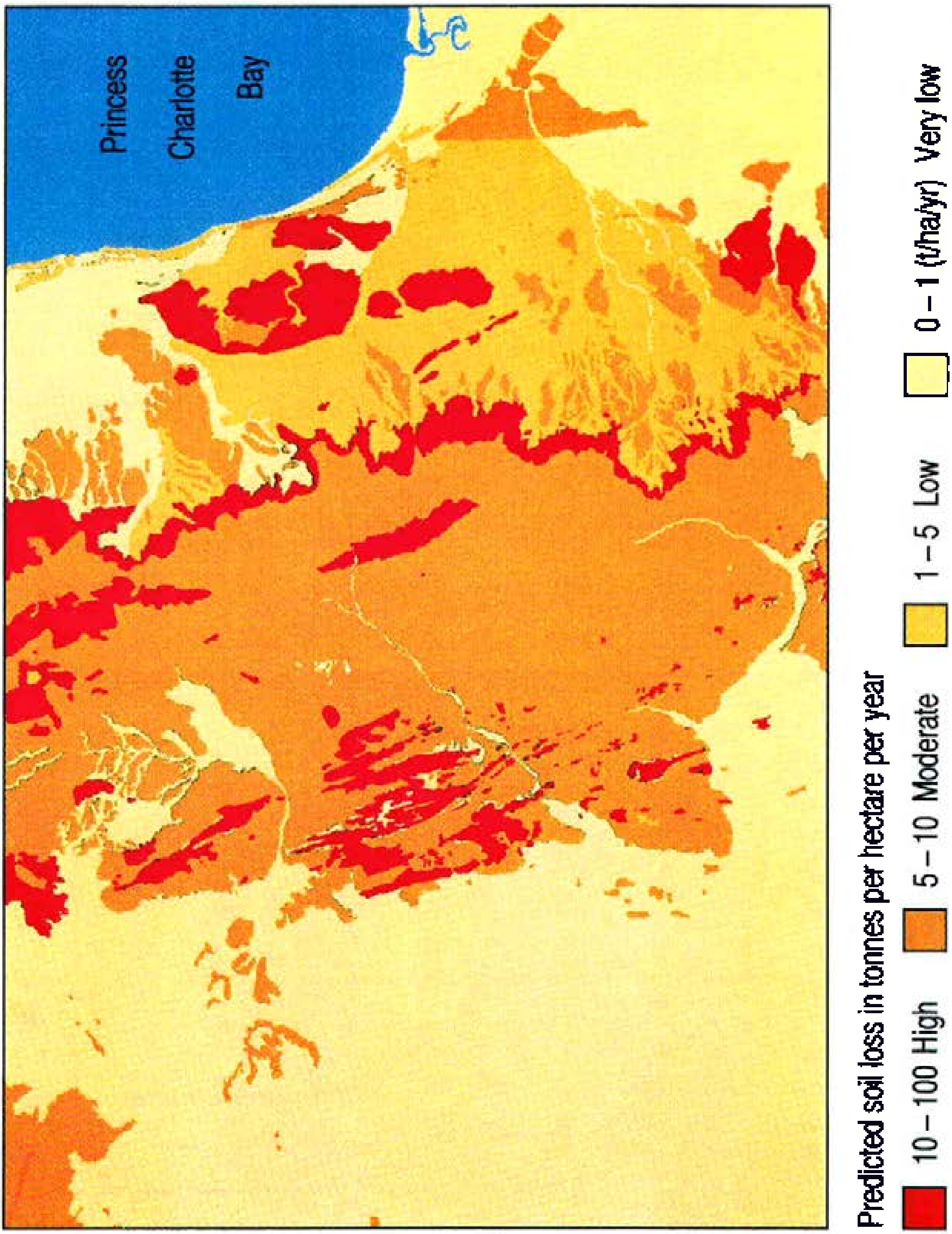
Princess
Charlotte
Bay
Predicted soil loss in tonnes per hectare per year
10 – 100 High
5 – 10 Moderate
1 – 5 Low
0 – 1 (t/ha/yr) Very low

**Figure 2. Gully system developed in fine grained sediments along the flood plain of the Palmer River**

**Figure 3. Gully erosion where water has been concentrated along a track.**

# 4. RESULTS

## 4.1 The Map of Water Erosion Hazard

The erosion hazard for most of the CYPLUS area is in the range very low to low. In general there is a gradient from high along the east coast to low along the west coast. This reflects the gradient of amount and intensity of rainfall, which is superimposed on other factors.

The main reason for the generally low predicted erosion rates is the high permeability of the sandy soils which reduces the amount and rate of runoff. Additional factors are the generally low slope angles of the plains and rises that make up most of the area, and the woodland vegetation which reduces the erosivity of the high intensity rain which is characteristic of the seasonally wet tropics. The difference between very low and low potential soil loss appears to be related to slope angle and to surface soil texture.

The main areas of high erosion potential are in areas with steeper slopes, mainly in the uplands of the Coen Inlier, and the ranges north and south of Cooktown. Steep slopes along the Great Escarpment also have a moderate to high erosion potential. Smaller scarps on Merluna, and south of Merapah also fall into this category because of the generally steeper slopes.

There are some areas where the erosion potential seems to be anomalous. These are considered briefly here:

1. There are small areas of high erosion hazard on the alluvial plains on the western side of the CYPLUS area. These occurrences are mainly in broad but shallow channels where the regolith has high percentages of silt and fine sand. Soils dominated by these particle sizes are highly erodible (see, for example, Morgan 1979). Water flow is concentrated in these shallow depressions increasing the potential for erosion. At present there is little erosion evident, although the combination of soil texture and landscape position has implications for management of land which contains these shallow depressions.

2. Large gully systems have formed in riparian areas which have been over grazed by cattle, and in gaining access to water in rivers and billabongs. These areas are found mainly on the flood plains of larger rivers such as the Archer and the Palmer Rivers. Again, the combination of susceptible soil particle sizes and concentration of overland flow because of landscape position imparts a higher erosion potential to these areas.

3. Areas of very high erosion potential occur south of Cooktown. This is an area of very steep slopes and generally rainforest vegetation. Such a result is consistent with the steep slopes, and the nature of the weathered granite. Also, even natural erosion by surface wash under rainforest can be high (Ruxton 1967), and accelerated erosion rates following clearing of rainforest in these areas could be extremely high.

4. A large area of heathlands in the north of the CYPLUS area is mapped as having a high erosional potential. The soil texture (fine sand) and the vegetation cover (very low

ground cover) increases values of the K and C factors, and the overall erosion potential.

As noted above, values obtained from the USLE were grouped into classes rather than used directly, in order to give a map showing relative rather than absolute soil erosion hazard. Moreover, we judge it better to comment on the anomalies rather than try to fix them and change map values subjectively.

**4.2 The Role of Vegetation**

The natural vegetation (woodlands and grasses) contributes to the protection of the soils from erosion. The importance of vegetation was assessed by varying the value of the vegetation factor in the USLE to simulate the clear felling of the trees and the burning or removal of the grasses. Predicted soil losses increased greatly where the vegetation cover is significantly depleted or removed, as would be the case following dry season fires which are common in CYP. For example, the predicted soil loss for regolith with a high (90%) grass cover and low erosion hazard can increase threefold or more when the vegetation cover is removed. In this case the risk of erosion increases from low to high. Erosion rates are highest on ground where grass cover has been destroyed by bush fires in the late dry season thus leaving it exposed to early wet season storms. The prediction of a high water erosion hazard for an area does not preclude a particular land use. Rather, it indicates that a particular type and level of management is required for the sustainable use of the land.

Erosion is also accelerated through the concentration of runoff by cattle pads and vehicle tracks. In CYP, soils formed on weathered granite (saprolite) that were assessed as being of moderate erosion hazard when undisturbed became highly erodible when runoff was concentrated down slope by vehicle tracks. At some sites, deep gully erosion made tracks unserviceable, necessitating the formation of new tracks parallel to the former tracks (Figure 3).

Erosion hazard is also increased if the surface structure of the soil is damaged by stock trampling or vehicle movements. Sandy soils are particularly prone to structure damage, which reduces infiltration and increases runoff. In CYP, soils in high usage areas such as around stock watering points showed evidence of structure damage, which would have contributed to the sheet and gully erosion at some of these sites. Other degradation includes erosion and accelerated sedimentation associated with small mining ventures, and disturbance in billabongs associated with overgrazing and trampling by cattle and feral pigs and horses.

## 5. CONCLUSIONS

The erosion characteristics of the land resources of CYP identified in this survey highlight the need for special management requirements if they are to be managed sustainably. These requirements could include, in the case of cattle raising - the use of conservative stocking rates, the location of stock watering points away from areas of high erosion risk, fencing soils and waterways either at risk of degradation or currently degraded, and the locating of roads and tracks to take account of local terrain and regolith characteristics.

The use of the USLE can be extended beyond its present application for assessing erosion hazard under present land conditions. For example, the technique could be used to evaluate and compare different land uses and management options in the region, because of its ability to make recommendations on ways to reduce erosion by changing land and crop management practices. This process of evaluation is critical for CYP where most soils have a low erodibility when undisturbed, they are highly susceptible to erosion under inappropriate management.

## 6. ACKNOWLEDGEMENTS

We acknowledge the advice on the application of the USLE generously provided by Mr Colin Rosewell of the New South Wales Department of Conservation and Land Management. Mr Andrew Biggs and his colleagues from the Queensland Department of Primary Industries provided the soils data. We warmly acknowledge the contribution of Mr Tas Armstrong as Field Operations Manager during the three field seasons spent on CYP, and those who supported that fieldwork as technical officers, field hands, mechanics, and cook. We are grateful for the assistance and hospitality of land holders in providing permission to enter their properties, and the National Parks and Wildlife Service for approval to enter National Parks.

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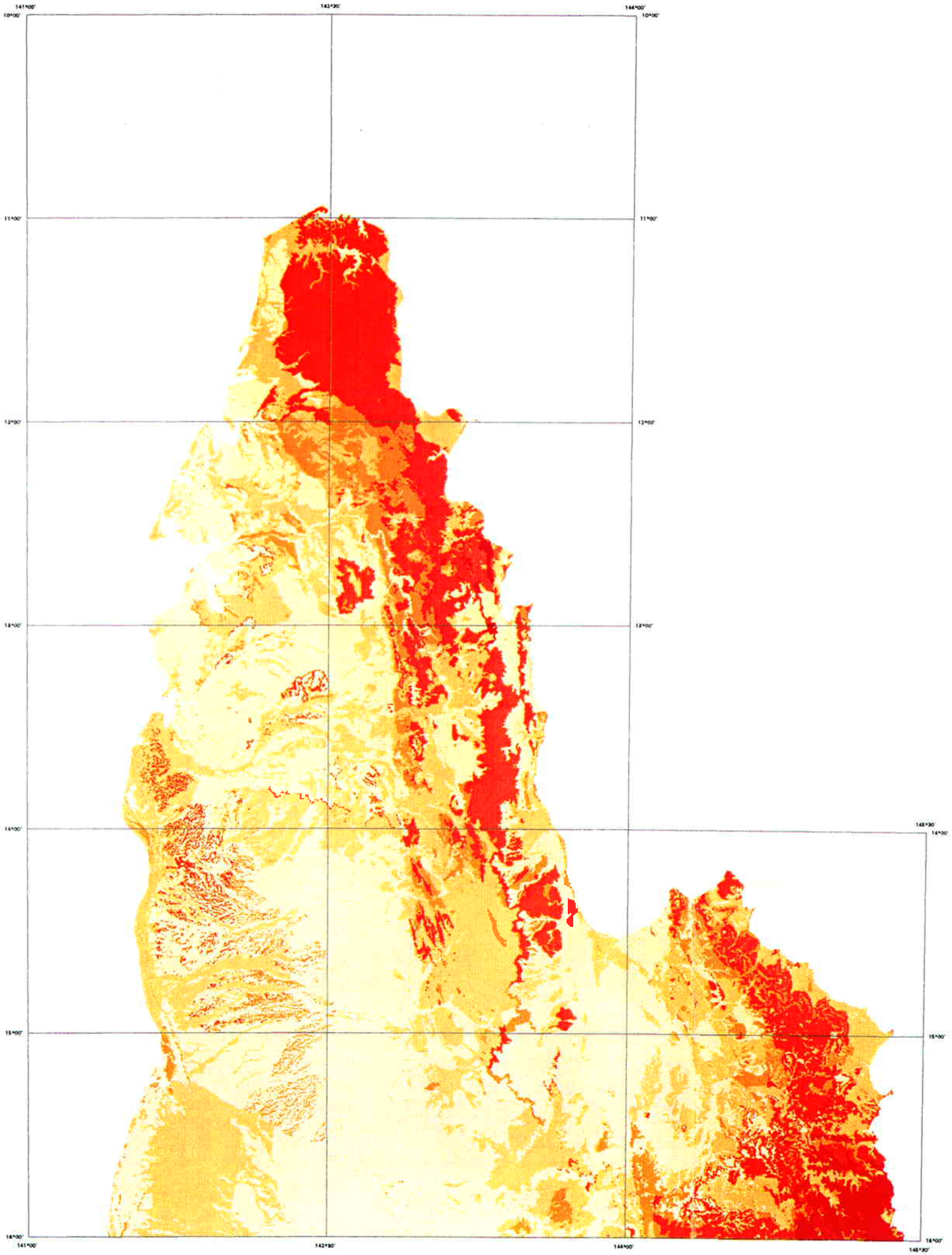

# CYPLUS

CYPLUS is a joint initiative between the Queensland and Commonwealth Governments

## SOIL LOSS POTENTIAL

EDITION 1

- Very high
- High
- Moderate
- Low
- Very low

SCALE 1:2,500,000

0 50 100 150 200 250 Kilometres

UNIVERSAL TRANSVERSE MERCATOR PROJECTION

Australian Map Grid Zone 54



The information shown on the map has been supplied by the Australian Geological Survey Organisation. Initial enquiries should be directed to the Principal Information Officer, AGSO, GPO Box 378, Canberra City, ACT 2601.

# PART 3

## SALINITY HAZARD
## OF
## CAPE YORK PENINSULA

A.J.W. Biggs

Queensland Department of Primary Industries

(Northern Region)

## CONTENTS

# TABLES

# FIGURES

## 1.0 INTRODUCTION

Salinity in soils refers to concentrations of soluble salts which impede plant growth directly, or indirectly through effects on soil properties such as permeability. Soluble salts may commonly comprise chloride, sulphate and bicarbonate anions associated with sodium, calcium and magnesium cations.

Saline soils occur naturally or can develop as a consequence of human activities. The latter is referred to as secondary salinisation, and is associated with an alteration of the hydrological balance of the landscape, through tree clearing, cropping or excessive irrigation.

Cape York Peninsula has both naturally saline areas and susceptible landscapes that have the potential for secondary salinisation if they were to undergo major hydrologic change.

## 2.0 CHARACTERISTICS OF SUSCEPTIBLE LANDSCAPES

The key indicators of landscapes that are saline or have the potential to become so are outlined by Shaw *et al.*, (1986). They include:

- Rocks or soils which are naturally saline e.g. marine clays
- Impermeable soils or geological restrictions to groundwater flow which are adjacent to permeable soils or rocks that allow water entry (*inflow zones**)
- Impermeable soils or layers that allow saline water to accumulate (*outflow zones)* and enter the root zone of plants
- Landscapes with existing shallow water tables which may or may not be saline
- Catchments with topographical or geological restriction to groundwater flow
- Presence of salt tolerant and/or water logging tolerant vegetation
- Soil morphological indicators of perched/intermittent shallow water tables

Present investigations on Cape York Peninsula, have identified many of these indicators, in particular, rocks or soils that contain appreciable levels of salts.

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* Further definition is provided on p59.

## 3.0 ASSESSMENT

Naturally occurring saline soils have been recognised by the staff who conducted the Soil Survey and Agricultural Land Suitability of Cape York Peninsula Report (NR02)in the course of normal soil survey techniques, using field Electrical Conductivity (EC) and laboratory chemical analysis.

The following methodology has been used to determine soils/landscapes that have the potential for secondary salinisation:

(i) Examine geological data to determine which lithologies are likely to provide a source of salts

(ii) Rank soils in terms of their potential as inflow, transmission or outflow zones

(iii) Carry out Electro-Magnetic induction (EM) testing in the field, in areas where both (i) and (ii) are indicated

All soils described in the NR02 Report were allocated a salinity ranking, as part of an agricultural suitability assessment process. The categories used were:

- soils that are non-saline (Sn),
- soils that may act as inflow zones i.e well drained, moderately to highly permeable soils in elevated landscape positions (Si),
- soils that may act as transmission zones i.e imperfectly drained, moderately to highly permeable soils in midslope positions (St),
- soils that may act as outflow zones i.e imperfectly to poorly drained, slowly permeable soils in lower landscape positions (So), and
- soils that are naturally saline (Ss)

Those soils that were allocated either Si, St or So ranking's were further sub-divided on a scale of one to three, based on their properties in relation to salinity potential (Table 1).

**Table 1 Salinity ranking's used in Soil Survey and Agricultural Land Suitability of Cape York Peninsula Report.**

| **SLIM*** | **Salinity potential** |
|---|---|
| (Si, St, So) 1 | Soils that are located in landscapes not likely to develop secondary salinity |
| (Si, St, So) 2 | Soils that are located in landscapes that have a low probability of developing secondary salinity |
| (Si, St, So) 3 | Soils that are located in landscapes that have a significant potential to develop secondary salinity |

*Salinity Limitation

*Inflow zones* are those portions of the landscape in which there is a downward component to groundwater flow near the surface, that is, water is received at the surface and flows downward through the soil to lower parts of the landscape.

*Transmission zones* are those portions of the landscape where the dominant groundwater flow is lateral, generally downslope, that is, areas through which water flows from inflow zones to outflow zones.

*Outflow zones* are those portions of the landscape in which there is an upward component to groundwater flow near the soil surface, that is, water rises to, or near the soil surface (Shaw *et al.*, (1986).

## 4.0 SUMMARY OF FINDINGS

**The potential for secondary salinity** is generally restricted to soils associated with two geological units - the Rolling Downs Group, and the Hodgkinson Formation. Both consist of marine origin sediments, although their structure and landforms differ greatly. The soils associated with these lithologies have been assessed as having intake, transmission or outflow characteristics, and some have appreciable levels of salts at depth.

**Soils found to be naturally saline** in this study are chiefly associated with Quaternary coastal deposits. The only soil mapped as naturally saline that is not associated with coastal deposits is derived from the Hodgkinson Formation.

Table 2 provides a list of all the soils in the NR02 study that were found to be naturally saline or implicated in landscapes with a potential to develop secondary salinity. They are listed according to their geological origin and salinity ranking. The accompanying map depicts all land that is dominated by naturally saline soils, as well as inflow, transmission or outflow zones that have been identified as having a potential to contribute to secondary salinity.

The following sections provide more detailed discussion of the relationships between the three geological units and their associated soils, in the context of salinity assessment. The discussion is based on information gathered during the NR02 investigation, and additional information provided by Natural Resource Management Group (QDPI).

**Table 2 Salinity categories for selected soils of CYP**

| Geology | Salinity category (SLIM)* | Soil |
|---|---|---|
| Aurukun Surface | Si1 | Andoom (Ad), Weipa (Wp) |
| | Si3 | Bertie (Bt), Scorpion (Sp) |
| Rolling Downs Group | Si3 | Batavia (Bv), Lydia (Ld) |
| | St3 | Batavia (Bv), Lydia (Ld), Myall (Ml) |
| | So3 | Batavia (Bv), Lydia (Ld), Myall (Ml), Picanninny (Pn) |
| Hodgkinson Formation | Si2 | Hodge (Hg), Kingjack (Kj) |
| | St2 | Kingjack (Kj) |
| | So2 | Kingjack (Kj), Greenant (Ga) |
| | Si3 | Jeannie (Jn) |
| | So3 | Eykin (Ek), Gibson (Gs) |
| | Ss | Victor (Vc) |
| Quaternary coastal deposits | Ss | George (Go), Marine (Mn), Nassau (Ns), Skardon (Sd) |

*(SLIM) - Salinity Limitations - as defined in Appendix 3 of Soil Survey and Agricultural Land Suitability of Cape York Peninsula Report (NR02)

# 5.0 ROLLING DOWNS GROUP AND ASSOCIATED SURFACES

## 5.1 General

The Rolling Downs Group covers an extensive band of country in the middle of the Peninsula from east of Weipa to west of Musgrave (Figure 1). It consists of Cretaceous sediments of marine origin - mostly mudstone and siltstone with minor labile glauconitic sandstone (Smart, 1977, Wilmott and Powell, 1977). The landscape is predominantly gently undulating (<3%) plains to undulating (3-10%) rises.

Rainfall ranges from approx. 900 mm to approx. 1700 mm per annum and is highly seasonal. Vegetation varies with soil type and landscape position but is dominated by *Eucalyptus* species *(E. tetrodonta, E. clarksoniana, E. leptophleba, E. papuana, Erythrophleum chlorostachya*) on the slopes, with *Melaleuca viridiflora* becoming more prevalent in the low lying country. *Petalostigma banksii* is a common understorey species on the nodular soils.

The Rolling Downs Group (Batavia) Landscape includes heavily laterised remnants of the Bulimba Formation, referred to as the Aurukun Surface (Doutch, 1976, Figure 1). The dominant soils, *Weipa* (Si1) and *Andoom* (Si1) are aluminous in nature, well drained and moderately permeable. A pallid zone (kaolin) is present at considerable depth. Much of the rainfall that infiltrates in the Aurukun Surface, particularly on the Weipa Plateau, flows to the west (Herbert pers. com.). Applied water i.e irrigation is therefore unlikely to constitute a large influence in terms of secondary salinisation within the Rolling Downs Group to the east. In addition, *Weipa* and *Andoom* are not suitable for cropping, and irrigation is unlikely.

