# GEMINI PROJECT
# SOIL AND LAND SUITABILITY ASSESSMENT

**PREPARED FOR**
MAGNETIC SOUTH PTY LTD

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GEMINI PROJECT
SOIL AND LAND SUITABILITY

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| | | |
|---|---|---|
| % | - | Percentage |
| < | - | less than |
| > | - | greater than |
| °C | - | Degrees Celsius |
| AARC | - | AARC Environmental Solutions Pty Ltd |
| ALS | - | Australian Laboratory Services |
| BoM | - | Bureau of Meteorology |
| Ca | - | Calcium |
| Ca/Mg | - | Calcium/Magnesium Ratio |
| CEC | - | Cation Exchange Capacity |
| CH4 | - | Methane |
| cm | - | Centimetre(s) |
| CO2 | - | Carbon Dioxide |
| Cu | - | Copper |
| DME | - | Department of Mines and Energy |
| DNRM | - | Department of Natural Resources and Mining |
| dS/m | - | deciSiemens(s) per metre |
| DSITI | - | Department of Science, Information Technology and Innovation |
| EC | - | Electrical Conductivity |
| EPC | - | Exploration Permit Coal |
| ESP | - | Exchangeable Sodium Percentage |
| GPS | - | Global Positioning System |
| ha | - | Hectare(s) |
| Iron | - | Fe |
| K | - | Potassium |

| | | |
|---|---|---|
| km | - | Kilometre(s) |
| $km^2$ | - | Kilometre(s) squared |
| m | - | metre(s) |
| m2 | - | metre(s) squared |
| m3 | - | metre(s) cubed |
| Magnetic South | - | Magnetic South Pty Ltd |
| MCA | - | Mineral Council of Australia |
| meq/100g | - | milliequivalent(s) per 100 grams |
| Mg | - | Magnesium |
| mg/kg | - | milligram(s) per kilogram |
| mm | - | Millimetre(s) |
| Mn | - | Manganese |
| N2O | - | Nitrous oxide |
| Na | - | Sodium |
| NATA | - | National Association of Testing Authorities |
| PAWC | - | Plant Available Water Capacity |
| ppm | - | Parts per million |
| PSA | - | Particle Size Analysis |
| ROM | - | Run of Mine |
| RPI Act | - | *Regional Planning Interests Act 2014 (Qld)* |
| RPI Regulation | - | Regional Planning Interests Regulation 2014 |
| SILO | - | Scientific Information for Land Owners |
| SC Act | - | *Soil Conservation Act 1986 (Qld)* |
| SCL | - | Strategic Cropping Land |
| SLSA | - | Soil and Land Suitability Assessment |
| SMU | - | Soil Management Units |
| Taunton national Park | - | Taunton National Park (Scientific) |
| The Project | - | Gemini Project |

| | | |
|---|---|---|
| tpa | - | tonnes per annum |
| V:H | - | vertical to horizontal ratio |
| Zn | - | Zinc |

# 1.0 INTRODUCTION

AARC Environmental Solutions Pty Ltd (AARC) was commissioned by Magnetic South Pty Ltd (Magnetic South) to conduct a Soil and Land Suitability Assessment (SLSA) for the Gemini Project (the Project).

An assessment of the Project's soil and land suitability values was conducted within Exploration Permit Coal (EPC) 881 near Dingo in Central Queensland. This assessment forms part of the supporting studies required for the Project's Environmental Authority (EA) Application.

The Project is a greenfield, open-cut metallurgical mine approval, proposing production of Pulverised Coal Injection (PCI) coal for export to the international steel making industry.

This SLSA documents the nature and distribution of major soil types in the target area and assesses their suitability for land uses such as cattle grazing and cropping. This assessment establishes baseline environmental characteristics and values relating to land use and suitability and makes recommendations for the management of soil resources.

## 1.1 SCOPE OF STUDY

The objectives of the SLSA were to:

- Describe the agricultural use of the land of the Project and the surrounding area, including any crop rotations;
- Describe, map and illustrate soil types and profiles according to the *Australian Soil and Land Survey Field Handbook* (NCST 2009), *Guidelines for Surveying Soil and Land Resources* (McKenzie et. al. 2008) and *Australian Soil Classification* (Isbell 2002);
- Identify soils that would require specialised management due to wetness, erosivity, depth, acidity, salinity or other features;
- Identify soil management units from representative samples down the soil profile, based on their physical and chemical properties;
- Describe and map land suitability classes of the potentially affected area in accordance with the *Guidelines for Agricultural Land Evaluation in Queensland – Second Edition (Draft)* (DSITI & DNRM 2015), and the *Regional Land Suitability Frameworks for Queensland Guidelines for Agricultural Land Evaluation in Queensland – Second Edition (Draft)* (DSITI & DNRM 2013);
- Assess the potential impacts of the Project on the soil and land use values and provide recommended mitigation measures to minimise negative impacts; and
- Include the findings in a stand-alone report suitable for reference in the Project's EA Application.

## 1.2 PROJECT BACKGROUND

The Project is situated in the Bowen Basin, Central Queensland, approximately 3 kilometres (km) west of the township of Dingo, 110 km east of Emerald, and 125 km south-west of Rockhampton (Figure 1). The study area is contained within the bounds of EPC 881.

The Project is proposed to be an open-cut coal mine, producing up to 1.9 Mtpa (million tonnes per annum) of ROM Coal with an average of 1.8 Mtpa for an operational mine life of approximately 20 years.

## 1.3 LOCAL WATERWAYS AND TOPOGRAPHY

The Project lies within the Fitzroy River Basin, which encompasses an area of 142,545 square kilometres ($km^2$) and contains the Comet, Connors, Dawson, Don, Nogoa and Mackenzie Rivers, which make up its six sub-catchment areas (BoM 2018; DES 2018).

The Project lies within the Mackenzie River sub-catchment, which covers a total area of 12,985 $km^2$, and is situated in the centre of the Fitzroy River catchment. The major water body associated with the Project site is Charlevue Creek, which dissects the EPC in a north-easterly direction. This creek begins within the boundaries of Blackdown Tablelands National Park, flowing north-east before joining with Springton Creek and the Fitzroy River, eventually reaching the Pacific Ocean approximately 46 km north of Gladstone. Two significantly smaller creeks, Stanley and Springton, cross the Project boundaries in the north-west and south-east respectively. These two creeks also eventually converge with the Mackenzie River. Associated tributaries, dams and drainage features also appear across the site. Figure 2 displays the extent of the watercourses associated with the study area.

Topography of the land varies from flat to undulating hills, with elevation within the study area ranging between 120 metres (m) and 150 m above sea level. The landscape is influenced by the presence of Charlevue Creek and its associated flood plains, which have relatively lower elevations than the surrounding landscape of undulating hills. The topography of the Project is representative of the surrounding region.

## 1.4 CURRENT LAND USE

The land within the Project boundary is currently used for low intensity cattle grazing and resource exploration activities. There is one highway (Capricorn) and five publicly gazetted roads (Charlevue, Cooinda, Red Hill, Normanby, and Ellesmere) dissecting the area.

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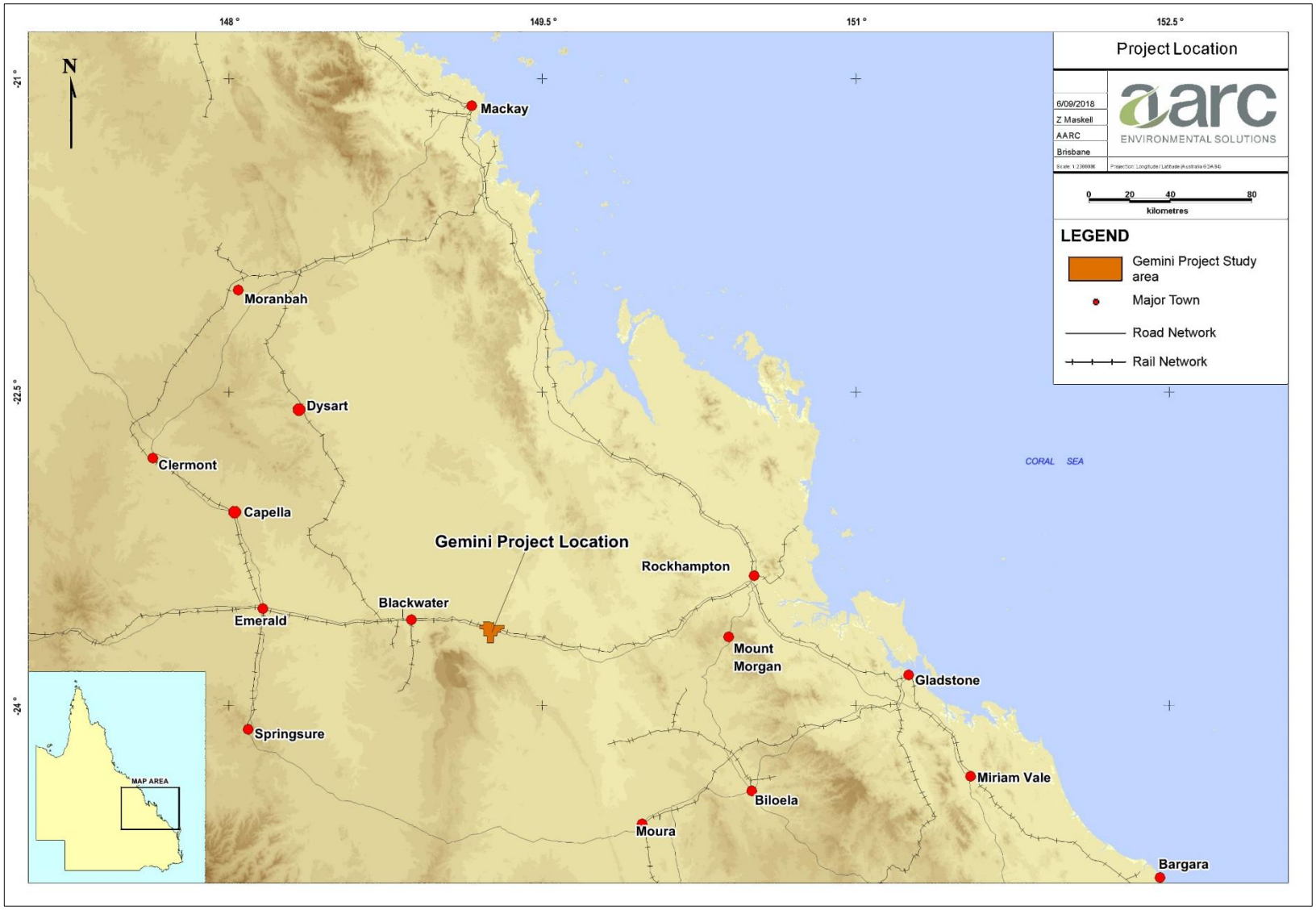