On the ferruginized remnants on the eastern edge of the Aurukun Surface, and scattered throughout the Rolling Downs Group are *Bertie* (Si3) and *Scorpion* (Si3). These

# BATAVIA LANDSCAPE

West | East

SOILS

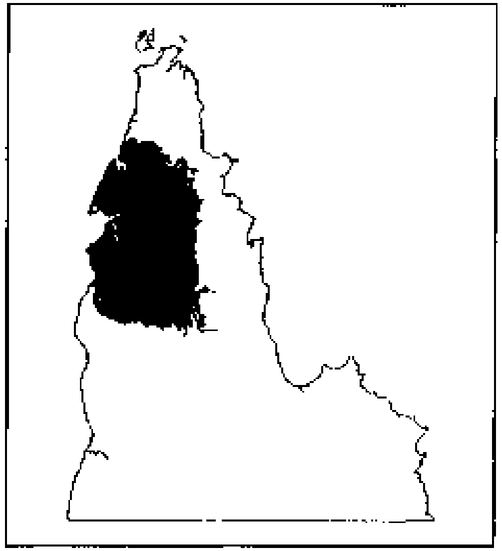
Ad Andoom - Very deep Uniform or Gradational yellow massive soils with aluminous concretions
Bt Bertie - Deep Gradational or Uniform red massive soils with ferruginous nodules
Bv Batavia - Deep Gradational mottled yellow soils formed on argillaceous sediments
Cx Cox - Deep Uniform or Gradational red massive soils on alluvial plains
Hk Hesket - Deep bleached Gradational grey soils occuring in drainage depressions and swamps
Ld Lydia - Deep bleached Gradational or Duplex mottled grey soils formed on argillaceous sediments
Mp Mapoon - Deep Duplex or Gradational soils with a dark loamy surface over a mottled grey clay, formed in swamps
Mk Merkunga - Deep bleached Gradational mottled grey soils formed on alluvia
Mg Moonlight - Deep bleached Gradational yellow massive soils developed on alluvia
Ml Myall - Deep Uniform or Gradational yellow structured clay soils formed on argillaceous sediments
Pn Picanniny - Deep Uniform cracking brown or grey structured clays formed on argillaceous sediments
Sp Scorpion - Deep Gradational or Uniform yellow massive soils with ferruginous or manganiferous nodules
Wp Weipa - Deep Gradational or Uniform red massive soils with aluminous concretions
Wl Wheeler - Deep bleached Gradational grey massive soils formed on alluvia

VEGETATION

7 Woodlands and open woodlands (*E. chlorophylla*, *E. microtheca* or *E. acroleuca*)
8 Woodlands and open woodlands (*E. clarksoniana*, *E. novoguinensis* or *E. polycarpa*)
11 Open woodlands and woodlands (*E. leptophleba*) on undulating plains and river frontages
16 Woodlands and tall woodlands (*E. tetrodonta*) on deeply weathered plateaus and remnants
17 Woodlands (*E. tetrodonta*) on erosional surfaces and residual sands
18 Low open woodlands and low woodlands (*Melaleuca viridiflora*) on depositional plains
19 Open forests and low open forests dominated by *Melaleuca spp.* in seasonally inundated swamps
22 Closed tussock grasslands and open woodlands on undulating clay plains
24 Open heaths and dwarf open heaths

(Not to scale)

60 km



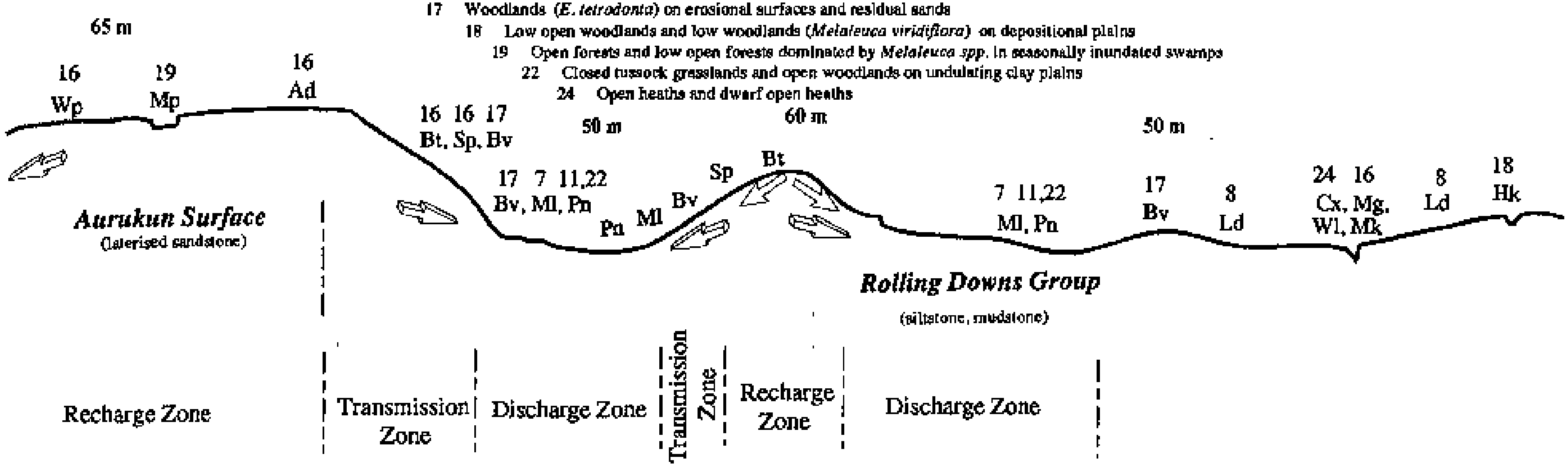



**Figure 1 Batavia Landscape**

ferruginous Kandosols[1] are generally lower in the Landscape with respect to *Weipa* and *Andoom*, but are still in upper slope and hillcrest positions within the Landscape, hence can act as intake zones. The generally poor grass cover and typical slopes of 3-5% would suggest high run-off rates. The rough ironstone surface would however aid in slowing run-off. The porosity of the underlying material is unknown, but given that the Bulimba Formation is dominantly sandstone, it is suggested that even in a laterised state, deep drainage would be high. Figure 2 illustrates calculated deep drainage curves for *Andoom* and *Bertie*. As with *Weipa* and *Andoom*, the nature of these soils is such that they are unsuitable for cropping or intensive pasture development, hence irrigation or tree clearing is unlikely.

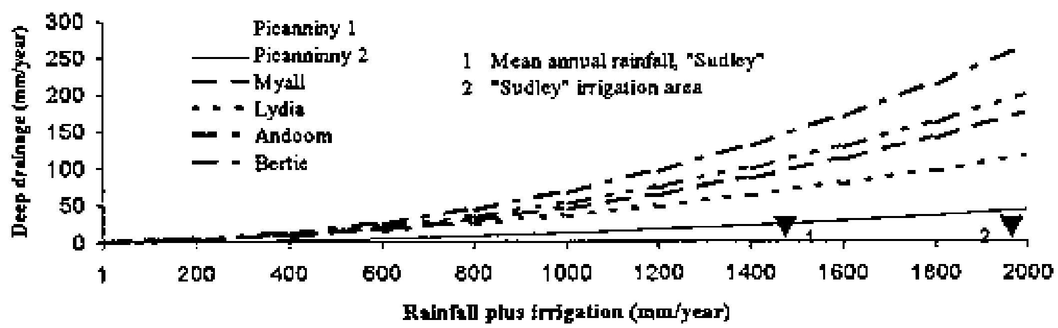



**Figure 2** **Calculated deep drainage for selected soils of the Batavia Landscape**

The soils derived directly from the Rolling Downs Group often reflect the argillaceous nature of the sediments. The hillslopes that appear to have been well weathered are dominated by *Batavia* (Si, St, So3). It can occur in either a localised upper slope position or, commonly between *Bertie* and *Scorpion* upslope and heavier clay soils downslope. It can also exist in footslopes. Poor drainage can lead to the development of a bleached version of the *Batavia* i.e. the *Lydia* (Si, St So3). It occupies similar landscape positions to the *Batavia*. Fresher exposures of the sediments, often in footslope areas (although also on plains) yield the highest clay soils such as the *Piccaninny* (So3) and *Myall* (So, St3). It is suggested that the *Myall* lies between the *Picanninny* and *Batavia* in a weathering sequence. Detailed soil descriptions are provided in Appendix 2.

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[1] A description of Australian Classification Orders is given in Appendix 1

## 5.2 Soil chemistry

Chemical analyses of the soils described above indicates very low Electrical Conductivity (EC), Chloride ($Cl^-$) and Exchangeable Sodium Percentage (ESP) values (Table 3). Figures of the order of 0.02 in the surface (0-10 cm) and the subsoil (110-120 cm) are common, however, one sample of a Piccaninny derived from the Wolena Unit did record values of 0.24 in the subsoil.

Appendix 3 details soil salinity and plant tolerance ratings with respect to EC, $Cl^-$ and clay content.

The values in Table 1 concur with those obtained by Gunn and Richardson (1979) in their investigation of the nature and origins of salts in Cretaceous sediments. These authors noted that the sediments contain appreciable levels of salts, particularly NaCl and sulphates, although the soils formed on fresh exposures of the sediments had low salt levels in comparison to mid-Tertiary relict surfaces. Gunn and Richardson (1979) also found appreciable levels of salts in relict lateritic features e.g mottled and pallid zones, particularly where they were developed on argillaceous sediments. The mode of accumulation of these salts is unclear.

Despite the low salt levels within the soil profiles, the Rolling Downs Landscapes are still considered as having a localised salinity hazard. This is largely due to the above-mentioned salt levels in the Rolling Downs Group sediments.

**Table 3** **Electrical conductivity, Chloride and ESP values for selected soils**

| SPC | $EC_{1:5}$ (dS/m)[1] | | | $Cl^-_{1:5}$ (g/100g)[2] | | | ESP (%)[3] | | |
|---|---|---|---|---|---|---|---|---|---|
| Depth (cm) | 0-10 | 50-60 | 110-120 | 0-10 | 50-60 | 110-120 | 0-10 | 50-60 | 110-120 |
| Pn | 0.02 (40-60)[4] | 0.01 (40-60) | 0.07 (40-60) | 0.001 | 0.001 | 0.006 | 0.7 | 2.3 | 6.2 |
| Pn | 0.09 (60-80) | 0.11 (60-80) | 0.24 (60-80) | 0.002 | 0.001 | 0.005 | 0.2 | 0.7 | 6.4 |
| Ml | 0.03 (40-60) | 0.01 (40-60) | 0.01 (40-60) | 0.002 | 0.001 | 0.001 | 1.7 | 2.6 | 5.6 |
| Bv* | 0.02 (10-20) | 0.02 (20-40) | 0.03 (40-60) | n/a | n/a | n/a | 3.5 | 10 | 24 |
| Bv* | 0.02 (10-20) | 0.01 (20-40) | 0.09 (40-60) | n/a | n/a | n/a | 5 | 7 | 8 |
| Ld* | 0.02 (10-20) | 0.01 (20-40) | 0.02 (40-60) | 0.001 | 0.001 | 0.001 | 12 | 3.8 | 8.7 |
| Ad* | 0.02 (20-40) | 0.01 (20-40) | 0.01 (20-40) | 0.001 | 0.001 | 0.001 | 5.7 | 7.7 | 6.5 |
| Bt* | 0.03 (20-40) | 0.01 (40-60) | n/a | 0.002 | 0.001 | n/a | 2.3 | 2.7 | n/a |

1 EC (Electrical Conductivity) is a measure of the total soluble salts

2 $Cl^-$ (Chloride) is a measure of the content of chloride ion within the soils solution, expressed on a weight of soil basis

3 ESP (Exchangeable Sodium Percentage) is the ratio of $Na^+$ to the Cation Exchange Capacity, expressed as a percentage

4 Clay content range expressed as a percentage

* Indicates the CEC of these soils is less than 6, and hence the absolute amount of $Na^+$ is not significant. A high ESP is not therefore as significant as it is for high CEC soils

## 5.3 Electro-magnetic induction assessment

The salt levels in the Rolling Downs Group were highlighted by Electro-Magnetic (EM) Induction measurements. The clay soils (*Picanniny, Myall, Batavia*) are often not very deep, with weathered sediments commonly encountered before a depth of 2.0 m. The EM31 used records to a depth of 6 m. Many high readings were recorded on the Rolling Downs Group.

Significant readings were commonly associated with mid- and lower slopes, particularly where a rapid change in soil texture (from a lighter to a heavier texture) and permeability/drainage occurred. Significant values were also recorded on large flat areas of Vertosols (cracking clays) e.g Picanninny Plains. Some of these high readings appear to be related to variations in the depth to parent material (Hill, pers. comm.). Few high values were recorded around the east and west sides of the Embley Range. This relict surface is probably a significant intake zone, and Grundy and Heiner (1991) suggested there may be potential for secondary salinisation in the heavy textured clays on the low slopes around the base of the range. The low readings on the only traverse in this area is not sufficient evidence that there is no potential for secondary salinisation.

## 5.3 Water resources

The Rolling Downs Group is generally regarded as an aquaclude (Herbert, pers. Com). Well yields are very low, and EC values are high (e.g 6000 mg/L).

## 5.4 Land use and salinity potential

The Rolling Downs Group country is considered by the graziers of the Peninsula as good quality country with a high potential for development. The clay soils, particularly the flats are favoured. Minor clearing and development has occurred on properties such as "Merluna", "Batavia Downs" and "Sudley". In recent times, minor irrigation of improved pasture has been undertaken at "Sudley".

Both tree clearing and irrigation have the potential to disturb the hydrological cycle. The clearing of vegetation from intake zones can have as much of an impact as clearing of discharge zones. Fortunately, the need for large-scale clearing on the Rolling Downs is negated by the general trend of decreasing vegetation density with increasing clay content of the soil (Figure 3). In addition, the afore-mentioned low suitability of the soils of the inflow zones (*Bertie, Scorpion*) makes tree clearing of the hillslopes unlikely.

An example of the type of development occurring on the Rolling Downs Group is found at "Sudley", a property owned by Comalco, and located approx. 40 km east of Weipa. Figure 4 depicts the landscape on the eastern (road) side of the homestead. In the mid 1980's, the flats of *Melaleuca viridiflora* on a *Myall* (Yellow Dermosol) were pulled. Some parts have been subsequently cleaned up and sown to pasture. The *Myall* is well gilgaied and drainage is poorer than usual. It extends to the footslope of the hill where it grades into a *Batavia* (Yellow Dermosol). The knoll itself is comprised of the *Scorpion* and *Bertie* soils (Ferruginous Yellow and Red Kandosols). Given that the homestead and a number of other buildings are on the hillslope, there has of necessity been some clearing of trees on the hill itself.

In late 1992 a dam was constructed on the southern side of the hill. Water from this is now used to irrigate pastures of *Brachiaria* spp on the footslopes and adjacent flats. Irrigation volumes have been low (approx. 40 mm per week), and has only occurred for the last two dry seasons. High EM values were recorded in the vicinity of the irrigation, but it is unlikely they can be attributed to major disturbances in the hydrological cycle given the nature of the soils and the quantity and extent of the irrigation. Figure 2 shows the projected deep drainage for the clay soils, and indicates the additional deep drainage caused by irrigation Although the graph suggests a moderate increase in deep drainage it is concluded that current levels of irrigation are not causing a significant increase in deep drainage due to the poorer than usual drainage of the soils at "Sudley".

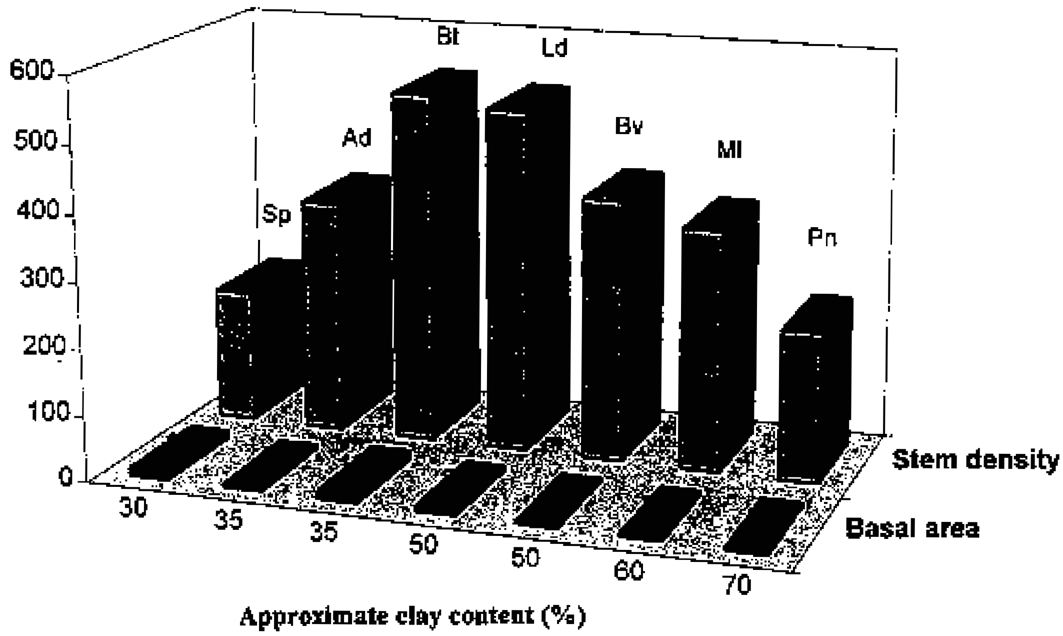


**Figure 3** **Relationship between clay content and vegetation structural parameters within the Batavia Landscape**

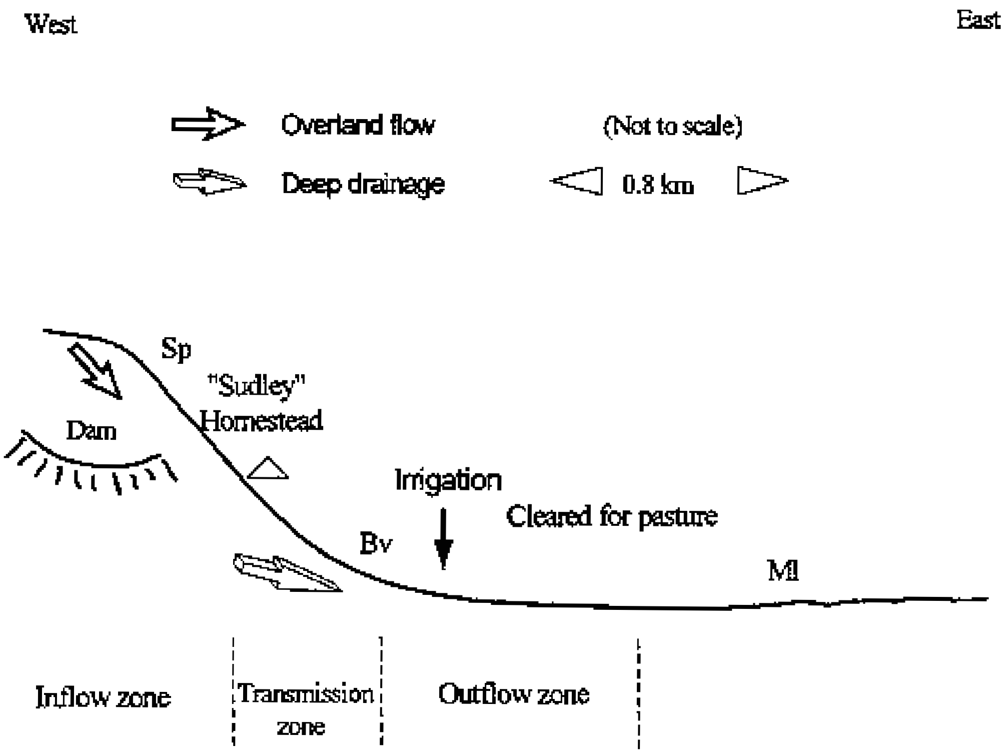


**Figure 4** **"Sudley" homestead area**

It is suggested that the high EM values recorded in the vicinity of the "Sudley" irrigation area are more likely to be associated with underlying sediments than secondary salinisation. While the present irrigation system is not likely to be a high salinity risk, dam leakage or further clearing of trees on the hillslope could cause enough hydrological imbalance for salinity to occur at the contact between the clay soils in the footslopes and the sandier upslope soils.

Future management of soils on the Rolling Downs Group should consider the potential for secondary salinisation. Although there is at present insufficient evidence to indicate precisely where it will occur, the presence of indicators such as high salts in the underlying sediments and poor drainage of clay soils suggest that there is a potential for secondary salinisation, if hydrologic disturbance occurs.

# 6.0 HODGKINSON FORMATION

## 6.1 General

The Hodgkinson Formation in the survey area is restricted to the eastern and southern margins of the Laura Basin, running south from Cape Melville to below 16°S (Figure 5). It also extends west from the south-eastern corner to the Yambo Inlier (approx 144 09° E). Of Devonian age, these marine sediments show evidence of having been deposited by turbidity currents in a continental shelf situation. It is dominated by micaceous siltstone, greywacke and slate, with minor occurrences of chert, conglomerate and limestone (Amos and de Keyser, 1964). Folding and faulting are common features. The resultant landscape consists of rolling (10-32%) to steep (32-56%) slopes on low hills to mountains with a fine dendritic drainage pattern. Extensive colluvial and alluvial fans have been derived from erosional and depositional activity within the unit. Land degradation, usually in the form of gully erosion, is quite severe in places and has undoubtedly been accelerated by man's activities.

The Formation underlies some of the driest (Palmerville with 1025 mm per annum) and wettest (Ayton with 1800 mm per annum) areas of the Peninsula. This climatic variation is reflected in both the vegetation and soils. The humid high rainfall areas are dominated by closed forest and wet sclerophyll forest (*E. teretecornis, E. grandis*). The drier hillslopes are vegetated with sparse woodlands of a variety of Eucalypts (*E. persistens, cullenii, hylandii*) and other species. Ground cover is generally poor, with Foliage Projective Covers of <15% common during the dry season.

Figure 5 presents a stylised illustration of the Hodgkinson Landscape. Under rainforest, deep red structured clay soils (*Rule*) are typical. A distinct boundary exists between this soil and the soils of the drier areas, particularly to the west, where Sodosols (*Eykin*), Dermosols/Kandosols (*Jeannie*) and Tenosols (*Hodge*) are common on the hillslopes. *Jeannie* and *Hodge* are the dominant of the three. Table 2 indicates that these soils are

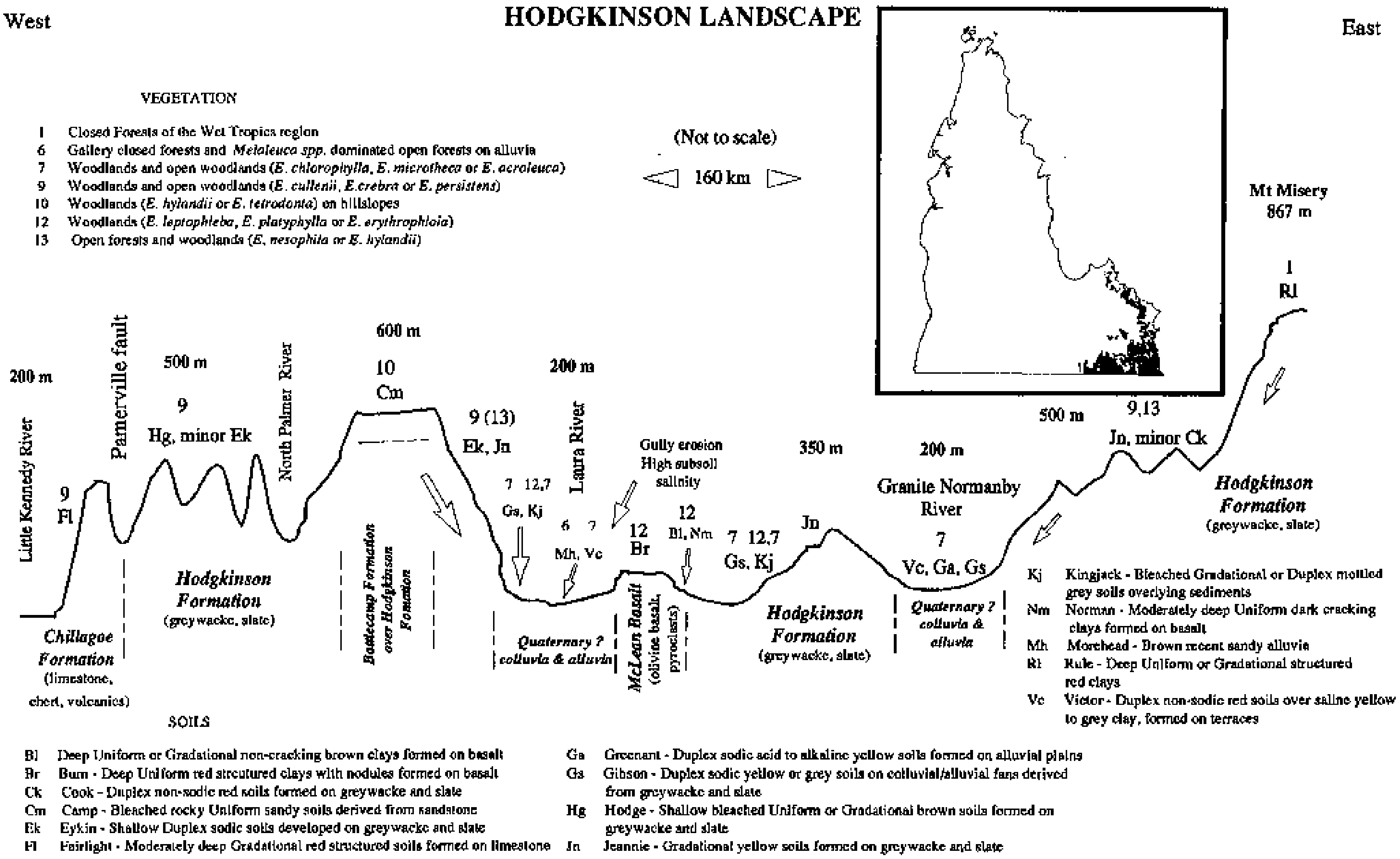


**Figure 5 Hodgkinson Formation**

ranked as intake zones with a moderate potential for contributing to secondary salinity (given hydrological disturbances). However, the lack of ground cover, the nature of the topography, the geology, and the shallowness of the soils, all contribute to relatively low infiltration rates (Lait, *pers. com.*).

Dermosols (*Kingjack*) and Sodosols (*Gibson*) are common in the footslopes where they are often intermingled. It is difficult to predict where one will occur in place of the other.

The alluvial plains associated with the Hodgkinson Formation are dominated by Dermosols (*Wakooka*) and Sodosols/Hydrosols (*Greenant*). The boundary between the colluvial and alluvial influences is quite often blurred. It is not likely that salinity will be a problem on *Wakooka*, although *Greenant* does have a moderate potential. Scattered pockets of a Red Dermosol (*Victor*) are associated with old terraces on the Laura and Palmer rivers. This alluvial soil has been designated as naturally saline due to the presence of a D horizon with considerable soluble salts. Appendix 4 provides detailed descriptions of these soils.

The links between Hodgkinson Formation and salinity development have been studied recently in the Mareeba Dimbulah Irrigation Area. In that area, it has given rise to saline/sodic soils and is clearly the source of salts in highly saline groundwater which is rising rapidly as a consequence of excessive irrigation. This evidence reinforces the need for caution when any form of development is proposed on land associated with the Hodgkinson Formation.

## 6.2 Soil chemistry

The chemistry of these soils is variable and indicative of both their parent material and conditions under which they form. Table 4 lists EC, $Cl^-$ and ESP values for the soils. The low values for *Rule* can no doubt be attributed to the intense weathering environment in which it has formed. Similarly low figures were found on the Wet Tropic Coast (Smith, pers. com.).