**Figure 1 Project Location**

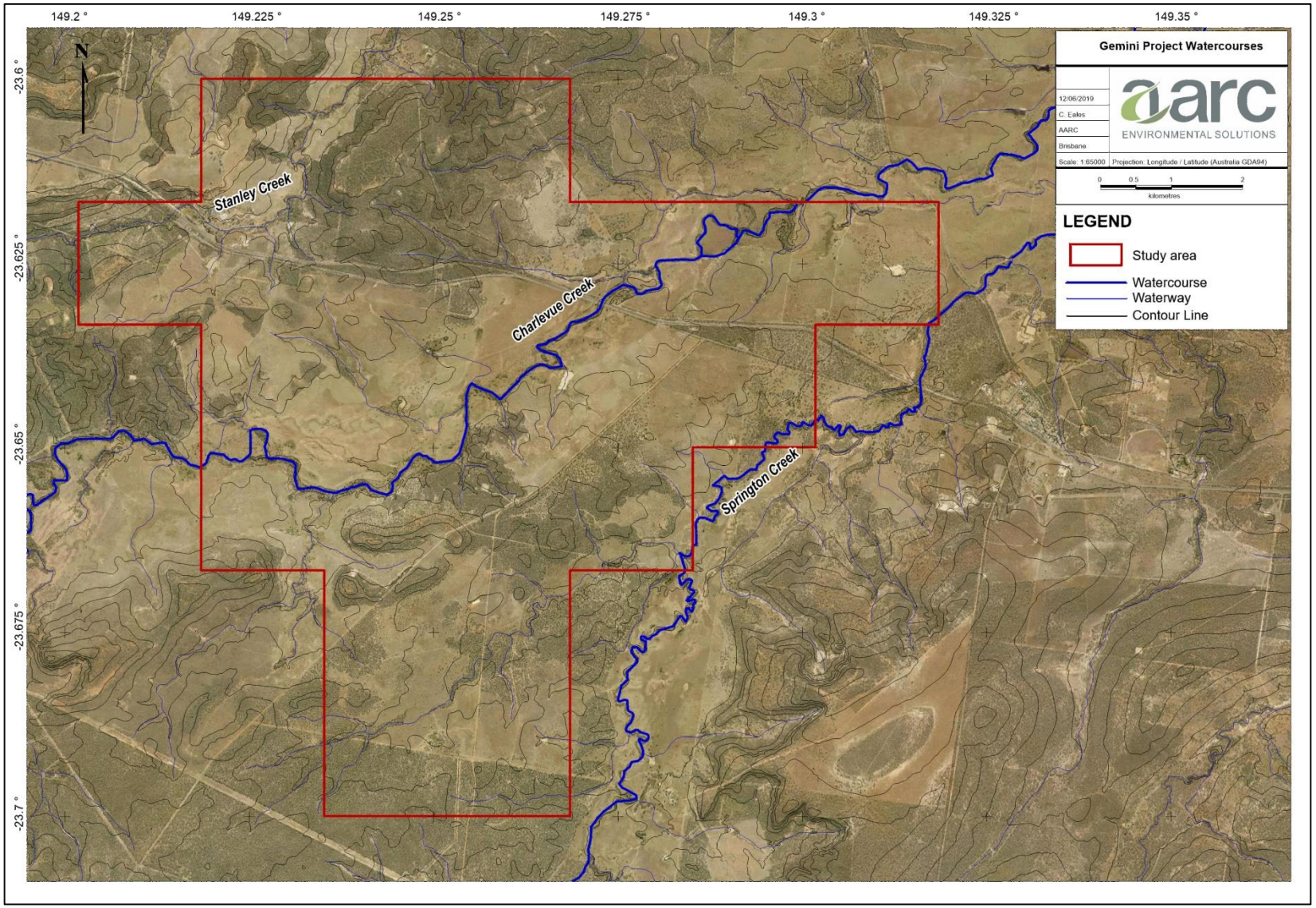



**Figure 2 Waterways and Topography associated with the Project**

## 1.5 REGIONAL GEOLOGY

The geology of the Dingo area is dominated by its position within the Bowen Basin. The Bowen Basin is one of Queensland's largest depositional zones, forming through a period of rifting and subsidence lasting from the Early Permian to Mid-Triassic. The area surrounding the Project is dominated by clastic sedimentary rocks of marine and lacustrine origin, including sandstones, conglomerates, mudstones, siltstones and coal (Geoscience Australia 2018).

The coastal and inland depositional environments which created these deposits allowed for the formation of extensive coal seams throughout the Bowen Basin, with the anoxic deposition of organic matter subsequently compacted and de-volatised through compression and increased temperatures (Brooks & Smith 1969).

Generally, coal seams found in the east-central part of the basin contain higher quality coking coal deposits, with rank falling below coking range farther south and west (Hutton 2009). The high-quality coal measures found at within the Gemini Project are of Permian age, and are generally located less than 60 m from the surface (Mutton 2003).

### 1.5.1 Solid Geology

The following solid geology map units were identified within the Project area.

- Rangal Coal Measures (Pwj) – Late Permian sedimentary unit comprised of sandstone, siltstone, mudstone, coal, tuff and conglomerate;
- Gyranda Subgroup (Pwy) – Late Permian sedimentary unit comprised of siltstone and shale with minor tuff and volcanilithic sandstone and rare coal (lower part - Banana Formation); calcareous sandstone, mudstone and siltstone (upper part - Wiseman Formation); and
- Rewan Group (Rr) – Early Triassic – Middle Triassic sedimentary unit comprised of lithic sandstone, pebbly lithic sandstone, green to reddish brown mudstone and minor volcanilithic pebble conglomerate (at base).

These map units are displayed below in Figure 3.

### 1.5.2 Surface Geology

The following surface geology map units were identified within the Project area.

- Qa-QLD (Qa) – Quaternary clay, silt, sand and gravel; flood-plain alluvium
- Td-QLD (Td) – Tertiary duricrusted palaeosols at the top of deep weathering profiles, including ferricrete and silcrete; duricrusted old land surfaces.
- Duaringa Formation (Tu) – Eocene-Oligocene mudstone, sandstone, conglomerate, siltstone, oil shale, lignite and basalt.
- Gyranda Subgroup (Pwy) – Late Permian sedimentary unit comprised of siltstone and shale with minor tuff and volcanilithic sandstone and rare coal (lower part - Banana Formation); calcareous sandstone, mudstone and siltstone (upper part - Wiseman Formation);

These map units are displayed below in Figure 4.

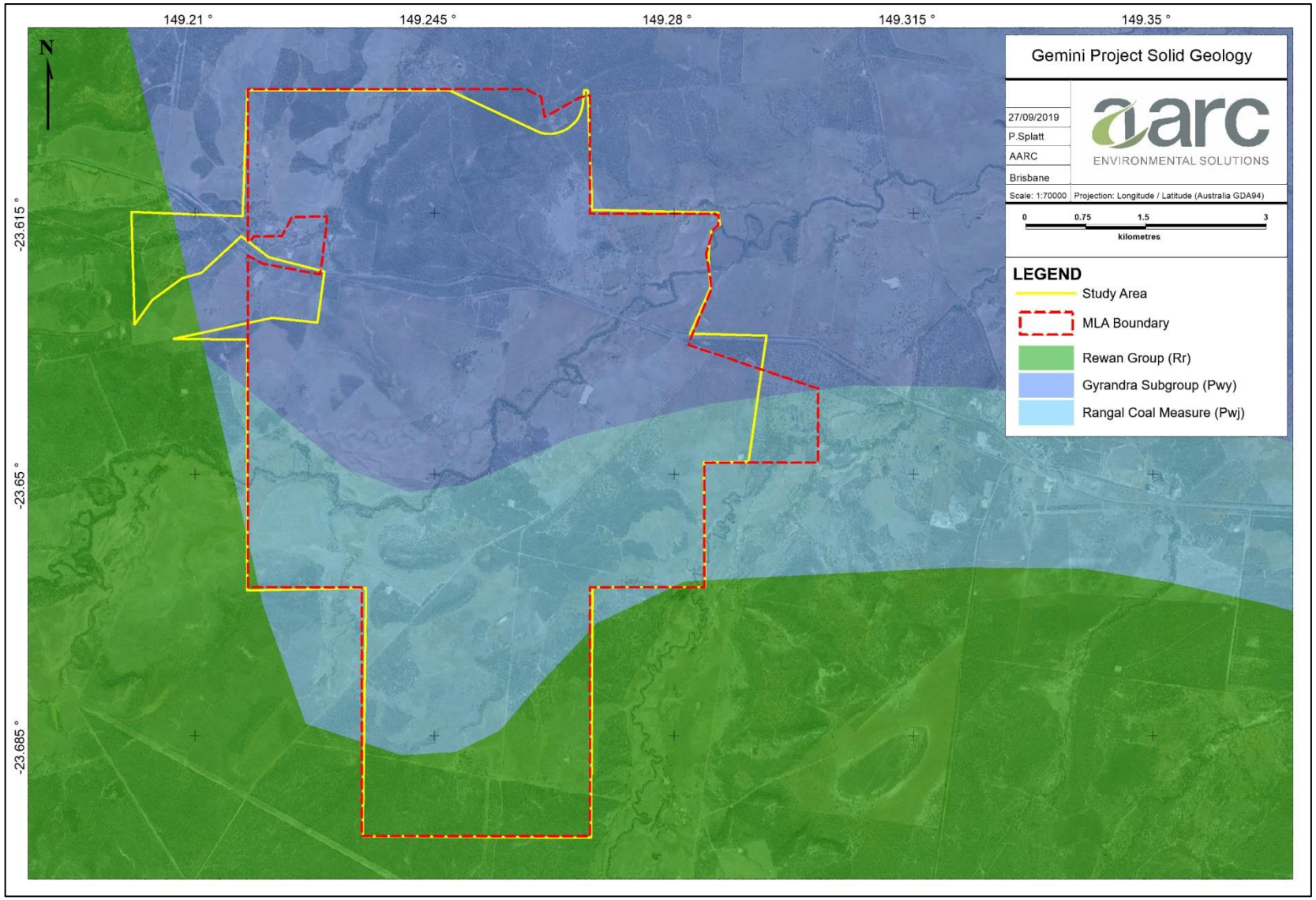



**Figure 3 Solid Geology**

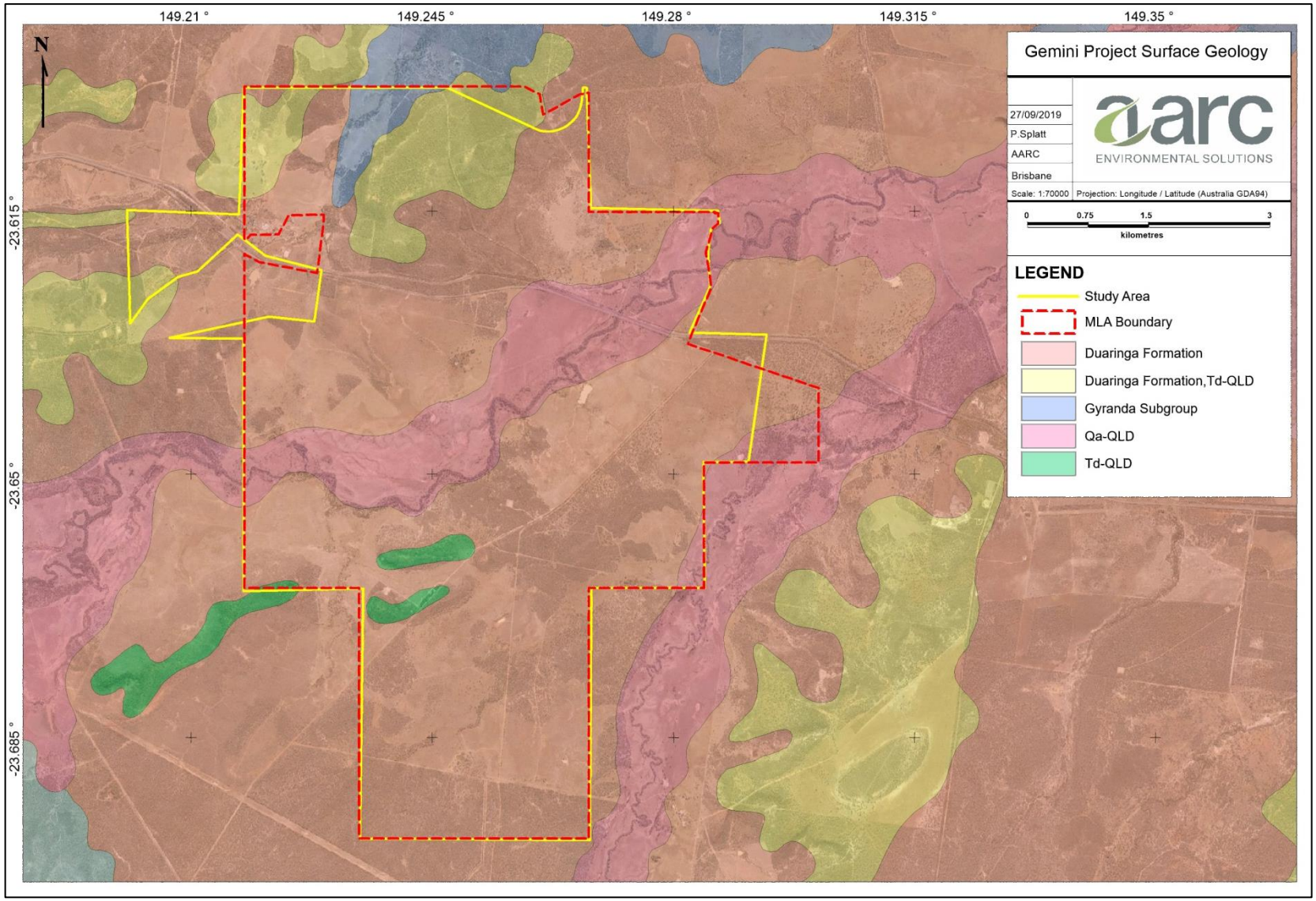



**Figure 4 Surface Geology**

## 1.6 REGIONAL CLIMATE

The regional climate is classified as semi-arid, characterised with warm dry summers and warm winters. Climate data for the Project has been sourced from Scientific Information for Land Owners (SILO) climate database (Queensland Government), which operates by interpolating data from the Commonwealth Bureau of Meteorology (BoM) into a single point data drill. SILO was selected to obtain the data, instead of weather station data from BoM, due to the significant distance between the Project and the closest weather station located in Blackwater Water Treatment Plant weather station approximately 50 km away, which only recorded weather data between 1995 and 2008.

Figure 5 shows average temperature and rainfall registered in the area from January 1999, to present. The data indicates the annual mean rainfall for the region is highest between December and March with the maximum average registering in December (111.5 millimetres (mm)).

The hottest months typically occur between October and March while the coldest months occur between May and September. The highest mean maximum temperature typically occurs in December (34.2 degrees Celsius (°C)) and the lowest mean minimum temperature in July (8.5°C). The mean annual maximum temperature for the region is 29.8°C and the mean annual minimum temperature is 16 °C.

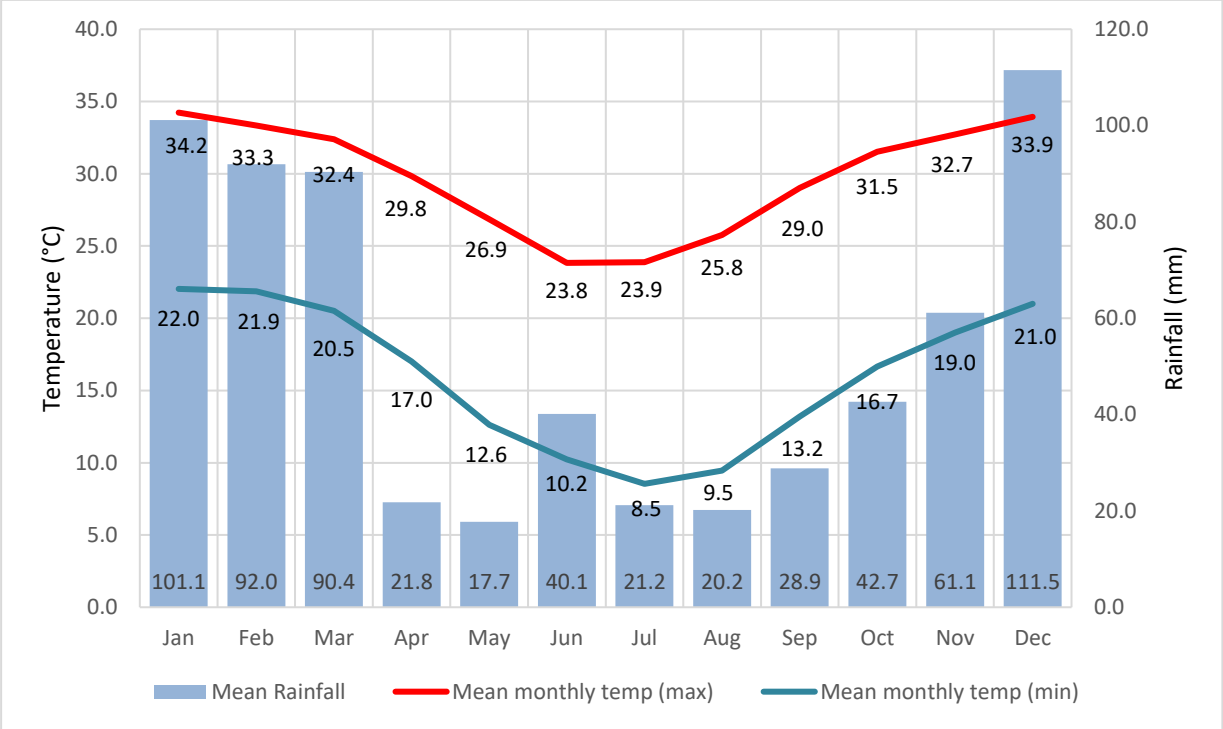



**Figure 5 Mean temperature and rainfall data for the region**

## 1.7 LAND SYSTEMS

The General Report on Lands of the Dawson-Fitzroy Area (Speck et. al. 1967) mapped at a scale of 1:80,000 indicated the study area contains the Dingo Land System and the Melbadale Land System.