**Table 4** **Selected chemistry for soils derived from Hodgkinson Formation**

| SPC | EC (1:5) (dS/m) | | | $Cl^-$ (1:5) (g/100 g) | | | ESP (%) | | |
|---|---|---|---|---|---|---|---|---|---|
| Depth (cm) | 0-10 | 50-60 | 110-120 | 0-10 | 50-60 | 110-120 | 0-10 | 50-60 | 110-120 |
| Rl | 0.05 (20-40) | 0.01 (20-40) | 0.01 (20-40) | 0.003 | 0.001 | 0.001 | 1 | 1 | 2 |
| Gs | 0.07 (20-40) | 0.24 (40-60) | 0.28 (40-60) | 0.007 | 0.022 | 0.030 | 4 | 14 | 20 |
| Ga | 0.02 (10-20) | 0.01 (40-60) | 0.08 (20-40) | 0.001 | 0.001 | 0.009 | 2 | 7 | 27 |
| Ek | 0.02 (10-20) | 0.02 (40-60) | n/a | 0.001 | 0.001 | n/a | 3.5 | 9 | n/a |
| Vc | 0.03 (10-20) | 0.01 (20-40) | 0.01 (20-40) | 0.002 | 0.001 | 0.001 | 0.1 | 0.9 | 1 |
| Vc | 0.03 (10-20) | 0.03 (20-40) | 0.02 (20-40) | 0.001 | 0.001 | 0.001 | 0.6 | 1.3 | 1.3 |
| | | | 3.7* (20-40) | | | 0.785* | | | 36 |
| Wk | 0.03 (20-40) | 0.02 (20-40) | n/a | 0.003 | 0.001 | n/a | 5 | 5 | n/a |

1 EC (Electrical Conductivity) is a measure of the total soluble salts

2 $Cl^-$ (Chloride) is a measure of the content of chloride ion within the soils solution, expressed on a weight of soil basis

3 ESP (Exchangeable Sodium Percentage) is the ratio of $Na^+$ to the Cation Exchange Capacity, expressed as a percentage

4 Clay content range expressed as a percentage

* These values are from the D horizons, at a depth of 2.5 m

*Gibson*, and *Greenant* have predictably high values for that soil type.

*Victor* is as mentioned, noteworthy. The surface horizons are similar in nature to those of a Non-Calcic Brown Soil (Stace *et al.*, 1968), and have desirable agricultural properties. However, the presence of an extremely saline series of horizons reduces it's agricultural potential. The depth to these lower saline D horizons varies considerably, ranging from 1 to 3 m. The mode of formation of these horizons is unclear, although alluvial/colluvial influences are indicated. The difference in their morphology and chemistry, and the presence of coarse fragments suggests they are of different origin to the upper horizons. Unlike the other naturally saline soils, *Victor* does not contain high salt levels throughout the profile, only in the subsoil. However, given the very high salt content, and the variability in the horizon depths, it was considered necessary to allocate it a ranking of "naturally saline".

### 6.3 Electro-magnetic induction assessment

A transect from Lakelands to Carols Bridge on the Laura River was investigated with EM techniques. High values were intermittent but were associated with both footslopes and alluvia, particularly the Victor.

### 6.4 Water resources

Lait (unpub.) notes that the recharge of secondary porosity (porosity associated with fractures, and other such features) within the Formation is probably greatest in the elevated regions. These are often capped with a thin layer of sandstone (Battlecamp Formation and Dalrymple Sandstone). Well yields from aquifers vary considerably (0.5 to 30 L/s), but are generally low, with salinity ranges from <50 to 14 000 mg/L. Water samples from the drier locations within the Formation are generally higher in salts than those from the wetter south-east. It is suggested that longer residence period of infiltrated water in the drier areas is probably the reason for their higher salinity levels. The transmissivity of the rocks of the Hodgkinson Formation is probably low.

## 6.5 Land use and salinity potential

Land use is variable throughout the area covered by the Hodgkinson Formation. Grazing is the dominant industry, but minor areas of horticultural development are present, located primarily on alluvia. Minor areas on the alluvial flats have been cleared for improved pasture establishment.

Most soils are relatively infertile, and their morphological characteristics are not condusive to agriculture, hence it is unlikely that many areas will be developed for intensive land uses. As with the Rolling Downs Group, the hillslope (inflow) soils are unlikely to be irrigated due to limitations such as rockiness and slope. Development may be possible on some of the plains, and risks would be associated with such moves.

The possible effects of irrigation are illustrated in the Figure 6, which contains projected deep drainage values of the higher risk soils (*Eykin, Gibson, Greenant, Victor*). These values are in the range to be expected from these types of soils. The freely draining nature of the upper horizons of the *Victor* enables considerable downwards movement of water. The change in drainage down the profile is shown in Figure 7. Excess applied water i.e irrigation would infiltrate until it contacts the D horizons. If lateral drainage is prevented, water tables will rise, bringing with them mobilised salts.

Tree clearing is not a large issue in this Landscape, but has occurred in a number of areas. If unplanned, it may be a cause of secondary salinisation. Clearing of slopes greater than 10% is not recommended. It is suggested that reference is made to the Tree Retention Guidelines (Salinity and Contaminant Hydrology Group, in prep) as part of a whole property plan when considering the removal of vegetation.

Large scale geological or topographical restrictions have not been directly considered. Given that they are indicated as significant factors in the development of secondary salinity in the MDIA, any development plan should include the investigation of such restrictions, if they exist.

Although the potential of secondary salinisation in the Hodgkinson Landscape exists, the likelihood of significant modifications in the hydrological balance occurring is low, due to the poor suitability of the soils for many land uses. Nevertheless, it is important that the potential for salinity is considered in any land management planning in this Landscape.

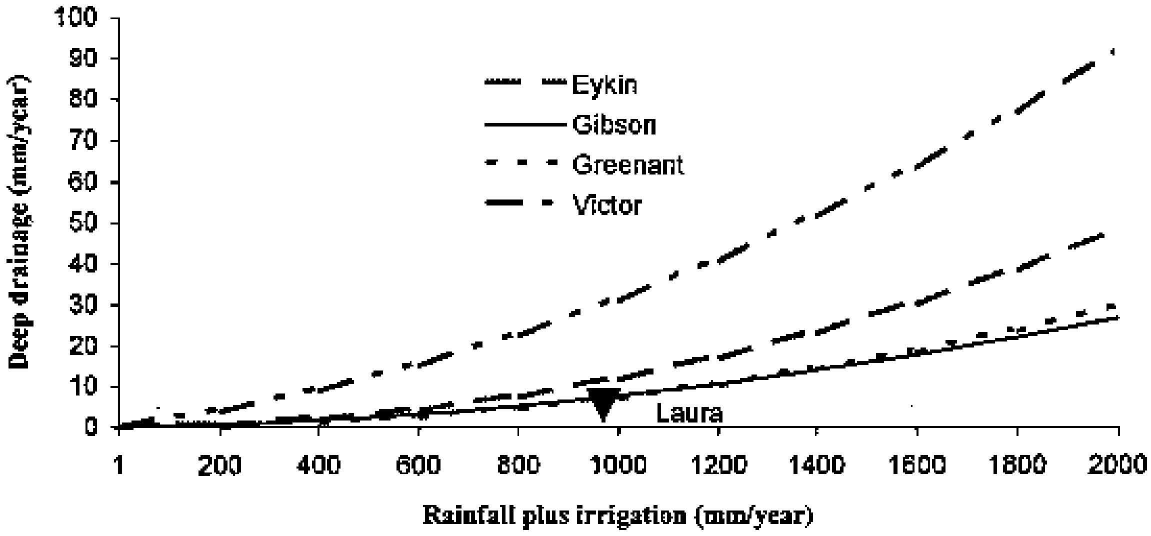


**Figure 6** **Calculated deep drainage for selected soils from the Hodgkinson Landscape**

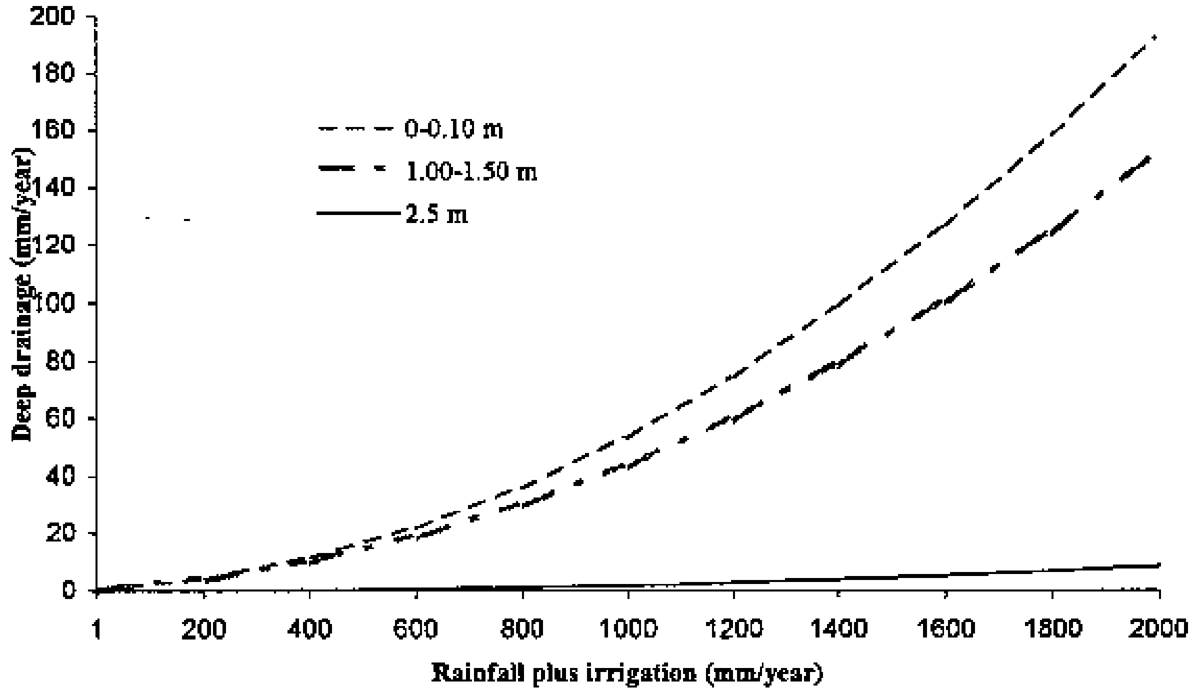


**Figure 7** **Extrapolation of calculated deep drainage in *Victor***

# 7.0 NATURALLY SALINE SOILS

## 7.1 General

Large areas of Quaternary coastal deposits, ranging from recent tidal flat deposits to older clay plains, exist on the west coast of the peninsula, and on the southern and eastern margins of Princess Charlotte Bay. The marine origin of these soils would suggest they would contain appreciable salt levels. Chemical analysis and EM work confirmed this.

The marine clay plains grade from slightly elevated areas (Grey Vertosols), up to 10 km inland, to lower, more poorly drained areas (Aquic Vertosols) closer to the tidal zones. Although under NR02 only one soil (*Marina*) is referred to, Gunn *et al.*, (1971) discriminated between these two zones, labelling the former as the *Marina*, and the latter as the *Carpentaria*. Both soils are cracking mottled heavy grey clays, but they vary in drainage and most probably salinity. *Carpentaria* commonly has salt encrustations on a surface which is sparsely vegetated with halophytes . The *Marina* of Gunn *et al.*, (1971) is slightly better drained, cracks more often and is frequently gilgaied. Grasslands of *Sporobolus virginicus, Panicum, Eriachne* and *Fimbristylus* spp. dominate. Within both of these soils, local variation can be significant.

The soils of the tidal flats and margins are also naturally saline. *Skardon* dominates the mangroves and is quite variable. Layered sands and muds with an accumulation of organic matter at the surface are common *George* is also variable, and dominates the saltpans. Seasonality has an effect on the nature of the soil. *Nassau* prevails along the drier margins of the saltpans. Appendix 5 provides detailed descriptions of these soils.

The other soil on the Peninsula that has been designated as naturally saline (*Victor*) was discussed under 5.2.

## 7.2 Soil chemistry

A sample taken from the Princess Charlotte Bay area indicated that chloride levels were expectably high, increasing with depth (Table 5). Conductivity, Exchangeable Sodium Percentage and S ulphate Sulphur were also high. Cation dominance was Na, Mg, Ca, K.

**Table 5 Selected chemistry for *Marina*, Princess Charlotte Bay**

| Depth (cm) | EC (1:5) (dS/m) | $Cl^-$ (1:5) (g/100 g) | ESP (%) | $SO^-_4$ S (mg/Kg) | Clay (%) |
|---|---|---|---|---|---|
| 0-10 | 0.91 (60-80) | 0.186 | 26 | 247 | 68 |
| 20-30 | 1.3 (60-80) | 0.178 | 40 | 366 | 69 |
| 50-60 | 2.0 (60-80) | 0.284 | 48 | 620 | 68 |
| 80-90 | 1.6 (60-80) | 0.230 | 48 | 480 | 69 |
| 110-120 | 1.6 (40-60) | 0.248 | 50 | 299 | 52 |
| 140-150 | 1.7 (40-60) | 0.269 | 53 | 218 | 38 |

## 7.3 Electro-magnetic induction assessment

Electro-magnetic induction readings in the Princess Charlotte Bay area were high, and corresponded well with predictions.

## 7.4 Land use and salinity

All of the naturally saline soils except for the *Marina* are unsuitable for agricultural use, for a number of reasons e.g flooding, wetness. The fact that they are naturally saline does therefore not have many land use implications for current agricultural practices on the Peninsula. The coastal clay plains, particularly in the west are grazed extensively. Improvement of these native pastures is unlikely, unless salt tolerant species are used.

# 8.0 OTHER SOILS/LANDSCAPES WARRANTING INVESTIGATION

## 8.1 General

A number of other soils/landscapes on the Peninsula contain soils with appreciable salt levels at depth. The potential for secondary salinisation in these landscapes is unclear, due to insufficient information. The current level of understanding of these landscapes suggests that secondary salinity is not likely to be a problem under current land management practices, but further investigation is warranted if land use practices change.

## 8.2 The south-western plains

The alluvial soils, *Kennedy* and *Antbed* dominate the floodplains in the Kowanyama/Pormpuraaw, and Lakefield areas. These soils, particularly those examples on the western side of the Peninsula contain notable salt levels at depth (Table 6).

Given that these soils are on alluvial plains that are flooded nearly every year, the importance of these levels with regards to secondary salinisation is unclear. Both *Kennedy* and *Antbed* are very hardsetting and slowly to very slowly permeable. Figure 8 illustrates their calculated deep drainage in comparison to the saline coastal clay *Marina*. It is unlikely that surface irrigation would permeate to such depths to interact with the salts (Shaw, pers. com). Detailed descriptions of the alluvial soils are provided in Appendix 6.

**Table 6 Selected chemistry for *Antbed* and *Kennedy***

| Depth (cm) | EC 1:5 (dS/m)[1] | | Cl⁻ 1:5 (g/100 g)[2] | | ESP (%)[3] | |
|---|---|---|---|---|---|---|
| | Ab | Kd | Ab | Kd | Ab | Kd |
| 0-10 | 0.01 (40-60)[4] | 0.02 (60-80) | 0.001 | 0.001 | 2 | 3 |
| 20-30 | 0.01 (40-60) | 0.02 (60-80) | 0.001 | 0.03 | 6 | 17 |
| 50-60 | 0.04 (50-60) | 0.27 (60-80) | 0.002 | 0.039 | 11 | 17 |
| 80-90 | 0.09 (40-60) | 0.66 (60-80) | 0.010 | 0.098 | 26 | 29 |
| 110-120 | 0.40 (40-60) | 0.82 (60-80) | 0.054 | 0.121 | 47 | 37 |
| 140-150 | 0.45 (40-60) | 0.56 (60-80) | 0.063 | 0.075 | 52 | 40 |

1 EC (Electrical Conductivity) is a measure of the total soluble salts
2 $Cl^-$ (Chloride) is a measure of the content of chloride ion within the soils solution, expressed on a weight of soil basis
3 ESP (Exchangeable Sodium Percentage) is the ratio of $Na^+$ to the Cation Exchange Capacity, expressed as a percentage
4 Clay content range expressed as a percentage

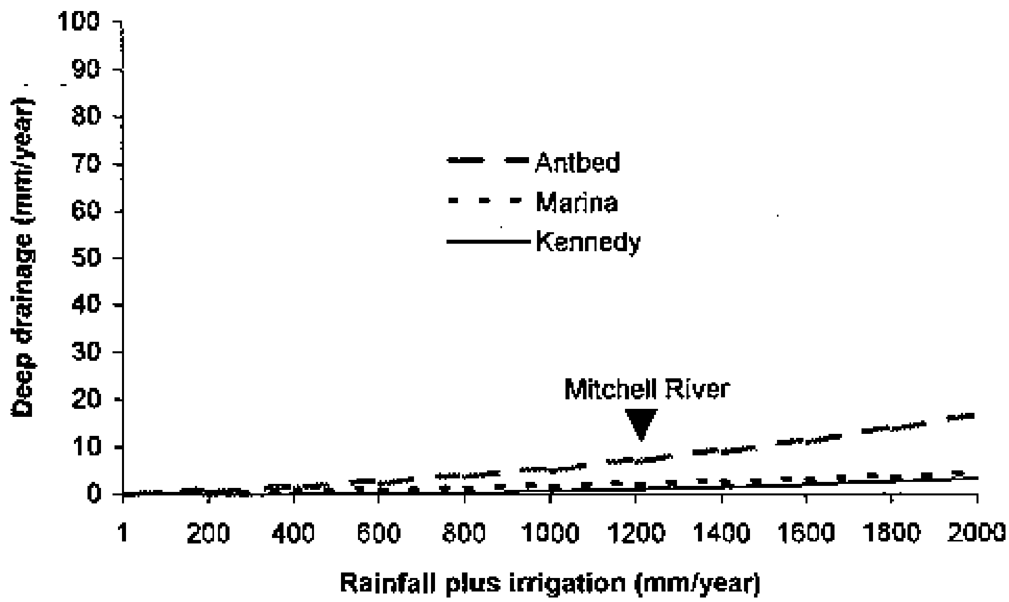


**Figure 8 Calculated deep drainage for *Marina, Antbed and Kennedy***

## 8.3 Edward River Landscape

The Edward River Landscape consists of gently undulating (1-3%) to undulating (3-10%) plains to rises of Kandosols (*Clark, Kimba*), frequently dissected by shallow, narrow (usually <50 m across) drainage depressions (Figure 9). A more detailed discussion of the Landscape is provided by Biggs and Philip (1994). The presence of shallow water tables and a soil (*Citri*) that contains significant salt levels at depth indicates that further investigation of the hydrological cycle in the localised landscape is necessary. Detailed descriptions of the soils in this landscape are provided in Appendix 7.

Although only one sample of *Citri* was analysed by NR02, and the depth of that sample was severely restricted by the very hard consistence of the soil, the rapid increase in EC from the A to the B horizon (Table 7) warrants further investigation, particularly as the upslope soils are suitable for a range of agricultural uses, including cropping. Tree clearing and irrigation are likely possibilities in the future.

**Table 7 Selected chemistry for *Citri***

| Depth (cm) | EC (1:5) (dS/m) | $Cl^-$ (1:5) (g/100 g) | ESP (%) |
|---|---|---|---|
| 0-10 | 0.02 (<10) | 0.002 | 8* |
| 20-30 | 0.22 (20-40) | 0.026 | 44 |

* CEC is less than 6 m.eq. $100g^{-1}$ soil

The effect of hydrologic disturbance is difficult to predict. If the hillslopes are irrigated, the high permeability of the soils and lack of geological restriction would allow considerable deep drainage. It is unknown how much of this water moves laterally i.e downslope, but the presence of a seepage zone (*Hann*) at the margin of the drainage depressions suggests that lateral movement is significant. In some depressions, shallow water tables can still be found late in the dry season. The very low permeability of *Citri* presents a barrier to further lateral movement. Increased water tables, containing salts derived from *Citri* are possible in *Hann*.

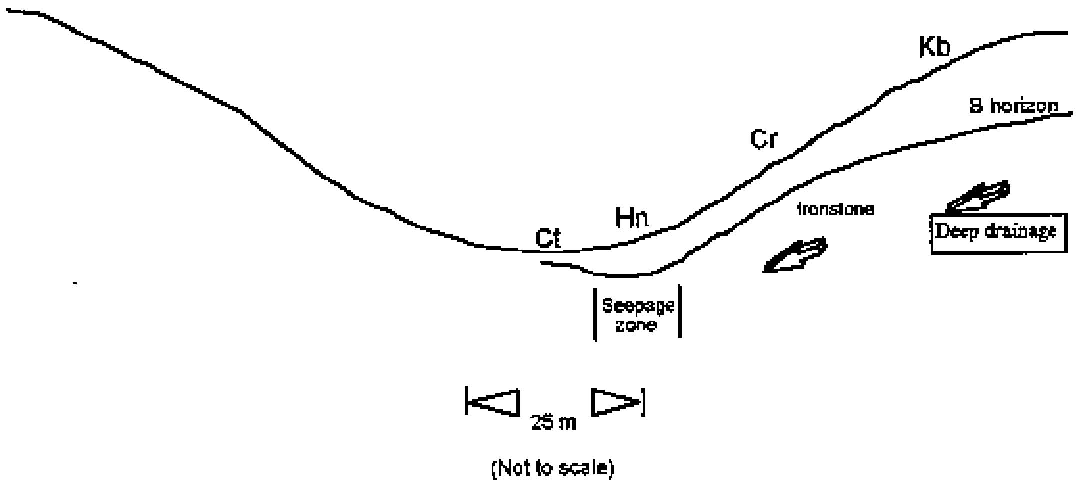


**Figure 9** **Cross-section of a drainage depression, Edward River Landscape**

## 9.0 SALINITY MANAGEMENT GUIDELINES

Strategies for managing salinity in landscapes are outlined in "Salinity management guidelines for Queensland" (Salinity and Contaminant Hydrology Group, in prep). With reference to the particular areas of interest on the Peninsula, some key issues are:

- Development of a better understanding of soil/geological relationships, and the source, nature and mobility of the salts in key areas
- Development of a better understanding of the hydrological balance within the landscape
- Utilisation of tree clearing guidelines
- Preparation of strategies for managing irrigation, in particular the removal of excess water by de-watering, drainage or other methods

The particular strategies employed will vary with individual landscapes and the circumstances involved.

## 10.0 CONCLUSION

Current information suggests that salinity hazard on Cape York Peninsula is restricted to the soils and/or sediments associated with the Rolling Downs Group and the Hodgkinson Formation. Significant areas of naturally saline soils are present on the coastline of the Peninsula, particularly in the central- and south-west.

Soils associated with the Rolling Downs Group contain low levels of salts and have significant potential for development. Unplanned development, including tree clearing and/or irrigation, could result in hydrological imbalance and mobilisation of salts held in the near surface sediments.

The soils formed on the Hodgkinson Formation are less likely to be intensively developed, but many contain appreciable salt levels at depth. One soil (*Victor*) contains very high salt levels at variable depths. Unplanned tree clearing or irrigation may result in mobilisation of salts contained in subsoils.

A number of other soils/landscapes on the Peninsula have been identified as having some potential, which is less clearly able to be defined, to develop secondary salinisation.

Management/prevention of secondary salinisation on the Peninsula will primarily require further investigation of the key soils/landscapes. Property management plans will need to include this information and refer to recommended guidelines to develop a long term approach to the prevention of secondary salinisation on the Peninsula.

**Acknowledgements**

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## APPENDIX 1

## AUSTRALIAN CLASSIFICATION - BRIEF DESCRIPTIONS

CHROMOSOLS Soils with a strong texture contrast between A horizons and B horizons which are not strongly acid (pH 5.5 or greater) and are non-sodic (ESP less than 6).

DERMOSOLS Soils with structured B horizons and lacking strong texture contrast between A and B horizons.

HYDROSOLS Soils in which the greater part of the profile is saturated for at least several months in most years.

KANDOSOLS Soils which lack strong texture contrast and have massive or only weakly structured B horizons and are not calcareous throughout.

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

TENOSOLS Soils with only weak pedological organization apart from the A horizons.

VERTOSOLS Clay soils with swell-shrink properties that exhibit strong cracking when dry and at depth have slickensides and/or lenticular structural aggregates.