### 1.7.1 Dingo Land System

The Dingo Land System is characterised by fluvial plains surrounding significant waterways. It is mostly composed of stable flood plains traversed by a branching pattern of drainage floors. The majority of deposits are weathered alluvium, with slopes of coarser or finer textured alluvium (depending on flow patterns). Channels can be up to 30 m wide and 3 m deep, with fringing riparian vegetation. Main drainage floors can then extend 800 m outwards, with deep texture contrast sandy loams over mottled clays, and open spaces of *Eucalyptus tereticornis* (Blue gum) and *Eucalyptus crebra* (Narrow-leaved ironbark) with sparse shrubs. Large plains surround drainage features (up to 3 km wide) which can contain either deep texture contrast soils with *Eucalyptus populnea* (Poplar box) woodlands, or deep layered soils on alluvium with woodlands of Blue gum and Narrow-leaved ironbark. Slopes within this land unit are usually the result of strongly gilgaied shrink-swell clays, forming depressions of finer soil textures with *Acacia harpophylla* (Brigalow) scrub.

Geology in this unit is comprised of weathered Quaternary alluvium.

### 1.7.2 Melbadale

The Melbadale Land System in characterised by the shallow dissection of weathered tertiary land surfaces, forming undulating plains dominated by complex depositional mid and lower slopes, with minor lateritic upper slopes in some places. This land system features moderately dense branching drainage patterns, with local relief usually less than 15 m. Depending on the steepness of terrain, upper slopes are often dominated by deep loamy red earths (gentle slopes) with *Eucalyptus crebra*, or shallow fine sandy loams (steep terrain) with *Acacia shirleyi* (lancewood) forests. Mid to lower slopes are often associated with deep texture contrast soils of loamy sands overlying mottled sandy clays, with grassy woodlands of open-spaced narrow-leaved ironbark and shrubs. Lower slopes are often associated with deep light to medium clays, with tall forests of narrow-leaved ironbark. Tributaries have variable soil textures depending on slope, though stratified loams and texture contrast soils are common.

Geology in this land system is comprised of Quaternary to Late Tertiary colluvial/alluvium, laterised tertiary sandstone, conglomerate, and shale.

# 2.0 RELEVANT LEGISLATION, POLICY AND GUIDELINES

Relevant legislation, and supporting policy and guidelines, relevant to the assessment of soil and land suitability values on the Project are discussed below.

## 2.1 REGIONAL PLANNING INTERESTS ACT 2014 (QLD)

The *Regional Planning Interests Act 2014 (Qld)* (RPI Act) aims to identify areas of Queensland that are of regional interests because they contribute, or are likely to contribute, to Queensland's economic, social and environmental prosperity. The RPI Act also aims to give effect to the policies about matters of State interest stated in regional plans and effectively manage impact of resource activities on the areas of regional interest and the coexistence of the two and other regulated activities such as highly productive agricultural activities.

Areas of regional interest that the RPI Act aims to protect are classified as:

- Living areas in regional communities (Priority Living Areas);
- High-quality agricultural areas from dislocation (Priority Agricultural Areas);
- Strategic cropping areas; and
- Regionally important environmental areas (Strategic Environmental Areas).

Detailed description of what constitutes each type of area of regional interest are addressed in Section 8 – 11 of the Act and the Regional Planning Interests Regulation 2014 (RPI Regulation). The RPI Act and RPI Regulation seeks to strike an appropriate balance between protecting priority land uses and delivering a diverse and prosperous economic future for our regions.

There are no areas of regional interest within the study area. Bluff is located just over 6 km to the west is mapped as a Priority Living Area and the nearest SCAs are about 5 km to the north and north-east.

## 2.2 GUIDELINES

Below is a summary of all relevant guidelines and resources pertaining to the assessment of soil and land suitability for the Project. These guidelines form the basis of the methodology and requirements around these assessments.

- *Australian Soil and Land Survey Field Handbook* (NCST 2009),
- *The Australian Soil Classification Revised Edition* (Isbell 2002);
- *Guidelines for Agricultural Land Evaluation in Queensland – Second Edition* ( DSITI & DNRM 2015);
- *Guidelines for Surveying Soil and Land Resources* (McKenzie et al. 2008);
- *Regional Land Suitability Frameworks for Queensland Guidelines for Agricultural Land Evaluation in Queensland – Second Edition* (DSITI & DNRM 2013); and
- *Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques* (DME 1995).

# 3.0 SOIL SURVEY METHODOLOGY

## 3.1 DESKTOP ANALYSIS

Desktop analysis was conducted prior to field sampling. This analysis was comprised of background research and evaluation of available information for the study area. Resources used included:

- The Digital Atlas of Australian Soils (BRS, 1991). Australian soils were mapped at a scale of 1:2,000,000. Although this scale is broad it provided a good foundation for understanding the soils that may be present in the Project region.
- Government maps featuring regional topography, geology, contour data, and watercourse locations was used to help refine mapping boundaries, particularly where soil types were a function of gradient.
- Reference information for land systems: *Lands of the Dawson-Fitzroy Area, Queensland* (Speck et al. 1967).
- Reference Information for regional geology: *Geology of the Bowen Basin, Queensland* (Dickins & Malone 1973).
- Reference information for land management: *Understanding and Managing Soils in the Central Highlands* (DPI, 1993).

## 3.2 SURVEY DESIGN

Methodologies employed throughout this study followed procedures detailed in the *Australian Soil and Land Survey Field Handbook* (NCST, 2009) and the *Guidelines for Surveying Soil and Land Resources* (McKenzie et. al. 2008). The soil survey was based on a free-survey technique with soil profile and observation sites located to best represent all soil types present in the Project.

For this site, a scale between 1:25,000 to 1:100,000 was deemed most appropriate. This scale was selected based on information contained within the *Guidelines for Surveying Soil and Land Resources* (McKenzie et. al. 2008). The final mapping scale for the Project site fell within the specified range.

To achieve a mapping scale of 1:25,000 to 1:100,000, McKenzie et. al. (2008) suggest a minimum recommended sampling density of 1 site per 25 ha with data collection comprising detailed soil profile descriptions (15 to 35 percent (%) of sites), representative profile sampling for lab analysis (1 to 5%) and mapping observations sites (55 to 83%).