Note: Only those Orders used in this report are summarised above. For further information, see "A Classification System for Australian Soils" (Isbell, 1993)

## APPENDIX 2

## SOILS OF THE ROLLING DOWNS GROUP AND ASSOCIATED SURFACES

**Name:** Andoom (Ad)

**Concept:** Very deep Uniform or Gradational yellow massive soils with aluminous concretions

**Classification:**

*Aust:* Bauxitic Dystrophic Yellow Kandosol

*GSG:* Yellow Earth

*PPF:* Um2.27, Um4.23, Gn2.21, Gn2.22, Gn2.25

**Landform:** Gently undulating plains on plateaux

**Geology:** Tertiary and Quaternary aluminous laterite (T&Qa)

**Vegetation:** *E. tetrodonta* woodlands and tall woodlands

**Microrelief:** None

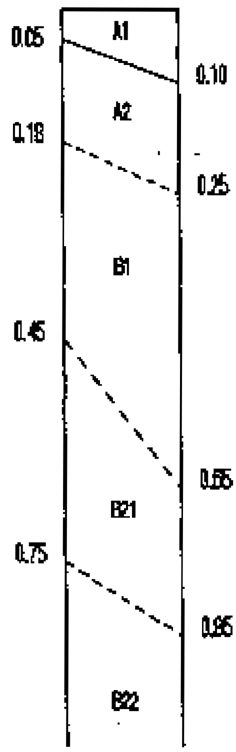
**Surface condition:** Hardsetting

**Land Use Limitations**

| | |
|---|---|
| **Climate:** | <35° C, >1500 mm (C2) |
| **Moisture Supply:** | 60 - 80 mm/m (M4) |
| **Fertility:** | <3 ppm P, <4 ppm $SO_4$ S (N8) |
| **Wetness:** | Well drained, moderately permeable (W2m) |
| **Flooding frequency:** | No flooding (F0) |
| **Rockiness:** | 2-6 mm, 20-50% (R24) |
| **Topography:** | No microrelief (T0) |
| **Soil physical condition:** | Slightly to moderately adhesive soils, moderate moisture range, moderately hardsetting (P1) |
| **Vegetation factor:** | Regrowth poses a problem, existing vegetation a problem (Ve2e2) |
| **Erodibility:** | 1-3%, stable (E2s) |
| **Landscape complexity:** | Unit size > 20 ha (X0) |
| **Salinity:** | Low risk recharge zone (Si1) |

**Surface coarse fragments:** Very many 2-6 mm rounded aluminous concretions occasionally present

**Soil Description:**




**A1** 0 - 0.10 Grey (10YR 4-5/1); Sandy clay loam to clay loam fine sandy; Massive or weak 2-5 mm angular blocky or moderate 2-5 mm cast; Dry, firm to very firm; Few to common 2-6 mm aluminous concretions; Field pH 6.0 to 7.0; Clear boundary to;

**A2** 0.10 - 0.20 Yellow-brown or brown or yellow-grey (10YR 4-6/3 or 2.5Y 6/3); Sandy clay loam to clay loam; Massive; Dry, weak to firm; Few to common 2-6 mm aluminous concretions; Field pH 6.0 to 6.5; Gradual boundary to;

**B1** 0.20 – 0.50 Pale-yellow or yellow-brown (10YR 7/4-5 or 7.5YR 5/5); Sandy clay loam to clay loam; Massive; Dry, weak to firm; Few to common 2-6 mm aluminous concretions; Field pH 6.0 to 7.0; Gradual or diffuse boundary to;

**B21** 0.50 - 0.80 Pale-yellow or yellow or brown or red-brown (10YR 7/6 or 6/6 or 7.5YR 6/4 or 5YR 5/7); Sandy clay loam to clay loam; Massive; Dry, weak to firm; Many to very many 6-20 mm aluminous concretions; Field pH 6.5 to 7.0; Diffuse boundary to;

**B22** 0.80 - 1.50 Red-brown or yellow-brown or yellow or pale-yellow (5YR or 7.5YR 6/6 or 10YR 6-7/6); Sandy clay loam to light clay; Many fine distinct red mottles occasionally present; Massive; Moderately moist, firm; Very many 2-20 mm aluminous concretions; Field pH 6.5 to 7.0.

Limit of augering

**Number of sites:** 7

**Name:** Batavia (Bv)

**Concept:** Deep Gradational mottled yellow soil formed on siltstone, mudstone or claystone

**Classification:**

*Aust:* Ferric or Bleached-Ferric or Mottled or Manganic Mesotrophic Yellow Dermosol; Bleached-Ferric or Mottled Mesotrophic Brown Dermosol

*GSG:* Yellow Podzolic Soil

*PPF:* Gn3.74, Gn3.84, Gn3.94, Gn3.04

**Landform:** Gently undulating plains to undulating rises

**Geology:** Rolling Downs Group (Klr, Klr*), Bulimba Formation (KTi), Wolena Claystone (Klo)

**Vegetation:** *E. tetrodonta* woodlands, minor *E. leptophleba* open-woodlands

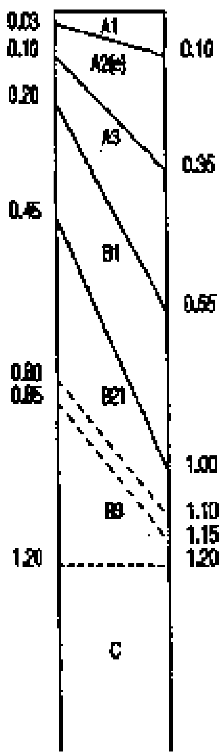
**Microrelief:** Occasionally normal gilgai; vertical interval 0.1 to 0.3 m; horizontal interval 5 to 10 m

**Surface condition:** Hardsetting

**Surface coarse fragments:** Common to abundant 2-6 mm ferruginous nodules occasionally present

| Land Use Limitations | |
|---|---|
| **Climate:** | <35°C, <1500 mm (C1), <35°C, >1500 mm (C2) |
| **Moisture Supply:** | 80 - 100 mm/m (M3) |
| **Fertility:** | <3 ppm P, <4 ppm $SO_4$ S (N8) |
| **Wetness:** | Imperfectly drained, moderately permeable (W4m) |
| **Flooding frequency:** | No flooding (F0) |
| **Rockiness:** | 2-6 mm, 20-50% (Rf4) |
| **Topography:** | No microrelief (T0) to microrelief vertical interval 0.1 - 0.3 m (T2) |
| **Soil physical condition:** | Slightly to moderately adhesive soils, moderate moisture range, moderately hardsetting (P1) |
| **Vegetation factor:** | Regrowth poses a problem, existing vegetation no problem (Ve2e1), Regrowth control no problem, existing vegetation no problem (Ve1e1) |
| **Erodibility:** | 1-3%, stable (E2a) |
| **Landscape complexity:** | Unit size > 20 ha (X0) |
| **Salinity:** | High risk transmission zone (St3), recharge zone (Sr3), occasionally outflow zone (So3) |

**Soil Description:**




**A1** 0 - 0.05 Dark or grey or brown (10YR 3/1-2 or 4/1-3); Very few to common, fine faint yellow or orange mottles; Sandy loam to fine sandy clay loam; Massive to weak 2-5 mm cast; Dry, firm to very firm; Very few to many 2-6 mm ferruginous, ferro-manganiferous or manganiferous nodules; Field pH 6.0 to 6.5; Abrupt or clear boundary to;

**A2(e)** 0.05 - 0.15 Occasionally conspicuously bleached - grey or yellow-brown or brown (10YR 4-6/2-4); Few to many fine faint to distinct yellow to orange mottles; Fine sandy loam to fine sandy clay loam; Massive; Dry, weak to very firm; Very few to common 2-6 mm ferruginous, ferro-manganiferous or manganiferous nodules; Field pH 5.5 to 6.0; Clear or gradual boundary to;

**A3** 0.15 - 0.45 Yellow-brown or yellow (10YR 5-6/4-6); Few to common fine faint yellow to red mottles; Fine sandy clay loam to light clay; Massive; Dry, firm to very firm; Very few to abundant 2-6 mm ferruginous, ferro-manganiferous or manganiferous nodules; Field pH 5.5 to 6.0; Clear or diffuse boundary to;

**B1** 0.45 - 0.55 Yellow-brown or yellow (10YR 5/4-8 or 6/6); Common, fine faint to distinct yellow to red mottles; Fine sandy clay loam heavy to light clay; Massive to moderate 2-5 mm sub-angular blocky or polyhedral; Dry to moderately moist, firm to very firm; Very few to many 2-20 mm ferruginous or ferro-manganiferous nodules; Field pH 5.5 to 6.0; Gradual or diffuse boundary to;

**B21** 0.60 - 0.70 Yellow-brown or yellow (10YR 5/6-8 or 6/4-8); Common to many, fine distinct red mottles; Light clay to light medium clay; Moderate to strong 2-5 mm polyhedral; Dry to moderately moist, firm to very firm; Few to abundant 2-20 mm ferruginous, ferro-manganiferous or manganiferous nodules; Field pH 5.5 to 6.0; Diffuse boundary to;

**B22** 0.70 - 0.95 Yellow or yellow-brown (10YR 5-6/4-6); Common to many, fine distinct to prominent red mottles; Light clay to medium heavy clay; Moderate to strong, 2-5 mm polyhedral; Dry to moderately moist, firm; Few to abundant 2-6 mm ferruginous, ferro-manganiferous or manganiferous nodules; Field pH 5.0 to 6.0; Clear or diffuse boundary to;

B3 1.00 - 1.20 Grey or pale or yellow-brown (10YR 6/2-3 or 7/1-2); Many, fine prominent red mottles; Medium heavy clay to heavy clay; Moderate to strong, 2-5 mm lenticular or sub-angular blocky; Moderately moist, firm; Very few to many 2-6 mm ferruginous nodules; Field pH 4.5 to 5.5; Gradual boundary to rock

**Phase:** Rocky phase (BvRp): Few, increasing to many, 6-60 mm angular platy siltstone throughout. **Number of sites:** 1

**Number of sites:** 42

**Name:** Bertie (Bt)

**Concept:** Deep Gradational or Uniform red massive soil with ferruginous nodules formed on remnant surfaces

**Classification:**

*Aust:* Ferric Mesotrophic Red Kandosol

*GSG:* Red Earth

*PPF:* Gn2.14, Um4.21, Gn2.75, Um4.23

**Landform:** Hillslopes on undulating plains to rises

**Geology:** Rolling Downs Group (Klr*), Bulimba Formation (KTi)

**Vegetation:** *E. tetrodonta* woodlands and tall woodlands

**Microrelief:** None

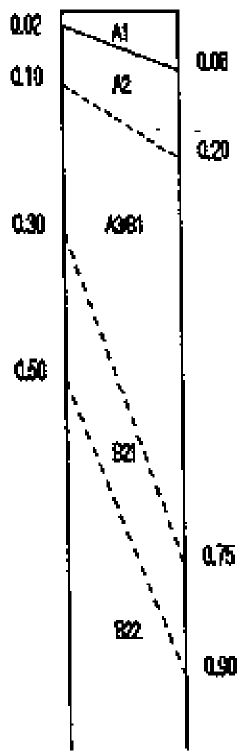
**Surface condition:** Hardsetting

**Surface coarse fragments:** Very many 2-20 mm sub-rounded ferruginous nodules occasionally present

**Land Use Limitations**

| | |
|---|---|
| **Climate:** | <35°C, >1500 mm (C2), <35°C, <1500 mm (C1) |
| **Moisture Supply:** | 40 - 80 mm/m (M3, M4) |
| **Fertility:** | <3 ppm P, <4 ppm $SO_4$ S (N8) |
| **Wetness:** | Well drained, moderately to highly permeable (W2m, W2h) |
| **Flooding frequency:** | No flooding (F0) |
| **Rockiness:** | 2-6 mm, 20-50% (Rf4) |
| **Topography:** | No microrelief (T0) |
| **Soil physical condition:** | Slightly to moderately adhesive soils, moderate moisture range, moderately hardsetting (P1) |
| **Vegetation factor:** | Regrowth poses a problem, existing vegetation no problem (Vo2e1), Regrowth poses a problem, existing vegetation a problem (Vo2e2) |
| **Erodibility:** | 3-10%, stable (E3s) |
| **Landscape complexity:** | Unit size > 20 ha (X0) |
| **Salinity:** | High risk inflow zone (Si3) |

**Soil Description:**




**A1** 0 - 0.03 Dark or grey-brown or brown (10YR 3/2 or 7.5YR 3-4/2-4 or 5YR 3-4/2); Sandy loam to clay loam; Massive; Dry, weak to firm; Many to very many 2-20 mm ferruginous nodules; Field pH 6.0 to 6.5; Abrupt or clear boundary to;

**A2** 0.03 - 0.15 Grey or yellow-brown or brown or red-brown or red (10YR 4-5/2-4 or 5YR 3/3-4 or 2.5YR 4/4); Sandy loam to clay loam; Massive; Dry weak to very firm; Many to very many 2-20 mm ferruginous nodules; Field pH 6.0 to 6.5; Gradual boundary to;

**A3/B1** 0.15 - 0.45 Red or red-brown or yellow-brown or yellow (2.5YR 4/6-8 or 5YR or 10YR 5-6/4-6); Sandy clay loam to clay loam; Massive; Dry, firm to very firm; Few to very many 2-20 mm ferruginous nodules; Field pH 6.0 to 6.5; Diffuse boundary to;

**B21** 0.45 - 0.65 Red or red-brown (10R 3-4/6-8 or 2.5YR or 5YR 3-4/4-6); Clay loam to sandy light clay; Massive; Dry, firm; Common to very many 2-20 mm ferruginous nodules; Field pH 6.0 to 6.5; Diffuse boundary to;

**B22** 0.65 - 1.00 Red (10R 4/6 or 2.5YR 3/6); Clay loam to light clay; Massive; Dry to moderately moist, firm; Many to very many 2-20 mm ferruginous nodules; Field pH 6.0.

Limit of augering

**Number of sites:** 12

**Name:** Lydia (Ld)

**Concept:** Deep bleached Gradational or Duplex mottled grey soils overlying siltstone or mudstone

**Classification:**

*Aust:* Bleached-Ferric or Bleached-Manganic Dermosolic Redoxic Hydrosol; Bleached-Acidic or Bleached-Mottled Mesotrophic Grey Dermosol

*GSG:* Gleyed Podzolic

*PPF:* Gn3.04, Dg2.41

**Landform:** Level plains to gentle rises

**Geology:** Rolling Downs (Klr), Leached clay and silt (Czc)

**Vegetation:** *E. clarksoniana, E. novoguinensis* or *E. polycarpa* woodlands and open woodlands

**Microrelief:** None

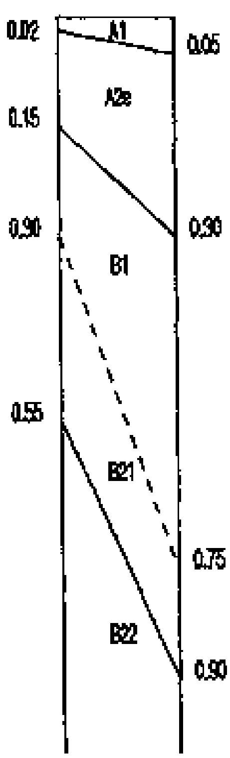
**Surface condition:** Hardsetting

**Surface coarse fragments:** Many 2-6 mm sub-rounded ferruginous nodules occasionally present

**Land Use Limitations**

| | |
|---|---|
| **Climate:** | <35°C, >1500 mm (C2), <35°C, <1500 mm (C1) |
| **Moisture Supply:** | 60 - 80 mm/m (M4) |
| **Fertility:** | <3 ppm P, <4 ppm $SO_4$ S (N8) |
| **Wetness:** | Poorly to imperfectly drained, moderately permeable (W5m, W4m) |
| **Flooding frequency:** | No flooding (F0), occasionally less than 1 in 10 years (F1) |
| **Rockiness:** | No rock (R0) |
| **Topography:** | No microrelief (T0) |
| **Soil physical condition:** | Slightly to moderately adhesive soils, moderate moisture range, hardsetting (including large aggregates) (P2) |
| **Vegetation factor:** | Regrowth control no problem, existing vegetation no problem (Vc1r1) |
| **Erodibility:** | 1-3 %, stable (E2a) |
| **Landscape complexity:** | Unit size > 20 ha (X0), Unit size < 20 ha (X1) |
| **Salinity:** | High risk outflow zone (So3), transmission zone (St3) |

**Soil Description:**




**A1** 0 - 0.03 Dark or grey (10YR 3-5/1-2); Few fine distinct orange mottles occasionally present; Loamy fine sand to silty clay loam; Massive; Dry, firm to very firm; Field pH 5.5 to 6.0; Abrupt boundary to;

**A2e** 0.04 - 0.20 Conspicuously bleached - grey or yellow-brown (10YR 5-6/2-3); Few fine distinct orange mottles occasionally present; Loamy fine sand to silty clay loam; Massive; Dry, firm to very firm; Few to common 2-6 mm ferruginous or manganiferous nodules occasionally present; Field pH 5.0 to 6.0; Clear or gradual boundary to;

**B1** 0.20 - 0.50 Grey or yellow-brown (10YR 6/2-4); Common to many fine faint yellow to red mottles; Fine sandy clay loam to fine sandy light clay; Massive to weak 2-5 mm sub-angular blocky; Dry, firm; Field pH 5.5 to 6.0; Diffuse boundary to;

**B21** 0.50 - 0.75 Grey or pale or yellow-brown (10YR 6-7/2-3); Many distinct fine orange or red mottles; Light clay; Moderate 2-5 mm polyhedral to angular blocky; Common to many 2-6 mm ferruginous nodules occasionally present; Dry, firm; Field pH 5.0 to 5.5; Clear or diffuse boundary to;

**B22** 0.75 - 1.00 Grey or pale (10YR 5-7/1-2); Few to many distinct fine yellow to red mottles; Light clay to medium clay; Strong 2-5 mm polyhedral; Dry to moderately moist, weak to firm; Very few to common 2-6 mm manganiferous, ferro-manganiferous or ferruginous nodules; Field pH 5.0 to 6.0.

Limit of augering

**Phases:** Rocky phase (LdRp): Many 6-20 mm sub-rounded platy ferruginized siltstone throughout. **Number of sites:** 1

**Number of sites:** 19

**Name:** Myall (Ml)

**Concept:** Deep Uniform or Gradational mottled yellow structured clay soils formed on siltstone, mudstone or claystone

**Classification:**

*Aust:* Mottled or Ferric or Manganic Eutrophic Yellow or Brown Dermosol

*GSG:* Xanthozem

*PPF:* Uf6.41, Gn3.71, Gn3.91

**Landform:** Gently undulating plains, to undulating rises

**Geology:** Rolling Downs Group (Klr), Bulimba Formation (KTi) and Wolena claystone (Klo)

**Vegetation:** *E. chlorophylla*, *E. leptophleba* woodlands and open woodlands

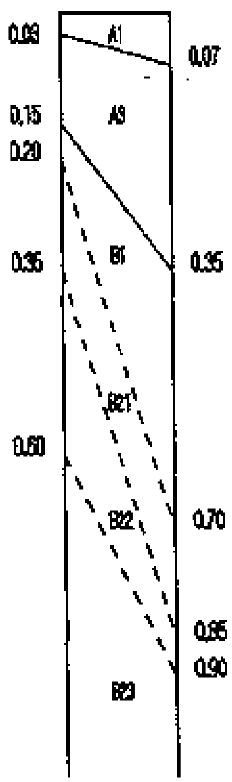
**Microrelief:** Normal gilgai; vertical interval 0.3 to 0.6 m; horizontal interval 5 to 10 m

| Land Use Limitations | |
|---|---|
| **Climate:** | <35°C, <1500 mm (C1) |
| **Moisture Supply:** | 100 - 140 mm/m (M2) |
| **Fertility:** | 3-8 ppm P, <4 ppm $SO_4$ S (N6) |
| **Wetness:** | Imperfectly drained, slowly permeable (W4a) |
| **Flooding frequency:** | No flooding (F0) |
| **Rockiness:** | No rock (R0) |
| **Topography:** | Microrelief vertical interval 0.3 - 0.6 m (T3) |
| **Soil physical condition:** | Slightly to moderately adhesive soils, narrow moisture range, hardsetting (including large aggregates) (P4) |
| **Vegetation factor:** | Regrowth control no problem, existing vegetation no problem (Vc1e1) |
| **Erodibility:** | 1-3%, stable (E2a) |
| **Landscape complexity:** | Unit size > 20 ha (X0) |
| **Salinity:** | High risk outflow zone (So3) |

**Surface condition:** Hardsetting

**Surface coarse fragments:** None

**Soil Description:**




**A1** 0 - 0.05 Dark or grey (10YR 3-4/1-2); Few fine faint yellow or orange mottles; Clay loam to light clay; Moderate 2-5 mm granular, cast or sub-angular blocky; Dry, firm to very firm; Few 2-6 mm manganiferous nodules; Field pH 5.5 to 6.5; Abrupt boundary to;

**A3** 0.05 - 0.20 Grey or yellow or yellow-brown or brown (10YR 4-5/2-5); Few to many fine, faint yellow, orange or brown mottles; Light clay; Moderate 2-5 mm polyhedral or sub-angular blocky; Dry, weak to very firm; Few to many 2-6 mm ferruginous or manganiferous nodules; Field pH 5.5 to 6.0; Clear or diffuse boundary to;

**B1** 0.20 - 0.35 Brown or yellow (10YR 4/4 or 5/4-6); Few to many fine faint to distinct yellow to red or grey mottles; Light clay to medium clay; Moderate to strong 2-5 mm polyhedral; Dry to moderately moist, firm to very firm; Few to common 2-6 mm manganiferous or ferruginous nodules; Field pH 5.5 to 6.0; Diffuse boundary to;

**B21** 0.35 - 0.50 Yellow-brown or yellow (10YR 5-6/4-6); Common to many, fine, faint to distinct red or grey mottles; Light clay to medium heavy clay; Moderate to strong 2-5 mm polyhedral or sub-angular blocky; Moderately moist, weak to very firm; Few to many 2-6 mm manganiferous or ferruginous nodules; Field pH 5.5 to 6.0; Diffuse boundary to;

**B22** 0.50 - 0.80 Yellow-brown or yellow (10YR 5-6/4-6); Few to many fine distinct yellow to red or grey mottles; Light medium clay to heavy clay; Moderate to strong 2-5 mm polyhedral, sub-angular blocky or lenticular; Moderately moist, weak to very firm; Few to many 2-6 mm manganiferous or ferruginous nodules; Field pH 5.5 to 6.0; Diffuse boundary to;

**B23** 0.80 - 1.10 Grey or yellow-brown (10YR 6/2-4); Common to many distinct red mottles; Medium heavy clay to heavy clay; Strong, 2-5 mm lenticular; Moderately moist, firm to very firm; Few 2-6 mm ferruginous to common 2-6 mm manganiferous nodules; Field pH 6.0 to 7.0

Limit of augering

**Number of sites:** 31

**Name:** Picamminy (Pn)

**Concept:** Deep Uniform cracking brown or grey structured clay, formed on recent exposures of siltstones, claystones or mudstones

**Classification:**

*Aust:* Mottled Pedal or Crusty Brown Grey Vertosol

*GSG:* Brown clay

*PPF:* Ug5.24, Ug5.34, Ug5.35

**Landform:** Level to gently undulating plains to undulating rises

**Geology:** Rolling Downs Group (Klr), Bulimba Formation(KTi) and Wolena claystone (Klo)

**Vegetation:** *E. leptophleba, E.chlorophylla* open woodlands or grasslands

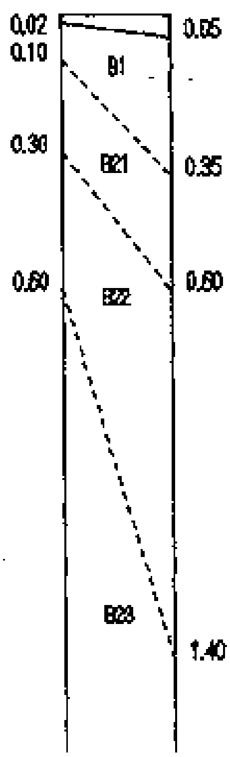
**Microrelief:** Normal gilgai; vertical interval 0.2-0.4 m; horizontal interval 3-8 m

| Land Use Limitations | |
|---|---|
| **Climate:** | <35°C, <1500 mm (C1) |
| **Moisture Supply:** | 100 - 140 mm/m (M2) |
| **Fertility:** | 3-8 ppm P, <4 ppm $SO_4$ S (N6) |
| **Wetness:** | Imperfectly drained, very slowly permeable (W4v) |
| **Flooding frequency:** | No flooding (F0) |
| **Rockiness:** | No rock (R0) |
| **Topography:** | Microrelief vertical interval 0.1 - 0.6 m (T2, T3) |
| **Soil physical condition:** | Strongly adhesive soils, narrow moisture range, moderately hardsetting (P7) |
| **Vegetation factor:** | Regrowth control no problem, existing vegetation no problem (Ve1e1) |
| **Erodibility:** | 1-3%, unstable (E2u) |
| **Landscape complexity:** | Unit size > 20 ha (X0), Unit size < 20 ha (X1) |
| **Salinity:** | High risk outflow zone (So3) |

**Surface condition:** Cracking, hardsetting

**Surface coarse fragments:** None

**Soil Description:**




**A1** 0 - 0.03 Dark or grey (10YR 3-4/1-2); Few to common fine faint orange mottles; Light medium clay to medium heavy clay; Moderate 2-5 mm granular; Dry, firm to strong; Few to common 2-6 mm manganiferous or ferruginous nodules; Field pH 5.5 to 6.5; Abrupt or clear boundary to;

**B1** 0.03 - 0.25 Grey or brown (10YR 4/2-4); Common fine faint orange or brown mottles; Light medium clay to medium heavy clay; Moderate 2-5 mm lenticular or sub-angular blocky; Dry to moderately moist, firm to very firm; Few to many 2-6 mm manganiferous nodules; Field pH 5.5 to 6.5; Gradual or diffuse boundary to;

**B21** 0.25 - 0.40 Grey or yellow-brown (10YR 4/2 or 2.5Y 5/4); Common to many fine, faint to distinct grey or orange mottles; Medium clay to heavy clay; Moderate to strong 2-5 mm lenticular or sub-angular blocky; Moderately moist, firm to very firm; Few to common 2-6 mm manganiferous or ferro-manganiferous nodules; Field pH 6.0 to 6.5; Diffuse boundary to;

**B22** 0.40 - 0.80 Grey or yellow-brown (10YR or 2.5Y 5/2-3); Common to many fine faint or distinct, yellow, grey or red mottles; Medium heavy clay to heavy clay; Moderate to strong 2-10 mm lenticular; Moderately moist, very firm; Very few to few 2-6 mm manganiferous nodules; Field pH 5.5 to 7.0; Diffuse boundary to;

**B23** 0.80 - 1.50 Grey or yellow-brown (2.5Y4/2 or 10YR 5/4); Common to many fine faint to distinct orange or grey mottles; Medium heavy clay to heavy clay; Strong 5-10 mm lenticular; Moderately moist, firm to very firm; Few 2-6 mm manganiferous nodules; Field pH 7.0 to 7.5.