The number of sites surveyed for the SLSA (Table 1) exceeded these minimum requirements.

**Table 1 Survey Site Numbers for SLSA 2018**

| Survey Site | Scale | Detailed Soil Profiles | Representative Profiles for Analysis | Mapping Observations | Total |
|---|---|---|---|---|---|
| Gemini (6,240 ha) | 1:70,000 | 60 | 12 | 180 | 252 |

## 3.3 FIELD INVESTIGATIONS

Field sampling at the Project was undertaken from 20th to 29th of June 2018, consisting of both primary sampling sites (profiles) and secondary visual assessments (observations).

During the survey, sampling site locations were determined using desktop analysis, land management units, landform and vehicle access. Visual assessments were conducted continually whilst traversing the landscape to confirm major soil types and boundaries between soil units. Each site location was recorded using a Global Positioning System (GPS).

Detailed soil profiles were undertaken at 60 sites within the Project boundaries. A jack hammer operated soil corer was used to excavate cores to a maximum depth of 120 centimetres (cm). Soil samples were collected from profiles at standard depths of 0-10, 20-30, 50-60, 80-90, and 110-120 cm where possible. Samples were sealed in clean, plastic zip-lock bags and labelled with the site number, date, depth of sampling, and the initials of the sampler.

Parameters recorded included micro-relief, permeability, drainage, substrate, site disturbance, landform (slope %, relief, elevation, morphological type, landform element and landform pattern), runoff, erosion, SC fragments, rock outcrops, surface condition and dominant vegetation type. Soil profile morphology was described in the field in terms of horizon type, horizon depth, boundary, colour, mottles, texture, coarse fragments, structure, segregations, consistency, and field pH.

## 3.4 LABORATORY ANALYSIS

Soil profiles from 12 representative sites were selected for analysis through Australian Laboratory Services (ALS) for National Association of Testing Authorities (NATA) approved physical and chemical analyses. All standard depths at the chosen sites were utilised in chemical analysis. Samples were analysed to:

- Confirm the classification of the described soil profile;
- Assist in the description of soil characteristics;
- Assist in the determination of land suitability classes;
- Assist in the determination of topsoil and subsoil as a suitable topdressing media; and
- Assist in the identification of soils that would require specialised management.

Physical and chemical parameters analysed for all samples included:

- pH;
- Electrical Conductivity (EC);
- Moisture Content;
- Chloride (Soluble);
- Exchangeable Cations (Calcium(Ca), Magnesium (Mg), Sodium (Na), Potassium (K));
- Cation Exchange Capacity (CEC); and
- Exchangeable Sodium Percentage (ESP).

Additional physical and chemical parameters analysed for topsoil samples included:

- Organic Matter (%);
- Particle Size Analysis (PSA);
- Extractable Trace Elements/Metals (Iron (Fe), Copper (Cu), Zinc (Zn), Manganese (Mn));
- Boron ($CaCl_2$ extractable);
- N as Nitrate;
- Sulphate (water soluble S as $SO_4$);
- Phosphorus and Potassium (Colwell); and
- Emerson Class.

## 3.5 CHARACTERISATION OF SOIL MANAGEMENT UNITS

Soil classification was undertaken using the methodologies specified in *The Australian Soil Classification* (Isbell 2002). Soil Management Units (SMUs) were then described based on the soils' physical and chemical attributes, and land attributes in accordance with the *Guidelines for Surveying Soil and Land Resources* (McKenzie et. al. 2008).

Typically, each SMU was described in terms of its soil profile class, defined as a group of similar soils, having soil profile properties in common. The soils' attributes/limitations were then interpreted using the *Guidelines for Agricultural Land Evaluation in Queensland – Second Edition* (DSITI & DNRM, 2015) to determine their suitability for cattle grazing and broadacre cropping. SMUs were mapped at a scale of 1:70,000 across the Project.

# 4.0 SOIL SURVEY RESULTS

Within the Project, a total of 12 SMUs were described. Table 2 provides an overview of each SMU and its extent within the Project. The spatial distribution of the SMUs is depicted in Figure 6.

Ratings and categories outlined in the CSIRO publications *Interpreting Soil Test Results – Third Edition* (Hazelton & Murphy 2016) and *Soil Chemical Methods of Australasia* (Rayment & Lyons 2011) were used to assist in interpretation of the SMU physical and chemical properties.

**Table 2 Area of Soil Management Units**

| SMU | Surface Area (ha) | Percent of Study Area (%) |
|---|---|---|
| Anderson | 37.78 | 0.61 |
| Barry | 156.5 | 2.54 |
| Charlevue | 232.9 | 3.79 |
| Cooinda | 34.94 | 0.57 |
| Ellesmere | 14.59 | 0.24 |
| Geoffrey | 4061 | 66.0 |
| James | 145.2 | 2.36 |
| Kosh | 924.0 | 15.0 |
| Namoi | 177.6 | 2.89 |
| Nigel | 284.6 | 4.63 |
| Normanby | 48.50 | 0.79 |
| Wallace | 32.04 | 0.52 |
| **Total Area** | **6149** | **100** |