Limit of augering

**Number of sites:** 21

**Name:** Scorpion (Sp)

**Concept:** Deep Gradational or Uniform yellow massive soil with ferruginous or manganiferous nodules formed on laterised remnants of Bulimba Formation

**Classification:**

*Aust:* Ferric or Bleached-Ferric or Manganic or Bleached-Manganic Mesotrophic Yellow Kandosol; Ferric Mesotrophic Brown Kandosol

*GSG:* Yellow Earth

*PPF:* Gn2.24, Gn2.34, Gn2.64, Gn2.84, Um4.23, Um5.51, Um5.52

**Landform:** Gently undulating plains to undulating rises

**Geology:** Rolling Downs Group (Klr')

**Vegetation:** *E. tetrodonta* woodlands and tall woodlands

**Microrelief:** None

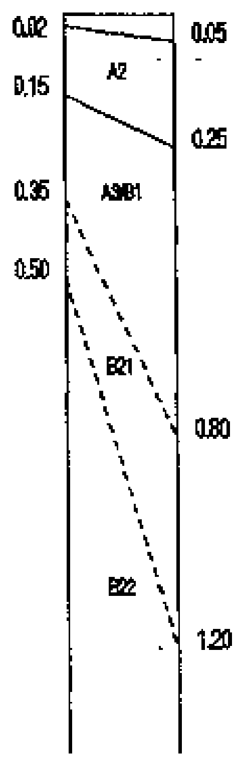
**Land Use Limitations**

| | |
|---|---|
| **Climate:** | <35°C, <1500 mm (C1), <35°C, >1500 mm (C2) |
| **Moisture Supply:** | 60 - 80 mm/m (M4) |
| **Fertility:** | <3 ppm P, <4 ppm $SO_4$ S (N8) |
| **Wetness:** | Well drained, moderately permeable (W2m) |
| **Flooding frequency:** | No flooding (F0) |
| **Rockiness:** | 2-6 mm, 20-50% (R4) |
| **Topography:** | No microrelief (T0) |
| **Soil physical condition:** | Slightly to moderately adhesive soils, moderate moisture range, moderately hardsetting (P1) |
| **Vegetation factor:** | Regrowth poses a problem; existing vegetation no problem (Ve2e1) |
| **Erodibility:** | 3-10%, stable (E3s) |
| **Landscape complexity:** | Unit size < 20 ha (X1), occasionally > 20 ha (X0) |
| **Salinity:** | High risk recharge zone (S3) |

**Surface condition:** Hardsetting

**Surface coarse fragments:** Many 2-6 mm ferruginous nodules occasionally present

**Soil Description:**




**A1** 0 - 0.03 Dark or brown or grey (10YR 3/2 or 4/1-3); Loamy fine sand to fine sandy clay loam; Massive; Dry, firm to very firm; Few to very many 2-6 mm ferruginous nodules; Field pH 6.0 to 6.5; Abrupt boundary to;

**A2** 0.03 - 0.20 Grey or brown (10YR 4/2-4 or 7.5YR 4-5/4); Loamy fine sand to fine sandy clay loam; Massive; Dry, firm; Common to many 2-6 mm ferruginous or manganiferous nodules; Field pH 5.5 to 6.5; Clear or diffuse boundary to;

**A3/B1** 0.20 - 0.45 Brown or yellow-brown or yellow (10YR 4/5 or 5-6/6 or 7.5YR 5/6); Fine sandy clay loam to clay loam; Massive; Dry, weak to firm; Common to very many 2-6 mm ferruginous or ferro-manganiferous or manganiferous nodules; Field pH 5.5 to 6.0; Gradual or diffuse boundary to;

**B21** 0.45 - 0.60 Yellow-brown or yellow (7.5YR 5/6-8 or 10YR 6/6); Few to many fine distinct orange to red mottles; Fine sandy clay loam to clay loam heavy; Massive; Dry, weak to firm; Many to very many 2-6 mm ferruginous or ferro-manganiferous or manganiferous nodules; Field pH 5.5 to 6.0; Diffuse boundary to;

**B22** 0.60 - 1.20 Yellow-brown or yellow (10YR 6/4-6); Fine sandy clay loam to clay loam heavy; Massive; Dry, weak to firm; Very many 2-6 mm ferruginous or ferro-manganiferous or manganiferous nodules; Field pH 5.5 to 6.0;

Limit of augering

**Number of sites:** 21

**Name:** Weipa (Wp)

**Concept:** Deep Gradational or Uniform red massive soil with aluminous concretions

**Classification:**

*Aust:* Bauxitic Dystrophic Red Kandosol

*GSG:* Red Earth

*PPF:* Gn2.14, Gn2.15, Um4.21, Um4.23

**Landform:** Level to gently undulating plains on plateaux

**Geology:** Tertiary and Quaternary aluminous laterite (T&Qa)

**Vegetation:** *E. tetrodonta* woodlands and tall woodlands

**Microrelief:** None

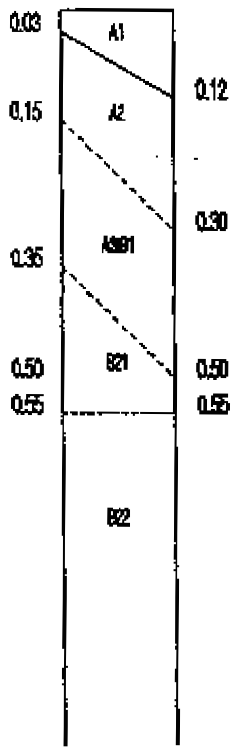
**Surface condition:** Hardsetting

**Surface coarse fragments:** Very many 2-6 mm aluminous concretions

**Land Use Limitations**

| | |
|---|---|
| **Climate:** | <35°C, <1500 mm (C1), <35°C, >1500 mm (C2) |
| **Moisture Supply:** | 60 - 80 mm/m (M4) |
| **Fertility:** | <3 ppm P, <4 ppm $SO_4$ S (N8) |
| **Wetness:** | Well drained, moderately permeable (W1m) |
| **Flooding frequency:** | No flooding (F0) |
| **Rockiness:** | 2-6 mm, 20-50% (R4) |
| **Topography:** | No microrelief (T0) |
| **Soil physical condition:** | Slightly to moderately adhesive soils, moderate moisture range, moderately hardsetting (P1) |
| **Vegetation factor:** | Regrowth poses a problem, existing vegetation a problem (Vo2e2) |
| **Erodibility:** | 1-3 %, stable (E2s) |
| **Landscape complexity:** | Unit size > 20 ha (X0) |
| **Salinity:** | Low risk inflow zone (Si1) |

**Soil Description:**




**A1** 0 - 0.08 Dark or grey or brown or red-brown (10YR 2-4/2; or 7.5YR 4/3-4; or 5YR 4/3); Loam to clay loam heavy; Massive or weak 2-5 mm sub-angular blocky or moderate 2-5 mm cast; Dry firm; Few 2-6 mm medium aluminous to ferruginous concretions; Field pH 6.0 to 7.0; Abrupt or clear boundary to;

**A2** 0.08 - 0.25 Grey or brown or red-brown (10YR 4/2-4; or 5YR 4/6 or 5/5); Clay loam sandy to clay loam heavy; Massive; Dry, firm; Very few to few 2-6 mm aluminous to ferruginous concretions; Field pH 6.0 to 6.5; Gradual boundary to;

**A3/B1** 0.25 - 0.35 Red or red-brown or brown (2.5YR 3/8 or 4/5; or 5YR 3/6 or 4/4 or 5/6-8; or 7.5YR 4/6); Sandy clay loam to clay loam; Massive; Dry, firm; Very few to common 6-20 mm aluminous to ferruginous concretions; Field pH 7.0; Gradual or diffuse boundary to;

**B21** 0.35 - 0.55 Red or red-brown (2.5YR 3/8 or 4/6-8; or 5YR 4/6 or 5/8); Fine sandy clay loam to clay loam; Massive; Dry, weak to firm; Few to very many 6-20 mm aluminous concretions; Field pH 7.0; Gradual boundary to;

**B22** 0.55 - 0.90 Red or red-brown (2.5YR 4/6 or 5YR 5/8); Fine sandy clay loam to light clay; Massive; Dry, weak; Very many 6-20 mm aluminous or ferruginous concretions; Field pH 7.0.

Limit of augering

**Number of sites:** 10

## APPENDIX 3

## SALINITY RATINGS

| Plant salt tolerance group | Soil salinity rating | 10-20% clay | | 20-40% clay | | 40-60% clay | | 60-80% clay | |
|---|---|---|---|---|---|---|---|---|---|
| | | $EC_{1:5}$ (dS/m) | $Cl_{1:5}$ (g/100g) | $EC_{1:5}$ (dS/m) | $Cl_{1:5}$ (g/100g) | $EC_{1:5}$ (dS/m) | $Cl_{1:5}$ (g/100g) | $EC_{1:5}$ (dS/m) | $Cl_{1:5}$ (g/100g) |
| Sensitive | Very low | <0.05 | <0.008 | <0.08 | <0.012 | <0.12 | <0.01 | <0.18 | <0.028 |
| Moderately sensitive | Low | 0.10 | 0.016 | 0.165 | 0.025 | 0.25 | 0.037 | 0.37 | 0.055 |
| Moderately tolerant | Medium | 0.25 | 0.038 | 0.40 | 0.060 | 0.58 | 0.09 | 0.85 | 0.13 |
| Tolerant | High | 0.45 | 0.066 | 0.67 | 0.10 | 1.00 | 0.15 | 1.5 | 0.22 |
| Very tolerant | Very high | 0.70 | 0.105 | 1.05 | 0.16 | 1.58 | 0.28 | 2.4 | 0.35 |
| Generally too saline | Extreme | >0.70 | >0.105 | >1.05 | >0.16 | >1.58 | >0.24 | >2.4 | >0.35 |

N.B. This table assumes most of the salts present are chloride. If other salts are present, permissible $EC_{1:5}$ values can be higher than those given above.

(Source: Shaw, 1988)

# APPENDIX 4

# SELECTED SOILS OF THE HODGKINSON FORMATION AND ASSOCIATED SURFACES

**Name:** Eykin (Ek)

**Concept:** Moderately deep Duplex sodic grey soils formed on greywacke and slate

**Classification:**

*Aust:* Eutrophic Mottled-Subnatric Grey Sodosol

*GSG:* Solodic Soil

*PPF:* Dy3.43, Dy3.42

**Landform:** Undulating rises to rolling hills

**Geology:** Hodgkinson Formation (D-Ch)

**Vegetation:** *E. cullenii*, *E.crebra* or *E. persistens* woodlands and open woodlands

**Microrelief:** None

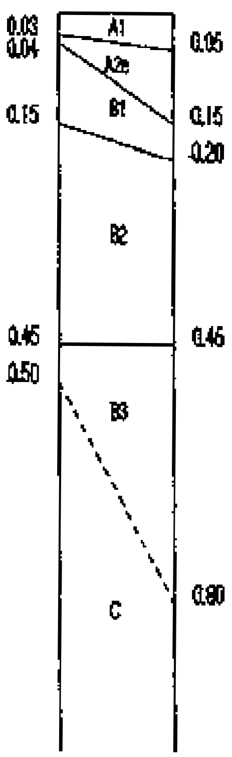
**Surface condition:** Hardsetting

**Surface coarse fragments:** Abundant 6-60 mm angular greywacke and slate

**Land Use Limitations**

| | |
|---|---|
| **Climate:** | <35°C, <1500 mm (C1) |
| **Moisture Supply:** | 40 - 60 mm/m (M5) |
| **Fertility:** | <3 ppm P, >4 ppm $SO_4$ S (N7) |
| **Wetness:** | Imperfectly to poorly drained, slowly permeable (W6s, W5s) |
| **Flooding frequency:** | No flooding (F0) |
| **Rockiness:** | 6-20 mm, 20-50 % (Rm4) |
| **Topography:** | No microrelief (T0) |
| **Soil physical condition:** | Slightly to moderately adhesive soils, moderate moisture range, moderately hardsetting (P1) |
| **Vegetation factor:** | Regrowth poses a problem, existing vegetation no problem (Vc2e1) |
| **Erodibility:** | 3-10%, unstable (E3u) |
| **Landscape complexity:** | Unit size > 20 ha (X0) |
| **Salinity:** | High risk outflow zone (So3) |

**Soil Description:**




**A1** 0 - 0.04 Dark or brown (10YR 3/2 or 7.5YR 4/3); Loamy sand to sandy loam; Few to many 2-6 mm angular metamorphic or sub-rounded quartz coarse fragments; Massive; Dry, firm; Field pH 5.5 to 7.0; Abrupt or clear boundary to;

**A2e** 0.04 - 0.15 Conspicuously bleached - brown or yellow-brown (10YR 4-5/4 or 5/3); Loamy sand to sandy loam; Common to many 6-20 mm angular metamorphic coarse fragments; Massive; Dry, firm; Field pH 5.5 to 6.5; Abrupt boundary to;

**B1** 0.15 - 0.20 Yellow-brown (10YR 5-6/4 or 7.5YR 5/4); Sandy clay to light medium clay; Common 6-20 mm angular platy metamorphic or sub-rounded quartz coarse fragments; Massive to weak 2-5 mm sub-angular blocky; Dry, very firm; Field pH 6.0; Clear or gradual boundary to;

**B2** 0.20 - 0.45 Yellow-grey (2.5Y 5-6/3-4); Common to many fine faint red or yellow mottles; Light medium clay to medium heavy clay; Many to very many 2-20 mm angular metamorphic or quartz coarse fragments; Moderate to strong 2-50 mm sub-angular to angular blocky; Dry, very firm to strong; Field pH 6.0 to 9.0; Clear or gradual boundary to;

**B3** 0.45 - 0.60 Yellow-grey or pale (2.5Y 6-7/3); Few to common fine faint grey to distinct red and yellow mottles; Light clay; Many 2-6 mm angular platy metamorphic coarse fragments; Moderate 2-5 mm sub-angular blocky; Dry, firm to very strong; Field pH 6.5 to 7.5; Diffuse boundary to;

**C** Rock

**Number of sites:** 4

**Name:** Gibson (Gs)

**Concept:** Deep Duplex sodic yellow or grey soils on colluvial and pediments from greywacke and slate

**Classification:**

*Aust:* Eutrophic Mottled-Subnatric Yellow Sodosol; Sodic Sodosolic Redoxic Hydrosol

*GSG:* Soloth/Solodic Soil

*PPF:* Dy3.41, Dy3.42, Dy3.43

**Landform:** Footslopes of rises and and hillslopes

**Geology:** Pleistocene? and recent colluvia (Czs)

**Vegetation:** *E. chlorophylla*, *E. microtheca* or *E. acroleuca* woodlands and open woodlands

**Microrelief:** None

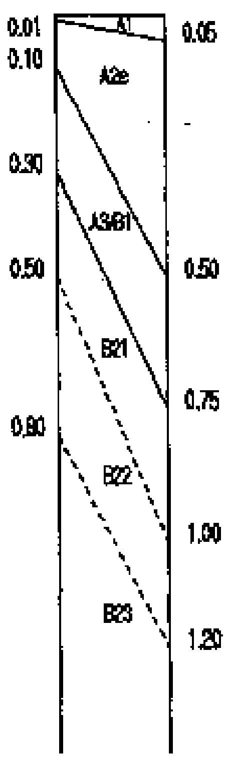
**Surface condition:** Hardsetting

**Surface coarse fragments:** None

**Land Use Limitations**

| | |
|---|---|
| **Climate:** | <35°C, <1500 mm (C1), <35°C, >1500 mm (C2) |
| **Moisture Supply:** | 40 - 60 mm/m (M5) |
| **Fertility:** | 8-20 ppm P, >4 ppm $SO_4$ S (N3) |
| **Wetness:** | Poorly drained, slowly permeable (W5a) |
| **Flooding frequency:** | No flooding (F0) |
| **Rockiness:** | No rock (R0) |
| **Topography:** | No microrelief (T0) |
| **Soil physical condition:** | Slightly to moderately adhesive soils, moderate moisture range, moderately hardsetting (P1) |
| **Vegetation factor:** | Regrowth poses a problem, existing vegetation no problem (Vc2e1) |
| **Erodibility:** | 3-10%, unstable (E3u) |
| **Landscape complexity:** | Unit size > 20 ha (X0) |
| **Salinity:** | High risk outflow zone (So3) |

**Soil Description:**




**A1** 0 - 0.03 Dark, grey or grey-brown (7.5YR 3-4/2 or 10YR 4-5/2 or 2.5Y 4/1-2); Loamy sand to loam; Massive; Dry, weak to firm; Field pH 6.0 to 7.0; Abrupt or clear boundary to;

**A2e** 0.03 - 0.25 Conspicuously bleached - grey or yellow-brown or yellow-grey (10YR 5/2-4 or 6/3 or 2.5Y 6/2-4); Loamy sand to sandy loam; Few to common 2-20 mm sub-angular quartz; Massive; Dry, weak to very firm; Field pH 5.5 to 6.5; Abrupt or gradual boundary to;

**A3/B1** 0.25 - 0.50 Grey or yellow-grey or yellow-brown or pale (2.5Y 5/2-3 or 10YR 6-7/4); Few to common fine distinct yellow to orange mottles; Sandy clay loam to sandy light clay; Massive to strong angular blocky; Few to many 2-5mm manganiferous nodules occasionally present; Field pH 6.0; Clear or gradual boundary to;

**B21** 0.50 - 0.80 Grey or yellow-brown or yellow-grey or yellow (10YR 6/2-5 or 2.5Y 5/1 or 5/4); Few to many fine distinct yellow, orange or red mottles; Sandy light medium clay to medium heavy clay; Strong 2-20 mm sub-angular blocky to prismatic; Moderately moist, firm to very strong; Field pH 5.0 to 8.0; Gradual or diffuse boundary to;

**B22** 0.80 - 1.00 Yellow-brown or grey (10YR 6/3-5 or 5Y 5/2); Few to many fine distinct yellow, orange or red mottles; Sandy medium clay to medium clay; Strong 2-5 mm angular blocky to 5-10 mm prismatic; Moderately moist, strong; Field pH 8.0 to 10.0; Diffuse boundary to;

**B23** 1.00 - 1.20 Yellow-grey or pale or grey (2.5Y 6/4 or 7/2 or 5Y 6/1); Few to many fine faint to distinct yellow, orange or red mottles; Light medium clay silty to medium clay; Strong 2-5 mm angular blocky to 10-20 mm prismatic; Moderately moist, strong; Many 2-6 mm calcareous nodules occasionally present; Field pH 9.0 to 10.0

Limit of augering

**Number of sites:** 10

**Name:** Greenant (Ga)

**Concept:** Deep Duplex sodic acid to alkaline yellow soils formed on alluvial plains

**Classification:**

*Aust:* Mesotrophic Mottled-Subnatric Yellow Grey or Brown Sodosol; Bleached-Manganic Sodosolic Redoxic Hydrosol

*GSG:* Solodic Soil/Soloth

*PPF:* Dy3.41, Dy3.42, Dy3.43, Dg2.41, Db2.41

**Landform:** Alluvial plains/fans

**Geology:** Quaternary alluvia (Qa) and Pleistocene? colluvia (Czx)

**Vegetation:** *E. chlorophylla, E. microtheca* or *E. terminalis* woodlands and open woodlands

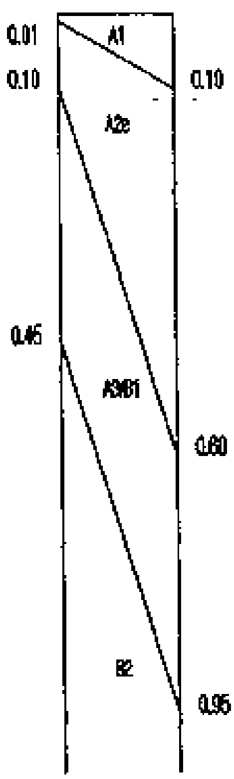
**Microrelief:** None

**Surface condition:** Hardsetting

**Surface coarse fragments:** None

| Land Use Limitations | |
|---|---|
| **Climate:** | <35°C, <1500 mm (C1) |
| **Moisture Supply:** | 40 - 60 mm/m (M5) |
| **Fertility:** | 3-8 ppm P, > 4 ppm $SO_4$ S (N5) |
| **Wetness:** | Poorly drained, slowly permeable (W5a) |
| **Flooding frequency:** | 1 in 2-10 years (F2) |
| **Rockiness:** | No rock (R0) |
| **Topography:** | No microrelief (T0) |
| **Soil physical condition:** | Slightly to moderately adhesive soils, moderate moisture range, moderately hardsetting (P1) |
| **Vegetation factor:** | Regrowth control no problem, existing vegetation no problem (Vc1e1) |
| **Erodibility:** | 1-3%, very unstable (E2v) |
| **Landscape complexity:** | Unit size > 20 ha (X0) |
| **Salinity:** | Medium risk outflow zone (So2) |

**Soil Description:**




**A1** 0 - 0.05 Dark or grey or grey-brown (10YR 3-5/2 or 7.5YR 4/2); Few fine faint brown or orange mottles occasionally present; Loamy sand to fine sandy clay loam; Massive; Dry, firm to strong; Field pH 6.0 to 7.0; Abrupt or gradual boundary to;

**A2e** 0.05 - 0.40 Conspicuously bleached - grey or yellow-brown or brown or pale (10YR 5-6/2-4 or 7.5YR 5-7/3); Loamy sand to fine sandy clay loam; Massive; Dry, firm to strong; Field pH 5.5 to 6.5; Clear or gradual boundary to;

**A3/B1** 0.40 - 0.85 Yellow-brown or yellow or pale (10YR 5/3-5 or 6/4-6 or 7/1-3); Few to common fine distinct orange or red mottles; Sandy clay loam to medium clay; Massive to moderate 2-5 mm sub-angular blocky; Dry, firm to strong; Field pH 5.5 to 6.0; Clear or gradual boundary to;

**B2** 0.85 - 1.20 Brown or yellow-brown or yellow or yellow-grey or pale (10YR 4-6/4 or 10YR 6/5 or 2.5Y 4/2 or 8/1); Few to many fine distinct yellow, orange or red mottles; Light clay to medium heavy clay; Moderate to strong 2-50 mm angular or sub-angular blocky, or prismatic; Dry to moderately moist, very firm to very strong; Field pH 5.5 to 9.0;

Limit of augering

**Number of sites:** 14

**Name:** Hodge (Hg)

**Concept:** Very shallow to shallow bleached Uniform or Gradational brown soils formed on greywacke and slate

**Classification:**

*Aust:* Haplic Paralithic Bleached-Leptic Tenosol; Bleached Dystrophic Brown Kandosol