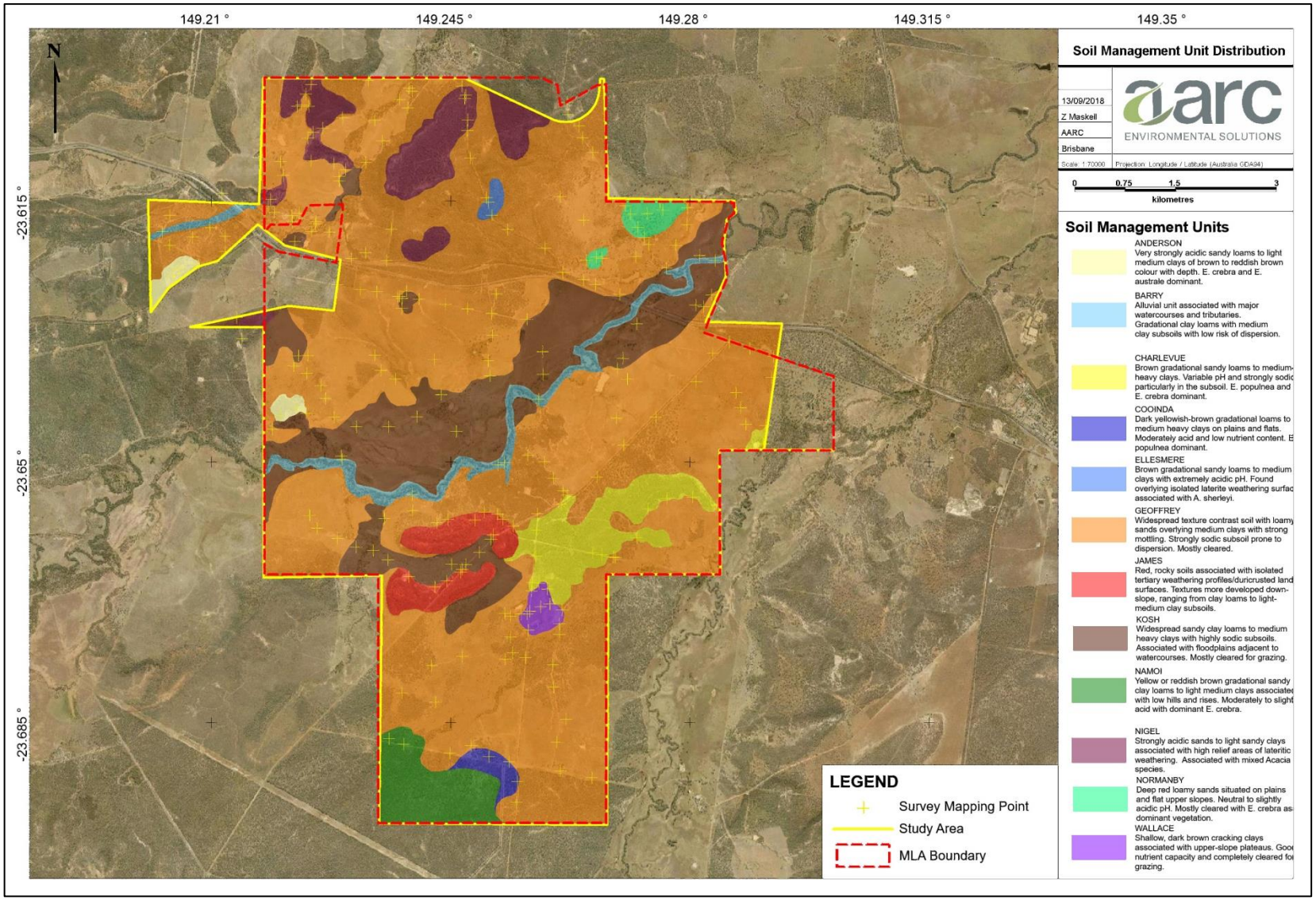



**Figure 6 Distribution of Soil Management Units**

## 4.1 ANDERSON SOIL MANAGEMENT UNIT

**Soil Unit Description:** Hard setting soil unit associated with isolated hills. Soil textures grade from loams at the surface, to light medium clays with depth, sometimes exhibiting red mottling. Vegetation associated with this unit includes *Eucalyptus crebra*, *Corymbia clarksoniana*, and *Acacia rhodoxylon* with *Erythroxylum australe* in the shrub layer.

**Australian Soil Classification:** Red Kurosol.

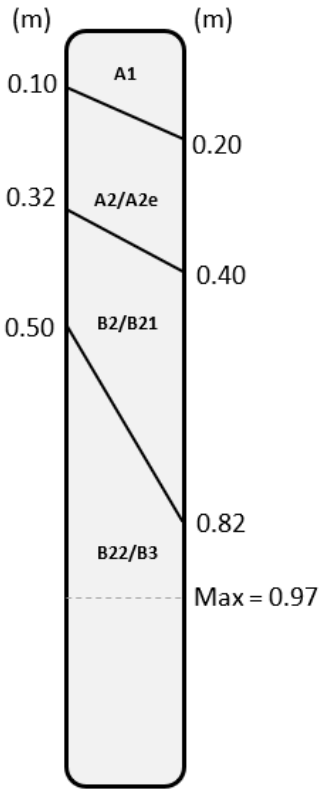
**Photo Plate 1 Anderson SMU Vegetation**

**Table 3 Anderson Soil Unit Description**

| Parameter | Soil Unit Description |
|---|---|
| **Profile Site Numbers** | DP37, DP26 |
| **Observation Site Numbers** | DO55, DO75 |
| **Landform** | Isolated hills |
| **Land System** | Melbadale |
| **Slope** | 1 to 6% |
| **Geology** | Rewan Group (Rr) – Early Triassic – Middle Triassic sedimentary unit comprised of lithic sandstone, pebbly lithic sandstone, green to reddish brown mudstone and minor volcanilithic pebble conglomerate (at base) |
| **Vegetation** | *Eucalyptus crebra, Corymbia clarksoniana,* and *Acacia rhodoxylon* with *Erythroxylon australe* in the shrub layer. |
| **Runoff** | Moderate to Rapid |
| **Permeability** | Slowly to moderately permeable |
| **Drainage** | Imperfectly to moderately well drained |

**Profile Description Representative Sites:** DP37 and DP26.

**Anderson SMU**




The **surface soil** (A1) is a reddish brown to dark greyish brown (5YR4/4, 10YR3/2) sandy loam to clay loam with massive structure. It has a field pH of 4.5, demonstrating a gradual change to;

The **lower surface soil** (A2/A2e) is a reddish brown (5YR4/4) sandy loam to light medium clay with some profiles exhibiting conspicuous bleaching. It has massive to weak polyhedral structure and a field pH of 4.5 to 5.0. Sub-rounded to rounded coarse fragments make up 1 to 20% of this soil horizon. Clear or gradual change to;

The **subsoil** (B2/B21) is a brown to yellowish red (10YR5/3, 5YR4/6) light to light medium clay with weak lenticular to moderate polyhedral structure. It can exhibit red mottles, and has angular course fragments making up to 20% of the horizon. This horizon has a field pH of 5.5, with a gradual change to;

The **lower subsoil** can present as two different horizons depending on slope. B22 is a light brownish grey (10YR6/2) medium clay with strong angular blocky structure with red mottles. B3 is a yellowish red (5YR4/6) light clay with massive structure, and a small amount of 2-6 mm diameter rounded coarse fragments. The pH in these horizons ranges from 5.5 to 5.8.

## Chemical and Physical Analysis

**Table 4 Chemical Properties of the Anderson SMU**

| Representative site: DP26 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Depth (m)** | **pH** | | **EC** | | **Cl** | **ESP%** | | **Moisture (%)** | **Emerson Class No.** |
| | **#** | **Rate** | **dS/m** | **Rate** | **mg/kg** | **%** | **Rate** | | |
| 0-0.1 | 4.6 | Very strongly acid | 0.064 | Very low | 30 | 3.7 | Non-sodic | 1 | 3 |
| 0.2-0.3 | 4.7 | Very strongly acid | 0.028 | Very low | 10 | 2.6 | Non-sodic | 4.3 | 4 |
| 0.5-0.6 | 4.8 | Very strongly acid | 0.02 | Very low | 10 | 4.5 | Non-sodic | 8.2 | 4 |

| **Depth (m)** | **CEC** | | **Exchangeable Cations (meq/100g)** | | | | **Ca/Mg Ratio** |
|---|---|---|---|---|---|---|---|
| | **meq / 100g** | **Rate** | **Ca** | **Mg** | **K** | **Na** | |
| 0-0.1 | 2.7 | Very low | 0.7 | 0.2 | 0.4 | <0.1 | 3.5 |
| 0.2-0.3 | 2.8 | Very low | 0.4 | 0.2 | 0.2 | <0.1 | 2.0 |
| 0.5-0.6 | 4.2 | Very low | 0.2 | 1 | <0.1 | <0.1 | 0.2 |
| **Percentage in Topsoil** | | | 25.93% | 7.41% | 14.81% | 3.70% | - |

Key: meq/100g milliequivalent per 100 grams
dS/m deciSiemens per metre
mg/kg milligrams per kilogram

The Anderson SMU has a very strongly acidic pH throughout the profile, ranging from 4.6 in the topsoil, to 4.8 in the lower subsoil. EC and chloride results indicate that at all depths, salinity is very low, with EC ranging from 0.064 deciSiemens per metre (dS/m) in the topsoil, to 0.02 dS/m in the subsoil layer. Chloride concentrations reflected this result, decreasing with depth from 30 milligrams per kilogram (mg/kg) to 10 mg/kg, both well below toxic limits.