*GSG:* Lithosol

*PPF:* Uc2.12, Um2.12, Gn2.81

**Landform:** Undulating rises to steep hills

**Geology:** Hodgkinson Formation (D-Ch), Chillagoe Formation (S-Db), Little River Coal Measures (Pur)

**Vegetation:** *E. cullenii*, *E.crebra* or *E. persistens* woodlands and open woodlands

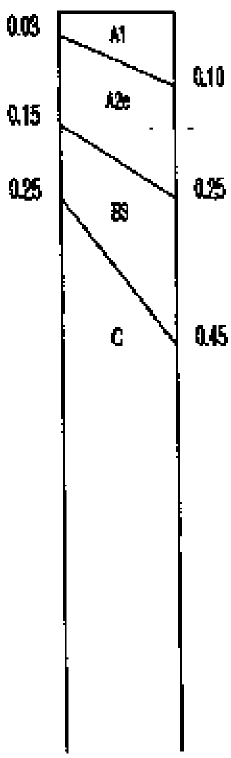
| Land Use Limitations | |
|---|---|
| **Climate:** | <35°C, <1500 mm (C1) |
| **Moisture Supply:** | < 40 mm/m (M6) |
| **Fertility:** | <3 ppm P, <4 ppm $SO_4$ S (N8) |
| **Wetness:** | Well drained, highly permeable (W2h) |
| **Flooding frequency:** | No flooding (F0) |
| **Rockiness:** | 20-60 mm, 20-50% (Rg4) |
| **Topography:** | No microrelief (T0) |
| **Soil physical condition:** | No restriction (P0) |
| **Vegetation factor:** | Regrowth control no problem, existing vegetation no problem (Vc1e1) |
| **Erodibility:** | 10-32%, unstable (E4u) |
| **Landscape complexity:** | Unit size > 20 ha (X0) |
| **Salinity:** | Moderate risk intake zone (Si2) |

**Microrelief:** None

**Surface condition:** Hardsetting, occasionally soft

**Surface coarse fragments:** Very many 6-200 mm angular greywacke, slate or quartz

**Soil Description:**




**A1** 0 - 0.05 Dark or grey (7.5YR 3-4/2); Sand to loam; Many 6-20 mm to very many 20-60 mm angular metamorphic; Massive; Dry, weak to firm; Field pH 5.5 to 6.5; Sharp or clear boundary to;

**A2e** 0.05 - 0.20 Brown (7.5YR 5/3-4); Sand to sandy clay loam; Many 6-20 mm to very many 20-60 mm angular metamorphic; Massive; Dry, weak to firm; Field pH 5.5 to 6.5; Clear or diffuse boundary to;

**B3** (frequently present) 0.20 - 0.30 Brown (7.5YR 6/4); Sandy loam to clay loam sandy; Many 6-20 mm to very many 20-60 mm angular metamorphic; Massive; Dry, weak to firm; Field pH 5.5; Clear or gradual boundary to;

**C** Rock

**Number of sites:** 4

**Name:** Jeannie (Jn)

**Concept:** Moderately deep Gradational or Uniform yellow soils formed on greywacke and slate

**Classification:**

*Aust:* Mottled or Bleached-Mottled Mesotrophic Yellow Dermosol Haplic Mesotrophic Brown Kandosol;

*GSG:* Yellow Earth/Yellow Podzolic Soil

*PPF:* Gn3.71, Gn3.74, Gn3.84, Um4.23, Uf6.51

**Landform:** Undulating rises to steep hills

**Geology:** Hodgkinson Formation (D-Ch)

**Vegetation:** *E. cullenii*, *E. crebra*, *E. persistens*, or *E. hylandii* woodlands and open woodlands

**Microrelief:** None

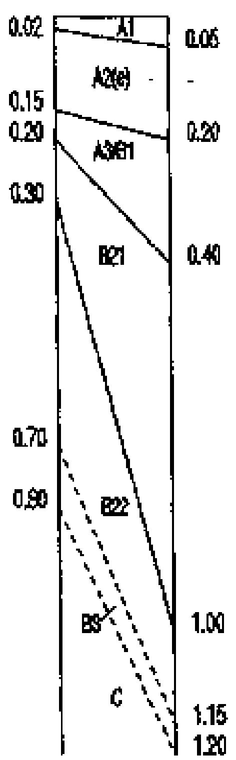
**Surface condition:** Hardsetting

**Surface coarse fragments:** Common to many 6-20 mm greywacke, slate or quartz

**Land Use Limitations**

| | |
|---|---|
| **Climate:** | <35°C, >1500 mm (C2), <35°C, <1500 mm (C1) |
| **Moisture Supply:** | 60 - 80 mm/m (M4) |
| **Fertility:** | <3 ppm P, <4 ppm $SO_4$ S (N8) |
| **Wetness:** | Imperfectly drained, moderately permeable (W4m) |
| **Flooding frequency:** | No flooding (F0) |
| **Rockiness:** | 6-20 mm; 20-50 % (Rm4) |
| **Topography:** | No microrelief (T0) |
| **Soil physical condition:** | Slightly to moderately adhesive soils, moderate moisture range, moderately hardsetting (P1) |
| **Vegetation factor:** | Regrowth control no problem, existing vegetation no problem (Vc1e1) |
| **Erodibility:** | 10-32%, stable (E4a) |
| **Landscape complexity:** | Unit size > 20 ha (X0) |
| **Salinity:** | Moderate risk inflow zone (Si2), Transmission zone (St2) |

**Soil Description:**




**A1** 0 - 0.03 Dark or grey-brown or brown (10YR 3/2 or 7.5YR 3/2 or 4/2-3); Sandy loam to light clay; Few to many 2-20 mm sub-angular to angular platy metamorphic coarse fragments; Massive; Dry, firm to very firm; Field pH 5.5 to 6.5; Clear or abrupt boundary to;

**A2(e)** 0.03 - 0.15 Occasionally conspicuously bleached - yellow-brown or brown (10YR or 7.5YR 5/3); Sandy loam to light clay; Common to many 2-60 mm sub-angular to angular platy metamorphic coarse fragments; Massive; Dry, firm to very fine; Field pH 5.5 to 6.0; Clear or gradual boundary to;

**A3/B1** 0.15 - 0.30 Yellow-brown, brown or grey (10YR 4-5/3 or 10YR 5-6/4 or 2.5Y 5/2); Few fine distinct red mottles occasionally present; Sandy loam to light medium clay. Few to many 2-60 mm sub-angular to angular platy metamorphic coarse fragments; Massive to moderate 2-5 mm sub-angular blocky to polyhedral; Dry, firm to very firm; Field pH 5.5 to 6.0; Clear boundary to;

**B21** 0.30 - 0.50 Yellow-brown or yellow (7.5YR or 10YR 5-6/5-6); Few to common fine distinct red mottles; Clay loam heavy to light medium clay; Massive to strong 2-5 mm angular blocky to polyhedral; Few to many 2-60 mm sub-angular to angular platy metamorphic coarse fragments; Dry, weak to firm; Field pH 5.5 to 6.0; Clear or gradual boundary to;

**B22** 0.50 - 0.70 Yellow (10YR 5/6 or 6/5); Common fine distinct red mottles; Light medium clay to medium clay; Massive to strong 2-5 mm angular blocky to polyhedral; Many 2-6 mm angular metamorphic coarse fragments; Dry to moderately moist, weak to firm; Field pH 5.0 to 6.0; Diffuse boundary to;

**B3** 0.70 - 90 Red-brown or yellow (5YR 5-6/6 or 10YR 5/6); Light clay to silty light medium clay; Many 2-6 mm angular platy metamorphic coarse fragments; Massive; Dry, firm; Field pH 6.0; Diffuse boundary to;

**C** Rock

**Number of sites:** 14

**Name:** Kingjack (KJ)

**Concept:** Moderately deep Gradational non-sodic yellow soils on colluvia and pediments from greywacke and slate

**Classification:**

*Aust:* Bleached-Mottled Mesotrophic Brown Dermosol

*GSG:* Yellow Podzolic Soil

*PPF:* Gn3.84, Gn3.04, Gn3.05, Dy5.41

**Landform:** Gently undulating plains, to undulating rises

**Geology:** Pleistocene? and recent colluvia (Czx)

**Vegetation:** *E. leptophleba*, *E. platyphylla* or *E. erythrophloia* woodlands

**Microrelief:** None

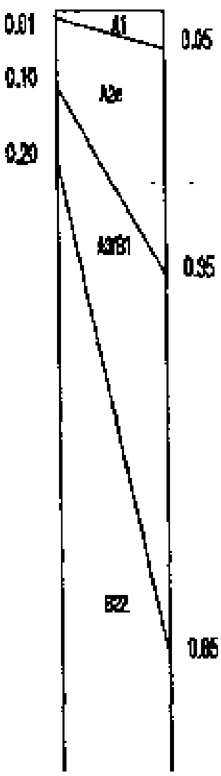
**Surface condition:** Hardsetting

**Surface coarse fragments:** None

**Land Use Limitations**

| | |
|---|---|
| **Climate:** | $<35°C$, $>1500$ mm (C2) |
| **Moisture Supply:** | 80 - 100 mm/m (M3) |
| **Fertility:** | 8-20 ppm P, >4 ppm $SO_4$ S (N3) |
| **Wetness:** | Imperfectly drained, slowly permeable (W4a) |
| **Flooding frequency:** | Less than 1 in 10 years (F1) |
| **Rockiness:** | No rock (R0) |
| **Topography:** | No microrelief (T0) |
| **Soil physical condition:** | Slightly to moderately adhesive soils, moderate moisture range, moderately hardsetting (P1) |
| **Vegetation factor:** | Regrowth poses a problem, existing vegetation no problem (Vc2a1) |
| **Erodibility:** | 1-3%, unstable (E2u) |
| **Landscape complexity:** | Unit size > 20 ha (X0) |
| **Salinity:** | Moderate risk outflow zone (So2) |

**Soil Description:**




**A1** 0 - 0.03 Dark or grey (10YR 3-5/1-2); Few fine distinct orange mottles occasionally present; Fine sandy loam to silty clay loam; Massive; Dry, weak to very firm; Field pH 6.0 to 7.0; Abrupt or clear boundary to;

**A2e** 0.03 - 0.15 Conspicuously bleached - grey or yellow-brown (10YR 4/2 or 5-6/2-3); Few fine faint to distinct orange mottles occasionally present; Fine sandy loam to silty clay loam; Massive; Dry, firm to very firm; Field pH 5.5 to 6.5; Abrupt or clear boundary to;

**A3/B1** 0.15 - 0.40 Yellow-brown or yellow-grey or yellow (10YR 5/4 or 6/6 or 2.5Y 5/3 or 6/6); Few to common fine faint to distinct yellow to red mottles; Fine sandy clay loam to light clay; Weak to moderate 2-5 mm sub-angular blocky; Dry, firm to very firm; Field pH 5.5 to 6.5; Clear or gradual boundary to;

**B22** 0.40 - 1.00 Yellow or yellow-grey (10YR 5-6/6-8 or 2.5Y 5-6/4); Few to many fine distinct to prominent brown, yellow, orange, red or grey mottles; Fine sandy light clay to medium clay; Many to abundant angular to sub-rounded quartz to metamorphic coarse fragments occasionally present; Moderate to strong 2-10 mm angular to sub-angular blocky; Dry to moderately moist, firm to strong; Few to many < 2-20 mm ferruginous nodules occasionally present; Field pH 5.5 to 7.0.

Limit of augering

**Number of sites:** 15

**Name:** Rule (Rl)

**Concept:** Deep Gradational or Uniform structured red clays derived from greywacke and slate

**Classification:**

*Aust:* Haplic Mesotrophic Red Dermosol

*GSG:* NSG

*PPF:* Gn3.11, Gn3.12, Uf5.22

**Landform:** Hillslopes on undulating rises to rolling hills

**Geology:** Hodgkinson Formation (D-Ch)

**Vegetation:** Closed forest of the Wet Tropics Region

**Microrelief:** None

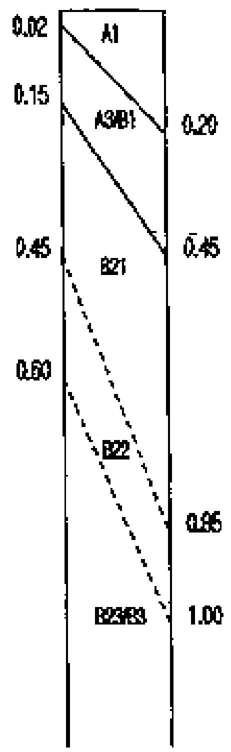
**Surface condition:** Firm, occasionally hardsetting

**Surface coarse fragments:** None

**Land Use Limitations**

| | |
|---|---|
| **Climate:** | <35°C, >1500 mm (C2) |
| **Moisture Supply:** | > 140 mm/m (M1) |
| **Fertility:** | 8-20 ppm P, >4 ppm $SO_4$ S (N3) |
| **Wetness:** | Well drained, moderately permeable (W2m) |
| **Flooding frequency:** | No flooding (F0) |
| **Rockiness:** | No rock (R0) |
| **Topography:** | No microrelief (T0) |
| **Soil physical condition:** | Slightly to moderately adhesive soils, moderate moisture range, moderately hardsetting (P1) |
| **Vegetation factor:** | Regrowth control no problem, existing vegetation a problem (Vc1s2) |
| **Erodibility:** | 3-10%, stable (E3s) |
| **Landscape complexity:** | Unit size > 20 ha (X0) |
| **Salinity:** | Low risk inflow zone (Si1) |

**Soil Description:**




**A1** 0 - 0.07 Dark (7.5YR 2/2 or 7.5YR or 10YR 3/1-2); Light clay loam to light clay; Moderate to strong 2-5 mm cast; Dry to moderately moist, weak to firm; Field pH 5.5 to 7.0; Clear boundary to;

**A3/B1** 0.07 - 0.35 Brown or red-brown (7.5YR or 5YR 3/3 or 4/4); Clay loam to light medium clay; Moderate to strong < 2-5 mm sub-angular to polyhedral; Moderately moist, weak to firm; Field pH 6.0 to 7.0; Clear or gradual boundary to;

**B21** 0.35 - 0.55 Red or red-brown (2.5YR or 5YR 3/4-5 or 4/6); Light medium clay to medium clay; Strong 2-5 mm sub-angular to polyhedral; Moderately moist, firm to very firm; Field pH 6.0 to 7.0; Gradual boundary to;

**B22** 0.55 - 0.80 Red (2.5YR 3-4/6); Light medium clay to medium heavy clay; Strong 2-5 mm sub-angular; Moderately moist, firm; Field pH 6.0 to 7.0; Gradual boundary to;

**B23/B3** 0.80 - 1.20 Red (2.5YR or 7.5YR 4/6); Light medium clay silty to medium clay; Strong 2-5 mm sub-angular blocky; Moderately moist, firm; Field pH 6.0 to 7.0.

Limit of augering

**Number of sites:** 12

**Name:** Victor (Vc)

**Concept:** Very deep Duplex non-sodic red soils over saline horizons, formed on terraces of major streams and rivers associated with Hodgkinson Formation

**Classification:**

*Aust:* Haplic Eutrophic Red Chromosol

*GSG:* Red Brown Earth

*PPF:* Dr2.22, Dr3.43, Dr3.42

**Landform:** Terraced land

**Geology:** Quaternary alluvia (Qa)

**Vegetation:** *E. chlorophylla*, *E. microtheca* or *E. acroleuca* woodlands and open woodlands, *E. tetrodonta* woodlands

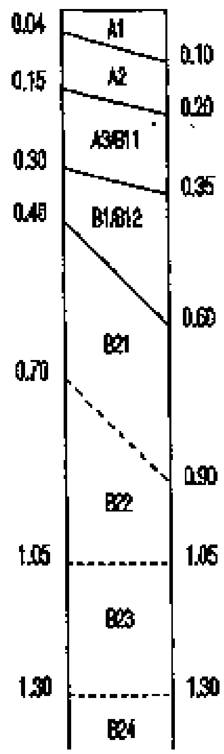
**Microrelief:** None

**Surface condition:** Hardsetting

**Surface coarse fragments:** None

| Land Use Limitations | |
|---|---|
| **Climate:** | <35°C, <1500 mm (C1), >35°C, <1500 mm (C3) |
| **Moisture Supply:** | 100 - 140 mm/m (M2) |
| **Fertility:** | <3 ppm P, >4 ppm $SO_4$ S (N7) |
| **Wetness:** | Well drained, moderately permeable (W2m) |
| **Flooding frequency:** | Less than 1 in 10 years (F1) |
| **Rockiness:** | No rock (R0) |
| **Topography:** | No microrelief (T0) |
| **Soil physical condition:** | Slightly to moderately adhesive soils, moderate moisture range, moderately hardsetting (P1) |
| **Vegetation factor:** | Regrowth control no problem, existing vegetation no problem (Vc1e1) |
| **Erodibility:** | 1-3 %, unstable (E2u) |
| **Landscape complexity:** | Unit size > 20 ha (X0) |
| **Salinity:** | Naturally saline (Ss) |

**Soil Description:**




**A1** 0 - 0.04 Dark or occasionally grey (7.5YR or 10YR 3/2 or 4/1); Fine sandy loam to clay loam fine sandy; Massive; Dry, firm to moist, weak; Field pH 7.0 to 8.0; Abrupt or clear boundary to;

**A2** 0.04 - 0.15 Red-brown or yellow-brown (5YR 4/3-6 or 10YR 6/4); Fine sandy loam to fine sandy clay loam; Massive; Dry firm to moist weak; Field pH 6.0 to 7.5; Clear boundary to;

**A3/B11** 0.15 - 0.30 Red-brown or brown or occasionally yellow (5YR 3/4 or 4/5-6 or 7.5YR 4/3 or 10YR 6/5); Common fine faint yellow mottles occasionally present; Fine sandy loam heavy to light clay; Massive or weak 2-5 mm sub-angular blocky; Dry to moderately moist, firm to very firm; Field pH 6.0 to 7.5; Clear or gradual to ;

**B1/B12** 0.30 - 0.50 Red or red-brown or yellow (2.5YR 4/5 or 5YR 3/5 or 4/4 or 10YR 6/5); Common fine faint red mottles; Clay loam fine sandy heavy to light medium clay; Massive to moderate < 2 mm angular blocky; Moderately moist, firm to very firm; Field pH 6.5 to 7.5; Clear or gradual boundary to;

**B21** 0.50 - 0.85 Red or red-brown (2.5YR 3-4/7 or 5YR 3/6 or 4/4); Many fine distinct yellow mottles; Fine sandy light medium clay to medium heavy clay; Strong 2-5 mm sub-angular to angular blocky; Moderately moist, very firm; Field pH 6.5 to 7.0; Gradual boundary to;

**B22** 0.85 - 1.05 Red (2.5YR 3/5 or 4/7); Fine sandy light clay to light medium clay silty; Moderate 5-10 mm angular blocky to strong 2-5 mm angular blocky; Dry, strong to moderately moist, very firm; Field pH 7.0; Gradual boundary to;

**B23** 1.05 - 1.30 Red (2.5YR 4/6 or 5/7); Fine sandy light clay to light medium clay silty; Moderate 5-10 mm angular blocky to strong 2-5 mm angular blocky; Dry, strong to moderately moist, very firm; Field pH 7.0; Gradual boundary to;

**B24** 1.30 - 1.50 Red or red-brown (2.5YR 5/7 or 5YR 4/6); Fine sandy light clay to medium clay silty; Moderate 2-10 mm angular blocky; Dry, strong to moderately moist, very firm; Field pH 7.0;

Limit of augering

Silcrete and saline horizons at depth

**Number of sites:** 6

**Name:** Wakooka (Wk)

**Concept:** Deep bleached Gradational non-sodic yellow soils formed on alluvial plains derived from greywacke and slate

**Classification:**

*Aust:* Bleached-Mottled or Bleached-Manganic or Bleached or Mottled Mesotrophic Yellow Dermosol

*GSG:* Yellow Podzolic

*PPF:* Gn3.84, Gn3.04

**Landform:** Gently undulating alluvial plains

**Geology:** Quaternary alluvia (Qa) and Pleistocene? and recent colluvia (Czx)

**Vegetation:** *E. clarksoniana*, *E. novoguinensis* or *E. polycarpa* woodlands and open woodlands

**Microrelief:** None

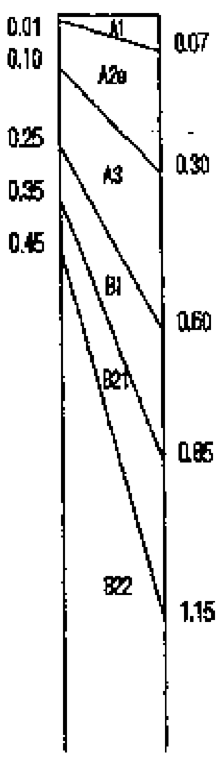
**Surface condition:** Hardsetting

**Surface coarse fragments:** None

**Land Use Limitations**

| | |
|---|---|
| **Climate:** | <35°C, >1500 mm (C1), <35°C, <1500 mm (C2) |
| **Moisture Supply:** | 80 - 100 mm/m (M3) |
| **Fertility:** | <3 ppm P, >4 ppm $SO_4$ S (N7) |
| **Wetness:** | Imperfectly drained, slowly to moderately permeable (W4s, W4m) |
| **Flooding frequency:** | Every year to 1 in 2-10 years (F3, F2) |
| **Rockiness:** | No rock (R0) |
| **Topography:** | No microrelief (T0) |
| **Soil physical condition:** | Slightly to moderately adhesive soils, moderate moisture range, moderately hardsetting (P1) |
| **Vegetation factor:** | Regrowth control no problem, existing vegetation no problem (Vc1a1) |
| **Erodibility:** | 0-1%, stable (E1s) |
| **Landscape complexity:** | Unit size > 20 ha (X0) |
| **Salinity:** | Non-saline (Sn) |

**Soil Description:**




**A1** 0 - 0.03 Dark or grey or brown (10YR 3-5/1-2 or 4/3); Fine sandy loam to fine sandy clay loam; Massive; Dry, weak to very firm; Field pH 5.5 to 6.5; Abrupt boundary to;

**A2e** 0.03 - 0.15 Conspicuously bleached - grey or yellow-brown (10YR 5-6/2-3); Few to common fine faint yellow to orange mottles; Fine sandy loam to fine sandy clay loam; Massive; Dry, firm to strong; Field pH 6.0 to 6.5; Clear boundary to;

**A3** 0.15 - 0.30 Yellow-brown or yellow (10YR 5-6/4-5); Common fine faint to distinct yellow to orange mottles; Fine sandy clay loam to clay loam heavy; Massive; Dry, firm to strong; Very few < 2 mm ferruginous or ferro-manganiferous manganiferous nodules occasionally present; Field pH 6.0; Clear boundary to;

**B1** 0.30 - 0.40 Yellow-brown or brown or yellow (10YR or 7.5YR 5/4 or 6/6); Common to many fine faint to distinct yellow to red mottles; Clay loam heavy to light clay; Weak to moderate 2-5 mm angular to sub-angular blocky; Dry, firm to strong; Very few < 2-6 mm ferruginous or ferro-manganiferous or manganiferous nodules occasionally present; Field pH 5.5 to 6.5; Clear or diffuse boundary to;

**B21** 0.40 - 0.55 Yellow or yellow-brown or yellow-grey (10YR 5/5-6 or 6/4-6 or 2.5Y 6/4-6); Common to many fine faint to distinct red or grey mottles; Light clay; Moderate to strong 2-5 mm subangular blocky; Dry, firm to very firm; Very few < 2-6 mm ferruginous or ferro-manganiferous or manganiferous nodules occasionally present; Field pH 5.5 to 6.5; Clear or diffuse boundary to;

**B22** 0.55 - 1.10 Grey or yellow-brown or yellow or yellow-grey (10YR 5/2-4 or 6/5-6 or 2.5Y 6/3); Common to many fine to medium distinct to prominent red or grey mottles; Light clay to medium clay; Moderate to strong 2-10 mm sub-angular blocky to polyhedral; Moderately moist firm to very firm; Very few to common < 2-6 mm ferruginous or ferro-manganiferous or manganiferous nodules occasionally present; Field pH 6.0;

Limit of augering

**Number of sites:** 19

## APPENDIX 5

## SELECTED SOILS OF THE COASTAL PLAINS

**Name:** George (Go)

**Concept:** Moderately deep Uniform saline mottled clays formed in recent estuarine deposits

**Classification:**

*Aust:* Haplic Supratidal Hydrosol

*GSG:* Solonchak

*PPF:* No provision

**Landform:** Supra-tidal and inter-tidal flats

**Geology:** Quaternary coastal alluvium (Qac)

**Vegetation:** Bare, occasionally mangroves or halophytes

**Microrelief:** None

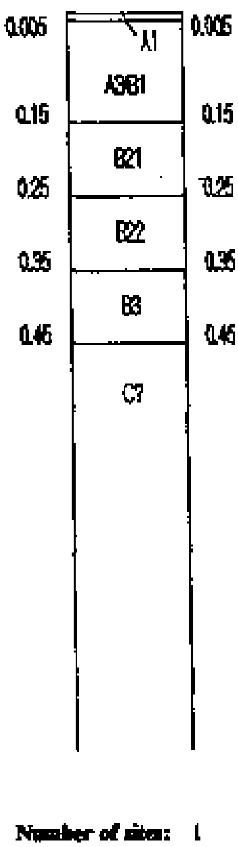
**Surface condition:** Soft, cracking

**Surface coarse fragments:** None

**Land Use Limitations**

| | |
|---|---|
| **Climate:** | <35°C, >1500 mm (C1), <35°C, <1500 mm (C2), >35°C, <1500 mm (C3) |
| **Moisture Supply:** | < 40 mm/m (M6) |
| **Fertility:** | <3 ppm P, <4 ppm $SO_4$ S (N8) |
| **Wetness:** | Very poorly drained, very slowly permeable (W6v) |
| **Flooding frequency:** | Every year (F3) |
| **Rockiness:** | No rock (R0) |
| **Topography:** | No microrelief (T0) |
| **Soil physical condition:** | Strongly adhesive soils, narrow moisture range, moderately hardsetting (P7) |
| **Vegetation factor:** | Regrowth control no problem, existing vegetation no problem (Vc1e1) |
| **Erodibility:** | 0-1%, very unstable (E1v) |
| **Landscape complexity:** | Isolated unit (Xi) |
| **Salinity:** | Naturally saline (Sn) |

**Soil Description:**




**A1** 0 - 0.005 Yellow-brown (10YR 5/4); Light medium clay; Massive? Moist, weak; Field pH 9.0; Sharp boundary to;

**A3/B1** 0.005 - 0.15 Grey (10YR 4/2); Light medium clay; Strong 2-5 mm polyhedral? Moist, weak; Field pH 8.0; Clear boundary to;

**B21** 0.15 - 0.25 Brown (10YR 4/4); Medium heavy clay; Strong 2-5 mm polyhedral? Moist, firm; Field pH 6.0; Clear boundary to;

**B22** 0.25 - 0.35 Brown (7.5YR 4/6); Medium clay; Strong 2-5 mm polyhedral? Moist, firm; Field pH 6.0; Abrupt boundary to;

**B3** 0.35 - 0.45 Yellow (2.5Y 7/6); Many fine prominent grey mottles; Medium clay; Weak 2-5 mm lenticular; Moist, firm; Field pH 5.0; Abrupt boundary to;

**C?** 0.45 - 0.60 Grey (10YR 5/1); Clay; Wet; Field pH 7.0.

Limit of augering

**Number of sites:** 1

**Name:** Marina (Mn)

**Concept:** Very deep Uniform frequently cracking saline grey clays formed on marine plains

**Classification:**

*Aust:* Sodic-Acidic, Sodic or Salic Pedal or Massive Grey or Aquic Vertosol

*GSG:* Grey Clay

*PPF:* Ug5.24, Ug5.5, Ug5.29, Uf6.41, Uf6.42

**Landform:** Level to gently undulating plains on beach ridge or chenier plains

**Geology:** Quaternary coastal alluvium (Qac)

**Vegetation:** Tussock grasslands

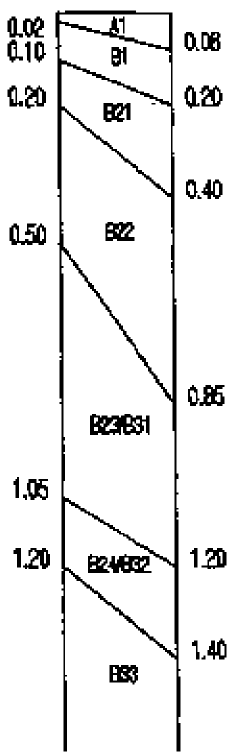
**Microrelief:** Normal gilgai; vertical interval 0.2-0.3m; horizontal interval 8-10 m

**Surface condition:** Hardsetting, and frequently cracking

| Land Use Limitations | |
|---|---|
| **Climate:** | >35°C, <1500 mm (C3), <35°C, >1500 mm (C1), <35°C, <1500 mm (C2) |
| **Moisture Supply:** | 40 - 60 mm/m (M5) |
| **Fertility:** | <3 ppm P, >4 ppm $SO_4$ S (N7) |
| **Wetness:** | Very poorly drained, very slowly permeable (W6v) |
| **Flooding frequency:** | Every year (F3) |
| **Rockiness:** | No rock (R0) |
| **Topography:** | Microrelief vertical interval 0.1 - 0.3 m (T2) |
| **Soil physical condition:** | Strongly adhesive soils, narrow moisture range, hardsetting (including large aggregates) (P8) |
| **Vegetation factor:** | Regrowth control no problem, existing vegetation no problem (Vc1e0) |
| **Erodibility:** | 1-3 %, unstable (E2u) |
| **Landscape complexity:** | Unit size > 20 ha (X0) |
| **Salinity:** | Naturally saline (Sn) |

**Surface coarse fragments:** None

**Soil Description:**




**A1** 0 - 0.04 Dark or grey (10YR 3-4/1 or 2.5Y 4/1); Few to many fine distinct to prominent orange mottles; Light clay to light medium clay; Moderate 2-5 mm sub-angular blocky, occasionally massive; Dry, firm to strong; Field pH 4.0 to 6.0; Sharp or clear boundary to;

**B1** 0.04 - 0.15 Dark or grey (10YR 3-4/1 or 5/2); Common fine distinct orange or red mottles; Light clay to light medium clay; Moderate to strong 2-5 mm sub-angular or angular blocky; Dry to moderately moist, very firm to very strong; Field pH 5.0 to 6.0; Clear or gradual boundary to;

**B21** 0.15 - 0.30 Grey (10YR 4/1-2 or 5/1 or 2.5Y 3/1); Common to many fine to medium distinct to prominent orange or red mottles; Medium clay to medium heavy clay; Strong 2-10 mm sub-angular or angular blocky; Dry to moderately moist, very firm to strong; Field pH 5.0 to 6.0; Clear or diffuse boundary to;

**B22** 0.30 - 0.70 Grey (10YR 4-5/1-2 or 2.5Y 4/1-2); Few to many fine to medium distinct to prominent red mottles; Medium heavy clay to heavy clay; Moderate to strong 2-5 mm sub-angular blocky, angular blocky or lenticular; Moderately moist, very strong to moist, firm; Few 2-6 mm manganiferous nodules occasionally present; Field pH 5.0 to 8.5; Clear or gradual boundary to;

**B23/B31** 0.70 - 1.10 Grey or yellow (10YR 5/1 or 6/6); Common fine prominent yellow mottles; Medium heavy clay; Strong 2-5 mm lenticular or angular blocky; Moderately moist, firm; Field pH 6.0 to 9.5; Clear to;

**B24/B32** 1.10 - 1.30 Grey (10YR 5-6/1); Common fine prominent yellow mottles; Sandy light clay to medium clay; Massive to strong 2-5 mm lenticular; Moderately moist to wet, weak; Field pH 6.5 to 8.0; Clear boundary to;

**B33** 1.30 - 1.60 Grey (10YR 5/1); Light medium clay; Wet, weak; Field pH 8.5;

Limit of augering

**Number of sites:** 15

**Name:** Nassau (Ns)

**Concept:** Moderately deep saline Duplex grey soils associated with saltpans on marine plains

**Classification:**

*Aust:* Sodic Mottled Hypersalic Hydrosol

*GSG:* Soloth

*PPF:* Dy3.41

**Landform:** Playa on marine plains

**Geology:** Quaternary coastal alluvium (Qac)

**Vegetation:** Low open woodlands and tall shrublands dominated by *Melaleuca* spp.

**Microrelief:** None

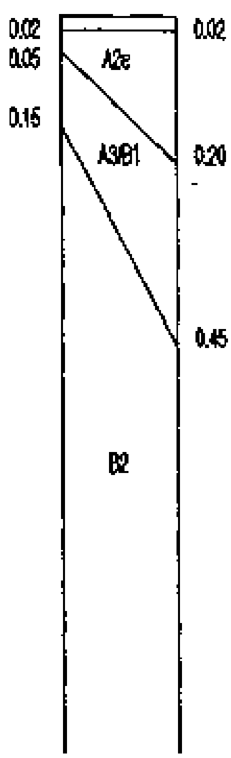
**Surface condition:** Hardsetting

**Surface coarse fragments:** None

**Land Use Limitations**

| | |
|---|---|
| **Climate:** | <35°C, >1500 mm (C1), <35°C, <1500 mm (C2) |
| **Moisture Supply:** | < 40 mm/m (M6) |
| **Fertility:** | <3 ppm P, >4 ppm $SO_4$ S (N7) |
| **Wetness:** | Very poorly drained, very slowly permeable (W6v) |
| **Flooding frequency:** | Every year (F3) |
| **Rockiness:** | No rock (R0) |
| **Topography:** | No microrelief (T0) |
| **Soil physical condition:** | Slightly to moderately adhesive soils, moderate moisture range, moderately hardsetting (P1) |
| **Vegetation factor:** | Regrowth control no problem, existing vegetation no problem (Vc1e1) |
| **Erodibility:** | 1-3%, unstable (E2u) |
| **Landscape complexity:** | Unit size < 20 ha (X1) |
| **Salinity:** | Naturally saline (Sa) |

**Soil Description:**




**A1** 0 - 0.02 Grey (10YR 5/2 or 6/1); Few fine distinct orange mottles; Light fine sandy clay loam to sandy clay loam; Massive; Dry, very firm; Field pH 5.8; Abrupt boundary to;

**A2e** 0.02 - 0.10 Conspicuously bleached - grey (10YR or 2.5Y 6/1); Few fine distinct orange mottles; Light fine sandy clay loam; Massive; Dry, very firm; Field pH 5.5; Abrupt or gradual boundary to;

**A3/B1** 0.10 - 0.30 Grey (10YR 6/2); Many fine distinct yellow mottles; Fine sandy clay loam to sandy light clay; Massive; Dry, very firm to strong; Field pH 4.5 to 5.0; Clear boundary to;

**B2** 0.30 - 0.90 Grey (10YR 4-5/1 or 2.5Y 5/1); Many fine prominent red mottles; Light medium clay to medium heavy clay; Moderate 2-5 mm lenticular structure or strong 10-20 mm angular blocky; Moderately moist, very firm to strong; Field pH 4.5 to 5.0

Limit of augering

**Number of sites:** 3

**Name:** Skardon (Sd)

**Concept:** Recent estuarine deposits under mangroves

**Classification:**

*Aust:* Arenaceous? Intertidal Hydrosol

*GSG:* No suitable group

*PPF:* No provision

**Landform:** Intertidal flats

**Geology:** Quaternary coastal alluvium (Qac)

**Vegetation:** Mangroves

**Microrelief:** None

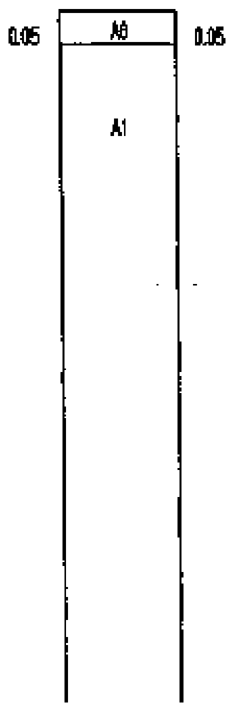
**Surface condition:** Soft

**Surface coarse fragments:** None

**Land Use Limitations**

| | |
|---|---|
| **Climate:** | <35°C, <1500 mm (C2) |
| **Moisture Supply:** | < 40 mm/m (M6) |
| **Fertility:** | <3 ppm P, <4 ppm $SO_4$ S (N5) |
| **Wetness:** | Very poorly drained, moderately permeable (W6m) |
| **Flooding frequency:** | Every year (F3) |
| **Rockiness:** | No rock (R0) |
| **Topography:** | No microrelief (T0) |
| **Soil physical condition:** | No restriction (P0) |
| **Vegetation factor:** | Regrowth control no problem, existing vegetation no problem (Vc1e1) |
| **Erodibility:** | 0-1%, very unstable (E1u) |
| **Landscape complexity:** | Isolated unit (X?) |
| **Salinity:** | Naturally saline (Sn) |

**Soil Description:**




**A0** 0 - 0.05 Leaf litter (layered); Dark (7.5YR 2/2); Wet, weak; Field pH 6.0; Clear boundary to;

**A1** 0.05 - 0.30 Dark (10YR 3/1); Sandy loam; Wet, very weak; Field pH 6.0.

Limit of augering

**Number of sites:** 1

# APPENDIX 6

# SELECTED SOILS OF THE ALLUVIAL PLAINS

**Name:** Anthed (Ab)

**Concept:** Very deep Gradational or occasionally Duplex sodic mottled grey soils formed on alluvial plains

**Classification:**

*Aust:* Ferric or Sodic Sodosolic or Dermosolic Redoxic Hydrosol

*GSG:* Solodic Soil

*PPF:* Gn3.91, Dy3.43, Gn3.06, Gn3.93, Gn3.96

**Landform:** Level to gently undulating alluvial plains

**Geology:** Quaternary alluvium (Qa)

**Vegetation:** *M. viridiflora* low open woodlands and woodlands

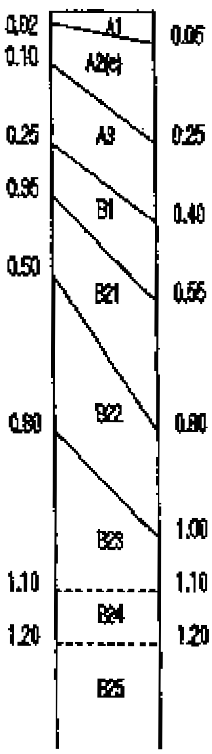
**Microrelief:** None

**Surface condition:** Hardsetting

**Surface coarse fragments:** None

| Land Use Limitations | |
|---|---|
| **Climate:** | $>35°C$, $<1500$ mm (C3), $<35°C$, $<1500$ mm (C1) |
| **Moisture Supply:** | 40 - 60 mm/m (M5) |
| **Fertility:** | $<3$ ppm P, $<4$ ppm $SO_4$ S (N8) |
| **Wetness:** | Very poorly drained, very slowly permeable (W6v) |
| **Flooding frequency:** | Every year (F3) |
| **Rockiness:** | No rock (R0) |
| **Topography:** | No microrelief (T0) |
| **Soil physical condition:** | Slightly to moderately adhesive soils, moderate moisture range, hardsetting (including large aggregates) (P2) |
| **Vegetation factor:** | Regrowth control no problem, existing vegetation no problem (Vc1e1), Regrowth poses a problem, existing vegetation a problem (Vc2e2) |
| **Erodibility:** | 0-1%, unstable (E1u) |
| **Landscape complexity:** | Unit size > 20 ha (X0) |
| **Salinity:** | Non-saline (Sn) |

**Soil Description:**




**A1** 0 - 0.05 Dark or grey (10YR 3-6/1-2); Few fine distinct orange mottles occasionally present; Loamy fine sand to silty loam to clay loam; Massive; Dry to moderately moist, weak to firm; Field pH 6.0 to 6.5; Abrupt or clear boundary to;

**A2(e)** 0.05 - 0.15 Occasionally conspicuously bleached - grey (7.5YR or 10YR or 2.5Y 5/2 or 6/1); Few to common fine distinct orange mottles; Loamy fine sand to fine sandy clay loam; Massive; Dry to moderately moist, weak to firm; Field pH 5.5 to 6.0; Clear boundary to;

**A3** 0.15 - 0.30 Grey or yellow-brown or yellow (10YR 5/2 or 6/1-5); Common to many fine faint or distinct yellow or orange mottles; Sandy clay loam to silty clay loam; Massive; Dry to moderately moist, weak to firm; Many 2-6 mm ferro-manganiferous nodules occasionally present; Field pH 5.5 to 6.5; Clear boundary to;

**B1** 0.30 - 0.40 Grey or yellow or occasionally yellow-brown (10YR 5-6/2 or 5/5 or 6/4); Common to many fine faint to distinct or prominent orange or red mottles; Fine sandy clay loam to light clay; Massive to weak < 2 mm sub-angular blocky; Dry to moderately moist, firm to strong; Few to common 2-6 mm ferruginous nodules occasionally present; Field pH 6.0 to 6.5; Clear boundary to;

**B21** 0.40 - 0.60 Grey or pale or yellow (10YR or 2.5Y 6/1-2 or 10YR 5-6/5); Common to many fine to medium distinct or prominent yellow, orange or red mottles; Light clay fine sandy to medium clay; Massive to strong < 2-10 mm angular or sub-angular blocky; Dry to moderately moist, firm to strong; Common to many 2-6 mm ferruginous nodules occasionally present; Field pH 6.0 to 7.0; Clear or gradual boundary to;

**B22** 0.60 - 0.90 Grey or pale or occasionally yellow-brown (N 6/0 or 10YR or 2.5Y 7/1 or 10YR 5/4); Common to many medium prominent yellow, orange or red mottles; Medium clay to heavy clay; Massive to strong < 2-10 mm angular or sub-angular blocky; Dry very strong to moderately moist, firm; Very few 2-6 mm manganiferous soft segregations or ferruginous nodules occasionally present; Field pH 6.0 to 8.0; Clear or gradual boundary to;

B23 0.90 - 1.10 Grey or pale (N 5-6/0 or 2.5Y 7/1); Many medium distinct or prominent orange mottles; Sandy medium clay to heavy clay; Strong < 2-10 mm angular blocky or 2-5 mm sub-angular blocky; Moderately moist, firm to very firm; Very few 2-6 mm ferruginous nodules occasionally present; Field pH 8.0 to 10.0; Gradual or diffuse boundary to;

B24 1.10 - 1.20 Grey or yellow (2.5Y 6/1 or 5/2 or 6/5); Many medium distinct or prominent yellow mottles; Coarse sandy light clay to medium heavy clay; Few 2-6 mm sub-angular quartz occasionally present; Massive or strong < 2-5 mm angular blocky; Moderately moist, firm to very firm; Very few 2-6 mm ferruginous nodules or common 2-6 mm soft manganiferous segregations; Field pH 8.5 to 10.0; Diffuse boundary to;

B25 1.20 - 1.50 Yellow (10YR 5/5); Medium clay sandy; Moderate 2-5 mm angular blocky; Moderately moist, firm; Field pH 10.0;

Limit of augering

**Variants:** Acid variant (AbAv): Field pH 5.5 at A1, grading to 3.5 in B23. Number of sites: 1

**Number of sites:** 43

**Name:** Kennedy (Kd)

**Concept:** Very deep Uniform or occasionally Gradational massive surfaced or cracking grey clays formed on alluvial plains

**Classification:**

*Aust:* Sodic or Vertic Dermosolic Oxyaquic Hydrosol; Mottled or Epihypersodic or Endohypersodic or Sodic-Acidic Massive Grey or Aquic Vertosol

*GSG:* Grey Clay/No suitable group

*PPF:* Uf6.33, Uf6.51, Ug5.24, Gn3.91, Gn3.92

| Land Use Limitations | |
|---|---|
| **Climate:** | >35°C, <1500 mm (C3), <35°C, <1500mm (C1) |
| **Moisture Supply:** | 80 - 100 mm/m (M3) |
| **Fertility:** | 3-8 ppm P, <4 ppm $SO_4$ S (N6) |
| **Wetness:** | Poorly drained, very slowly permeable (W5v) |
| **Flooding frequency:** | Every year (F3) |
| **Rockiness:** | No rock (R0) |
| **Topography:** | Microrelief vertical interval 0.1 - 0.3 m (T2) |
| **Soil physical condition:** | Strongly adhesive soils, narrow moisture range, hardsetting (including large aggregates) (P8) |
| **Vegetation factor:** | Regrowth control no problem, existing vegetation no problem (Vc1e1) |
| **Erodibility:** | 0-1%, very unstable (E1v) |
| **Landscape complexity:** | Unit size > 20 ha (X0) |
| **Salinity:** | Low risk outflow zone (So1) |

**Landform:** Drainage depressions to plains on alluvial plains

**Geology:** Quaternary alluvia (Qa)

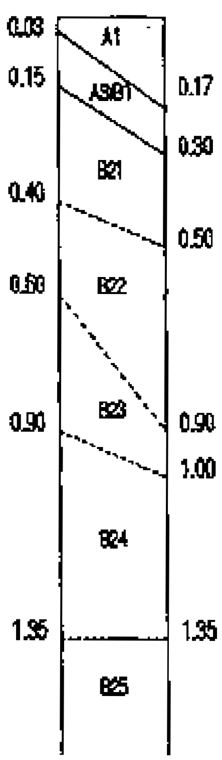
**Vegetation:** *E. chlorophylla*, *E. microtheca* or *E. acroleuca* woodlands and open woodlands

**Microrelief:** Normal gilgai occasionally present; vertical interval 0.30 m; horizontal interval 4-8 m

**Surface condition:** Hardsetting, frequently cracking

**Surface coarse fragments:** None

**Soil Description:**




**A1** 0 - 0.10 Grey or yellow-brown (10YR 4/1-2 or 5/1-3); Few to many fine distinct orange mottles; Silty clay loam to light medium clay; Massive; Dry, firm to strong; Field pH 6.0 to 6.5; Abrupt or gradual boundary to;

**A3/B1** 0.10 - 0.20 Grey or brown (10YR 4/1-3 or 5/2); Few to many fine distinct orange to brown mottles; Silty light medium clay to medium clay; Massive to moderate 2-5 mm sub-angular to angular blocky; Dry to moderately moist, firm to very firm; Field pH 6.0 to 6.5; Clear or gradual boundary to;

**B21** 0.20 - 0.45 Grey or olive-brown or brown or dark (10YR or 2.5Y 4/2-3 or 10YR 3/2-3); Few to common fine distinct orange mottles; Silty medium clay to medium clay; Moderate to strong 2-5 mm angular to sub-angular blocky; Moderately moist, firm to very firm; Field pH 6.0 to 7.0; Gradual boundary to;

**B22** 0.45 - 0.85 Grey or olive-brown or brown (10YR or 2.5Y 4/2-3); Few to common fine distinct orange mottles; Medium clay silty to medium heavy clay; Strong 2-5 mm angular blocky to lenticular; Moderately moist, firm to very firm; Very few to few 2-6 mm manganiferous nodules may be present; Field pH 4.5 to 7.0; Gradual or diffuse boundary to;

**B23** 0.85 - 1.00 Grey (10YR, 2.5Y or 5Y 4/1); Common fine distinct orange or brown mottles; Medium clay silty to medium heavy clay; Moderate 5-10 mm angular blocky to 2-5 mm lenticular; Moderately moist, very firm; Very few to few 2-6 mm manganiferous nodules; Field pH 7.0 to 10.0; Gradual boundary to;

**B24** 1.00 - 1.35 Grey (2.5Y 4/2); Heavy clay; Strong 5-10 mm lenticular; Moderately moist, very firm; Few 2-6 mm manganiferous nodules; Field pH 10.0; Gradual boundary to;

**B25** 1.35 - 1.50 Grey (10YR 4/2); Few fine distinct yellow mottles; Medium heavy clay; Strong 2-5 mm lenticular; Moderately moist, very firm; Field pH 10.0;

Limit of augering

**Number of sites:** 16

## APPENDIX 7

## SELECTED SOILS OF THE EDWARD RIVER LANDSCAPE

**Name:** Citri (Ct)

**Concept:** Deep bleached Duplex sodic soils formed in drainage depressions on residual sands

**Classification:**

*Aust:* Sodic or Bleached-Manganic Sodosolic Redoxic or Oxyaquic Hydrosol

*GSG:* Solodic Soil, Solodized Solonetz

*PPF:* Dy2.42, Dy2.43, Dy3.43, Dy3.42, Dy2.22

| Land Use Limitations | |
|---|---|
| **Climate:** | <35°C, >1500 mm (C1), >35°C, <1500 mm (C3) |
| **Moisture Supply:** | < 40 mm/m (M6) |
| **Fertility:** | 3-8 ppm P, <4 ppm $SO_4$ S (N6) |
| **Wetness:** | Poorly drained, very slowly permeable (W5v) |
| **Flooding frequency:** | Every year (F3) |
| **Rockiness:** | No rock (R0) |
| **Topography:** | No microrelief (T0) |
| **Soil physical condition:** | No restriction (P0) |
| **Vegetation factor:** | Regrowth poses a problem, existing vegetation no problem (Vc2e1) |
| **Erodibility:** | 0-1 %, very unstable (E1v) |
| **Landscape complexity:** | Unit size < 20 ha (X1) |
| **Salinity:** | Low risk outflow zone (So1) |

**Landform:** Drainage depressions in gently undulating plains to undulating rises.

**Geology:** Tertiary and Quaternary colluvial sands (TQs)

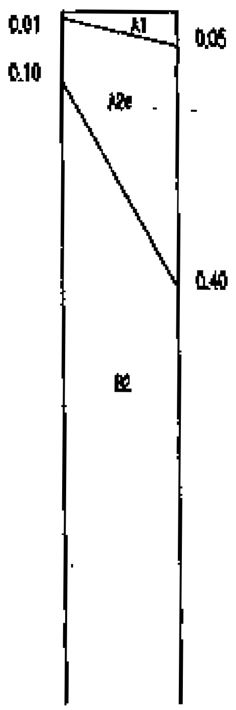
**Vegetation:** *M. viridiflora* low open woodlands and woodlands, tussock grasslands

**Microrelief:** None

**Surface condition:** Hardsetting

**Surface coarse fragments:** None

**Soil Description:**




**A1** 0 - 0.03 Dark or grey (10YR 2-4/1); Few fine distinct orange mottles occasionally present; Loamy sand to fine sandy loam; Massive; Dry, weak to firm; Field pH 5.0 to 6.0; Sharp or clear boundary to;

**A2e** 0.03 - 0.25 Conspicuously bleached - grey or brown or red-brown (10YR 5-6/1-2 or 7.5YR 6/3 or 5YR 4-5/4); Few fine distinct orange mottles occassionally present; Sand to fine sandy loam; Massive; Dry, very weak to very firm; Field pH 6.0 to 7.0; Sharp or clear boundary to;

**B1** (occasionally present) 0.25 - 0.55 Grey or yellow (10YR 4-5/1-2 or 2.5Y 5/5); Few to common fine to medium distinct to prominent yellow to grey mottles; Sandy light clay to light clay sandy; Strong 10-100 mm columnar to prismatic; Dry to moderately moist, very firm to very strong; Field pH 7.0 to 8.5; Abrupt boundary to;

**B2** 0.25 - 0.90 Grey (10YR 4-6/1-2); Few to many fine to medium distinct yellow to brown mottles; Light clay sandy to medium heavy clay; Strong 5-100 mm angular blocky to prismatic to columnar; Moderately moist, firm to very strong; Few to many 2-20 mm manganiferous nodules occasionally present; Field pH 7.0 to 9.5.

Limit of augering

**Variants:** Coarse phase (CtCp): Coarse sandy throughout. Number of sites: 1

**Number of sites:** 12

**Name:** Clark (Ct)

**Concept:** Deep bleached Gradational yellow massive soils formed on residual sands

**Classification:**

*Aust:* Bleached or Bleached-Mottled or Bleached-Ferric Mesotrophic Kandosol

*GSG:* Yellow Earth

*PPF:* Gn2.74, Gn2.34, Gn2.35, Gn2.64, Gn2.75

**Landform:** Gently undulating plains to undulating rises

**Geology:** Tertiary and Quaternary colluvial sands (TQs)

**Vegetation:** *E. tetrodonta* woodlands

**Microrelief:** None

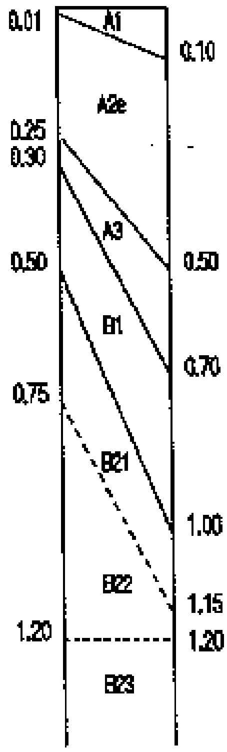
**Surface condition:** Firm to hardsetting

**Surface coarse fragments:** None

**Land Use Limitations**

| | |
|---|---|
| **Climate:** | <35°C, >1500 mm (C1), >35°C, <1500 mm (C3) |
| **Moisture Supply:** | 60 - 80 mm/m (M4) |
| **Fertility:** | 3-8 ppm P, < 4 ppm $SO_4$ S (N6) |
| **Wetness:** | Moderately well drained, moderately permeable (W3m) |
| **Flooding frequency:** | No flooding (F0) |
| **Rockiness:** | No rock (R0) |
| **Topography:** | No microrelief (T0) |
| **Soil physical condition:** | No restriction (P0) |
| **Vegetation factor:** | Regrowth poses a problem, existing vegetation no problem (Vc2e1) |
| **Erodibility:** | 1-3%, stable (E2s) |
| **Landscape complexity:** | Unit size > 20 ha (X0) |
| **Salinity:** | Low risk intake zone (Si1) |

**Soil Description:**




**A1** 0 - 0.05 Dark or grey (10YR 2-4/1-2); Sand to sandy loam; Very few to few 2-6 mm sub-angular to sub-rounded quartz coarse fragments occasionally present; Single grain to massive; Dry, very weak to firm; Field pH 6.0 to 7.0; Abrupt or clear boundary to;

**A2e** 0.05 - 0.35 Conspicuously bleached - grey or yellow-brown or brown (10YR or 2.5Y 4-6/2-4); Sand to loamy sand; Very few to few 2-6 mm sub-angular to sub-rounded quartz coarse fragments occasionally present; Massive; Dry, weak to firm; Field pH 6.0 to 7.0; Clear or gradual boundary to;

**A3** 0.35 - 0.45 Yellow-brown or yellow-grey or yellow (10YR 5-6/4-6 or 2.5Y 6/3-6); Few to common fine faint to distinct yellow mottles occasionally present; Loamy sand to light sandy clay loam; Few 2-6 mm sub-angular to sub-rounded quartz coarse fragments occasionally present; Massive; Dry to moderately moist, weak to very firm; Very few to common 2-6 mm ferruginous or ferro-manganiferous or manganiferous nodules occasionally present; Field pH 6.0 to 6.5; Clear or diffuse boundary to;

**B1** 0.45 - 0.70 Yellow-brown or yellow-grey or yellow (10YR 5-6/5-6 or 2.5Y 6/4-6 or 7.5YR 5/5-6); Few to many fine faint to prominent yellow to red mottles occasionally present; Sandy loam to sandy clay loam; Very few to common 2-6 mm sub-angular to sub-rounded quartz coarse fragments occasionally present; Massive; Dry to moderately moist, weak to very firm; Very few to common 2-6 mm ferruginous or ferro-manganiferous or manganiferous nodules occasionally present; Field pH 5.5 to 6.5; Gradual or diffuse boundary to;

**B21** 0.70 - 0.90 Yellow or pale-yellow (10YR 6/5-7 or 2.5Y 5-6/5-6 or 10YR or 2.5Y 7/4-6); Few to many fine faint to prominent orange to red mottles; Sandy clay loam to sandy light clay; Very few to common 2-6 mm sub-angular to sub-rounded quartz coarse fragments occasionally present; Massive; Dry to moderately moist, weak to very firm; Very few to abundant 2-20 mm ferruginous or ferro-manganiferous or manganiferous nodules occasionally present; Field pH 6.0 to 7.0; Gradual or diffuse boundary to;

B22 0.90 - 1.20 Yellow or pale-yellow (10YR 5-6/5-6 or 2.5Y 6/4-6 or 2.5Y 7/3-6 or 7.5YR 5/7-8); Few to many fine distinct to prominent yellow to red mottles; Sandy clay loam to sandy light clay; Very few to common 2-20 mm sub-angular to sub-rounded quartz coarse fragments occasionally present; Massive; Moderately moist, weak to very firm; Very few to abundant 2-20 mm ferruginous or ferro-manganiferous or manganiferous nodules occasionally present; Field pH 6.0 to 7.0.

Limit of augering

**Phases:** Coarse phase (CrCp): Coarse sandy throughout. **Number of sites:** 2

**Number of sites:** 65

**Name:** Haan (Hn)

**Concept:** Deep bleached Duplex soils on footslopes and drainage depressions in residual sands

**Classification:**

*Aust:* Sodic Sodosolic Redoxic Hydrosol; Bleached-Ferric Chromosolic Redoxic Hydrosol

*GSG:* Soloth/Gleyed Podzolic

*PPF:* Dg4.41, Dy5.41, Dg3.41

**Landform:** Footslopes on gently undulating plains or undulating rises

**Geology:** Tertiary and Quaternary colluvial sands (TQs)

**Vegetation:** *M. viridiflora* low open woodlands and woodlands

**Microrelief:** None

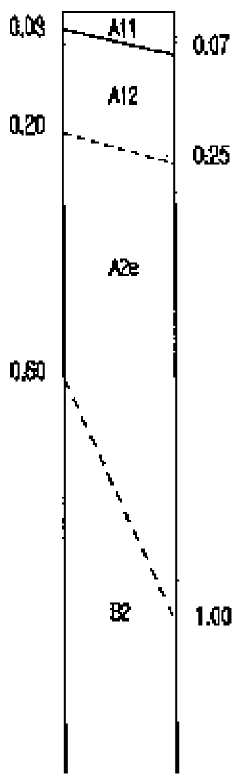
**Surface condition:** Firm to hardsetting

**Surface coarse fragments:** None

**Land Use Limitations**

| | |
|---|---|
| **Climate:** | >35°C, <1500 mm (C3), <35°C, >1500 mm (C1) |
| **Moisture Supply:** | 60 - 80 mm/m (M4) |
| **Fertility:** | 3-8 ppm P, <4 ppm $SO_4$ S (N6) |
| **Wetness:** | Poorly drained, slowly permeable (W5s) |
| **Flooding frequency:** | 1 in 2-10 years (F2) |
| **Rockiness:** | No rock (R0) |
| **Topography:** | No microrelief (T0) |
| **Soil physical condition:** | No restriction (P0) |
| **Vegetation factor:** | Regrowth poses a problem, existing vegetation a problem (Vc2c2) |
| **Erodibility:** | 1-3 %, unstable (E2u) |
| **Landscape complexity:** | Unit size < 20 ha (X1) |
| **Salinity:** | Low risk outflow zone (So1) |

**Soil Description:**




**A11** 0 - 0.04 Dark or grey (7.5YR 3/1 or 10YR 3/1-2 or 4/1); Sand to loamy sand; Single grain to massive; Dry to moderately moist, very weak to weak; Field pH 5.0 to 6.0; Clear boundary to;

**A12** 0.04 - 0.25 Grey or grey-brown (10YR 4/1 or 7.5YR 4-5/1); Sand to loamy sand; Massive; Dry, very weak to weak; Field pH 6.0; Gradual boundary to;

**A2e** 0.25 - 0.80 Conspicuously bleached - grey-brown or pale (7.5YR 6/1-2 or 7/3 or 10YR 6-7/1 or 7/2); Sand; Single grain to massive; Moderately moist to moist, very weak to weak; Field pH 6.0; Gradual boundary to;

**B2** 0.80 - 1.15 Pale or grey or yellow-brown (10YR or 7.5YR 7/1 or 10YR 6/1-3); Common to many fine prominent yellow to red mottles; Light clay to medium clay; Moderate < 2 to 10 mm lenticular or sub-angular; Moist, firm to very firm; Few to common manganiferous or ferruginous 2-6 mm nodules occasionally present; Field pH 5.0 to 6.0.

Limit of augering

**Number of sites:** 15

**Name:** Kimba (Kb)

**Concept:** Very deep Gradational red massive soils formed on residual sands

**Classification:**

*Aust:* Haplic Mesotrophic or Eutrophic Red Kandosol

*GSG:* Red Earth

*PPF:* Gn2.14, Gn2.15

**Landform:** Gently undulating plains to undulating rises

**Geology:** Tertiary and Quaternary colluvial sands (TQs)

**Vegetation:** *E. tetrodonta* woodlands and tall woodlands

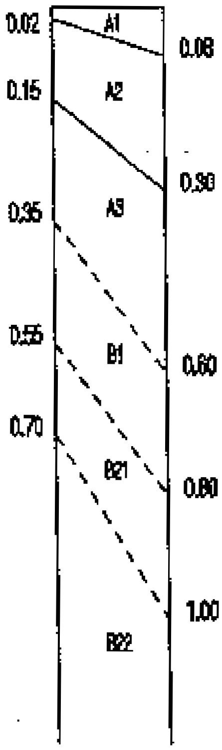
**Microrelief:** None

**Surface condition:** Loose to firm, occasionally hardsetting

| Land Use Limitations | |
|---|---|
| **Climate:** | <35°C, >1500 mm (C1), <35°C, <1500 mm (C2), >35°C, <1500 mm (C3) |
| **Moisture Supply:** | 60 - 80 mm/m (M4) |
| **Fertility:** | 3-8 ppm P, <4 ppm $SO_4$ S (N6) |
| **Wetness:** | Well drained, highly permeable (W2b) |
| **Flooding frequency:** | No flooding (F0) |
| **Rockiness:** | No rock (R0) |
| **Topography:** | No microrelief (T0) |
| **Soil physical condition:** | No restriction (P0) |
| **Vegetation factor:** | Regrowth poses a problem, existing vegetation no problem (Vc2e1) |
| **Erodibility:** | 3-10%, stable (E3e) |
| **Landscape complexity:** | Unit size > 20 ha (X0) |
| **Salinity:** | Low risk intake zone (Si1) |

**Surface coarse fragments:** None

**Soil Description:**




**A1** 0 - 0.05 Dark or grey or grey-brown or brown or red-brown (10YR 3-4/1-2 or 7.5YR or 5YR 3-4/2-4); Loamy sand to sandy loam; Single grain to massive; Dry, very weak to firm; Field pH 5.5 to 7.0; Abrupt or clear boundary to;

**A2** 0.05 - 0.20 Grey or brown or red-brown (10YR 4-5/2 or 7.5YR or 5YR 4/3-4); Loamy sand to sandy loam; Single grain to massive; Dry, very weak to weak; Field pH 5.5 to 7.0; Clear or gradual boundary to;

**A3** 0.20 - 0.45 Brown or red-brown or red (7.5YR 3-4/3-4 or 5YR 4/3-6 or 2.5YR 3-4/4-6); Loamy sand to light sandy clay loam; Massive; Dry to moderately moist, weak to firm; Field pH 5.5 to 7.0; Gradual or diffuse boundary to;

**B1** 0.45 - 0.70 Red-brown or red (5YR 4/4-6 or 2.5YR 3/3-6 or 4/6); Sandy loam to sandy clay loam; Massive; Dry to moderately moist, weak to firm; Field pH 6.0 to 7.0; Gradual or diffuse boundary to;

**B21** 0.70 - 0.90 Red (2.5YR 3/4-6 or 10R 3/4 or 4/6); Light sandy clay loam to clay loam sandy; Few 2-6 mm angular to sub-angular quartz occasionally present; Massive; Dry to moderately moist, weak to very firm; Field pH 6.0 to 7.0; Diffuse boundary to;

**B22** 0.70 - 1.50 Red (2.5YR 3/6 or 4/8 or 10R 3-4/6); Sandy clay loam to clay loam sandy; Massive; Moderately moist, weak to very firm; Field pH 6.0 to 7.0.

Limit of augering

**Phase:** Rocky phase (KbRp): Few to many sub-rounded quartz throughout. Number of sites: 1

**Number of sites:** 41

CYPLUS
CAPE YORK PENINSULA
LAND USE STRATEGY

DPI DEPARTMENT OF PRIMARY INDUSTRIES
QUEENSLAND
NORTH REGION

CYPLUS is a joint initiative between the Queensland and Commonwealth Governments.

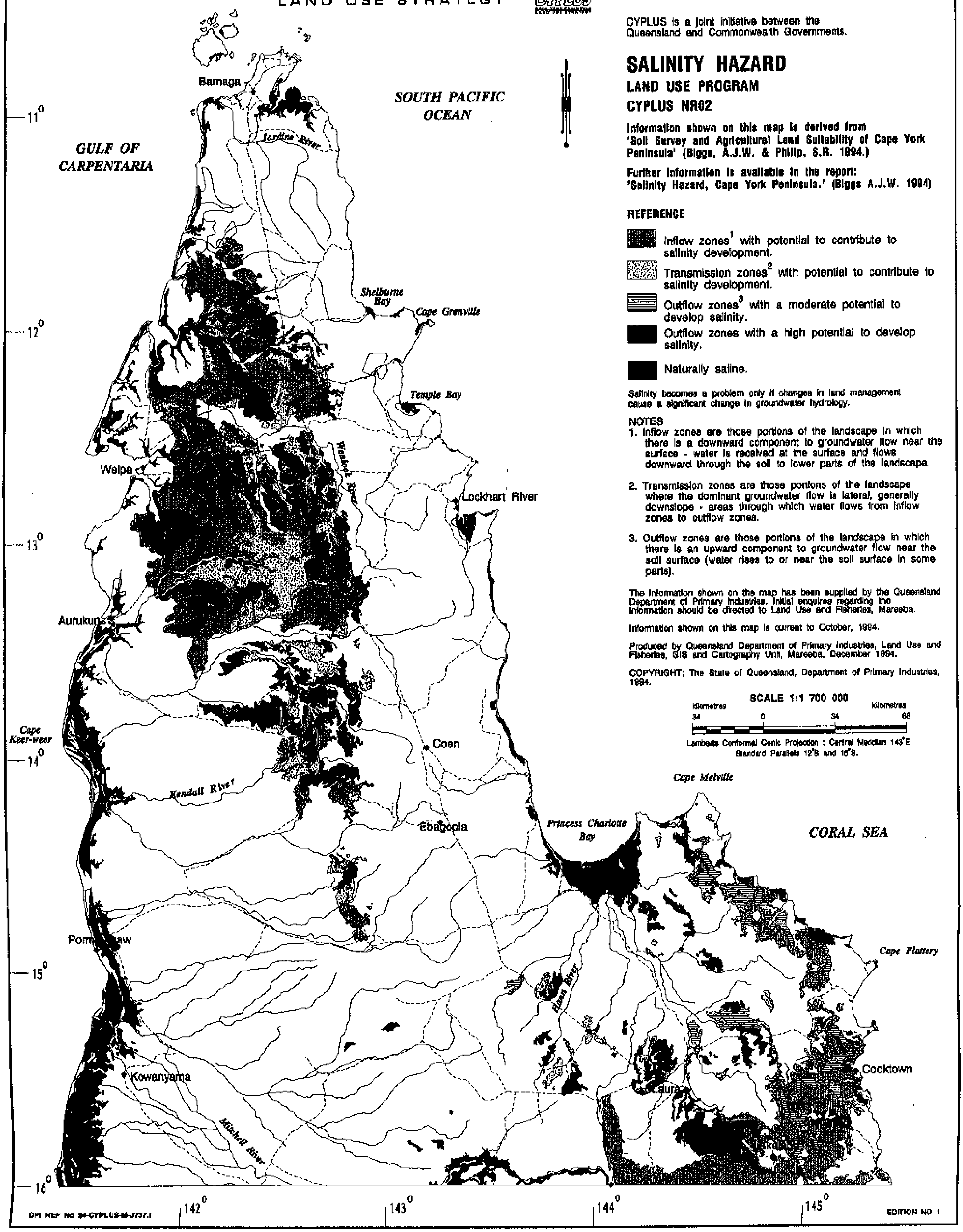
# SALINITY HAZARD

## LAND USE PROGRAM

## CYPLUS NR02

Information shown on this map is derived from 'Soil Survey and Agricultural Land Suitability of Cape York Peninsula' (Biggs, A.J.W. & Philip, S.R. 1994.)

Further information is available in the report: 'Salinity Hazard, Cape York Peninsula.' (Biggs A.J.W. 1994)




### REFERENCE

- Inflow zones[1] with potential to contribute to salinity development.
- Transmission zones[2] with potential to contribute to salinity development.
- Outflow zones[3] with a moderate potential to develop salinity.
- Outflow zones with a high potential to develop salinity.
- Naturally saline.

Salinity becomes a problem only if changes in land management cause a significant change in groundwater hydrology.

NOTES
1. Inflow zones are those portions of the landscape in which there is a downward component to groundwater flow near the surface - water is received at the surface and flows downward through the soil to lower parts of the landscape.
2. Transmission zones are those portions of the landscape where the dominant groundwater flow is lateral, generally downslope - areas through which water flows from inflow zones to outflow zones.
3. Outflow zones are those portions of the landscape in which there is an upward component to groundwater flow near the soil surface (water rises to or near the soil surface in some parts).

The information shown on the map has been supplied by the Queensland Department of Primary Industries. Initial enquires regarding the information should be directed to Land Use and Fisheries, Mareeba.

Information shown on this map is current to October, 1994.

Produced by Queensland Department of Primary Industries, Land Use and Fisheries, GIS and Cartography Unit, Mareeba. December 1994.



SCALE 1:1 700 000

Kilometres 34 0 34 68 Kilometres

Lamberts Conformal Conic Projection : Central Meridian 143°E
Standard Parallels 12°S and 16°S.

DPI REF No 94-CYPLUS-M-J737.1

EDITION NO 1

## ATTACHMENT 1

## COMMENTS OF REVIEWERS

The following attachment incorporates responses from community and other groups associated with the CYPLUS process in regards to this project. These comments were circulated to the author (where possible) to assist in the revision of the draft report.

From these responses, issues of fact were amended within the final report. Sections of the following comments also portray the views of the respondent and their 'constituency' (if available) in regards to the information presented by the report.

The Cape York Peninsula Land Use Strategy recognises that various and contrasting opinions exist within the wider community. The inclusion of these responses made in relation towards the information within this report, indicates that the CYPLUS process has been, and continues to be, inclusive of all points of view presented by the community.

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Mr J. Lane
Land Use Program Manager
CYPLUS
P.O. Box 7440
Cairns Qld 4870

2 February 1995

Dear John,

<u>Comments on Land Degradation Reports</u>

For the purposes of these comments we have referred to three papers :

(1) Potential Soil Loss by Water Erosion Pain, East & Wilford.
(2) Salinity Hazard, Cape York Peninsula , Biggs.
(3) Existing and Potential Erosion Hazard of Cape York Peninsula, Biggs.

<u>(1) Potential Soil Loss by Water Erosion, Pain, East and Wilford</u>

The main conclusions we draw from the report are the following:

* the maintenance of the existing vegetation cover of Cape York Peninsula is crucial in avoiding accelerated water erosion
* overgrazing, particularly in riparian areas presents a significant erosion hazard
* Cape York Peninsula's soils have low erodibility when undisturbed but this changes to high when disturbed through inappropriate management.

We have a number of other brief comments :

* the fourth anomaly listed on page 8 i.e. the high erosion potential in the heathlands area is not mapped on the Biggs and Philip map sheet called " Cape York Peninsula Erosion ".

* the map provided with the report to us was in black and white and therefore somewhat difficult to interpret. However, there still seems to us some major differences between it and the Biggs & Philip map.

<u>(2) Existing and Potential Erosion Hazard of Cape York Peninsula by A. Biggs</u>

We believe this report places too much store on the ability of land managers to avoid erosion problems on inherently erodable soils. Land managers throughout Australia's past two hundred year history have failed dismally in this task.

The report largely concentrates on two areas : the south east and south west. It is difficult to reconcile the remainder of the Cape with the Pain, East and Wilford report and in particular the maps accompanying each report.

Page 10: The map provided with the report ( Cape York Peninsula Erosion ) is not consistent with the statement in the second paragraph which says : " This type of disturbance is in fact not restricted to the three rivers mentioned above but can be found on most rivers and creeks on the Peninsula. "

Page 16 : the last sentence in paragraph one is very optimistic, requires a definition of " significant " and probably is an opinion with no scientific basis to support it.

The majority of Cape York Peninsula has not been discussed in the report. It seems to us that areas north of Coen have been inadequately dealt with.

CAFNEC and other community groups are obviously not soil scientists, however, it seems to us that this report needs some peer review because of the inadequacies mentioned above.

(3) Salinity Hazard Cape York Peninsula, A. Biggs

We do not feel qualified to comment on the technical aspects of the report, however, it is clear that in order to avoid secondary salinisation over large parts of Cape York Peninsula land use planning must take the precautionary principle seriously.

We have to comment on the second paragraph of the conclusion : What is the developemnt referred to ? and how is this reconciled with the next statement ? It is having " two bob each way. "

Yours faithfully,

Jim Downey

CYPLUS Co-ordinator.

**ATTACHMENT 2**

**TERMS OF REFERENCE**

**Land Degradation and Soil Erosion project**

**Tasks to be undertaken by the Australian Geological Survey Organisation (AGSO)**

1 Assess and map water erosion hazard in Cape York Peninsula (or the potential for erosion) using the USLE model and regolith-landform map polygons and propose report identifying water erosion hazard levels.

2. Produce draft erosion hazard maps.

3. In conjunction with QDPI- Natural Resources Analysis Program Report No. 2 (NR02), present findings to Land/Nature Working Groups, check and produce final soil erosion and salinity hazard maps, and produce final report of erosion hazard, salinity hazards and other forms of land degradation.

**Tasks to be undertaken by the Queensland Department of Primary Industries (QDPI)**

1. Erosion Hazard Assessment

   Collaborate with AGSO to reconcile their assessment for 2 sheet areas with QDPI assessment as a basis for extrapolation to the whole study area.

2. Degradation Status Assessment

   Interrogate final NR02 database to identify polygons assessed as showing evidence of degradation. Produce GIS layer and maps showing existing degradation as assessed by NR02.

3. Salinity Hazard Assessment

   Extend current data set from EM assessment by meshing soil attribute, elevation/drainage and geological coverage's. Draft soil salinity hazard maps.

4. Present findings to the Land and Nature Working Groups, check and produce final salinity hazard maps, and prepare final report.