CEC is considered very low throughout the profile, though increases from 2.7 milliequivalent per 100 grams (meq/100g) in the topsoil, to 4.2 meq/100g in the subsoil layer. This may be attributed to the high amount of sand in this Exchangeable cation concentrations reflect the low CEC, with calcium (Ca), magnesium (Mg), potassium (K) and sodium (Na) presenting with <1.0 meq/100g) at all depths. Cation percentages are also below appropriate levels, except potassium, which presents within the appropriate range.

The Ca/Mg ratio in the topsoil is between 1 and 4 (low calcium), though this is considered appropriate for sandy soils. This ratio falls to 0.2 in the lower subsoil (Ca deficient). Due to the low clay content of this soil, the low Ca/Mg ratio seen here isn't likely to increase the risk of dispersion in this soil unit.

**Table 5 Surface Soil (0-10 cm) Properties of the Anderson SMU**

| Particle Size Analysis % | | | | Emerson Class No. | Nitrate (mg/kg) | Sulphate (mg/kg) | Organic Matter (%) |
|---|---|---|---|---|---|---|---|
| Gravel | Sand | Silt | Clay | | | | |
| 10 | 66 | 13 | 11 | 3 | 10.2 | 20 | 3.3 |
| Extractable Nutrients (mg/kg) | | | | Extractable Metals (mg/kg) | | | |
| P | K | B | | Cu | Fe | Mn | Zn |
| 11 | <200 | 0.6 | | <1.00 | 296 | 5.46 | <1.00 |

Key: < less than

The surface soil (A1) was dominated by sand (66%), with 10% gravel, 13% silt, and 11% clay. It lacks true structure (massive), and is non-sodic, with a Ca/Mg ratio of 3.5, and an organic matter content of 3.3%. This information paired with the topsoil's Emerson Class Number of 3, indicates that this soil has favourable chemistry, and is unlikely to suffer from dispersion. The high concentration of coarse particles (sand and gravel) may mean this SMU has the tendency to slump under pressure, as it lacks the binding capacity provided by higher clay percentages.

Nutrient levels are variable, with nitrate concentration (10.2 mg/kg) within the guideline range for supporting plant life, while phosphorous (11 mg/kg) and potassium (<200 mg/kg) are not. Boron (0.6 mg/kg) and sulphate (20 mg/kg) concentrations are acceptable, though extractable metals are generally too low (copper and zinc) or too high (iron), with only manganese within the appropriate range for plant life. Acidic pH values in the topsoil will limit the availability of these nutrients to plants, by impacting solubility and speciation. In addition to this, high iron levels can lead to plant toxicity and inefficiency in photosynthesis (Connolly & Guerinot, 2002).

## 4.2 BARRY SOIL MANAGEMENT UNIT

**Soil Unit Description:** Hard setting soil associated with rivers, drainage lines and levees. Surface soils in this unit are comprised of clay loams to medium clays, grading into light or medium clays at variable depths. Dominant vegetation includes *Eucalyptus tessellaris, Eucalyptus populnea* and *Eucalyptus tereticornis,* with *Lysiphyllum hookeri*, *Cassia spinarum* and *Cassia brewsteri* in the shrub layer.

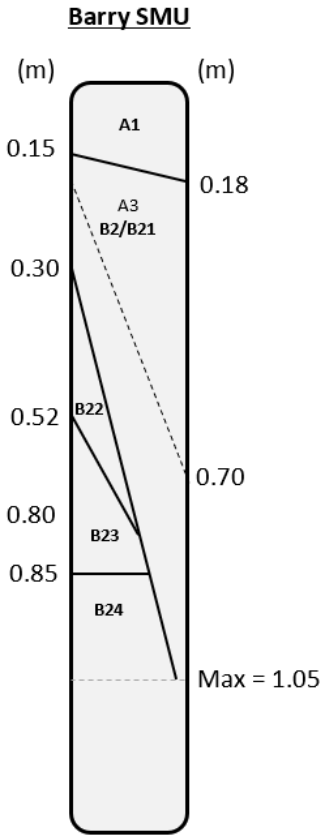
**Australian Soil Classification:** Brown Dermosol.

**Photo Plate 2 Barry SMU Vegetation**

**Table 6 Barry Soil Unit Description**

| Parameter | Soil Unit Description |
|---|---|
| **Profile Site Numbers** | DP14, DP29, DP36 |
| **Observation Site Numbers** | DO45, DO79, DO203 |
| **Landform** | Alluvial plains and levees |
| **Land System** | Dingo |
| **Slope** | 2 to 3% |
| **Geology** | Qa-QLD (Qa) – Quaternary clay, silt, sand and gravel; flood-plain alluvium |
| **Vegetation** | *Eucalyptus tessellaris, Eucalyptus populnea* and *Eucalyptus tereticornis*, with *Lysiphyllum hookeri, Cassia spinarum* and *Cassia brewsteri* in the shrub layer. |
| **Runoff** | Moderate to Rapid |
| **Permeability** | Moderately to highly permeable |
| **Drainage** | Moderately well drained |

**Profile Description – Representative Sites:** DP14, DP29 and DP36




The **surface soil** (A/A1) is a dark reddish brown (5YR3/4, 7.5YR4/3) clay loam to medium clay with weak to moderate polyhedral or platy structure. It has a field pH of 6.0 to 6.5, with a gradual change to either A3 or B2;

The **lower surface soil** (A3) was not present at all profile sites. It is a reddish brown (5YR4/4) sandy clay loam with massive structure and a field pH of 6.5. Gradual change to;

The **upper subsoil** (B2/B21) is a dark reddish brown to brown (5YR3/3, 7.5YR4/4) sandy light medium clay to medium heavy clay, with weak to moderate structure. It has a field pH of 6.0 to 6.5, with a gradual change to;

The **subsoil** (B22) is a brown to dark brown (7.5YR4/4, 7.5YR3/2) clay loam to medium clay, which can either extend to great depths in the profile, or grade into the subsoil horizons. It has moderate polyhedral structure and a field pH of 6.0 to 6.5. Gradual change to;

The **mid-subsoil** (B23) is a brown (7.5YR4/4) light clay with moderate platy structure and a field pH of 6.5. Clear change to;

The **lower-subsoil** (B24) is a dark brown (7.5YR3/3) light medium clay with moderate polyhedral structure and a field pH of 6.5.

## Chemical and Physical Analysis

**Table 7 Chemical Properties of the Barry SMU**

| Representative site: DP14 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Depth (m)** | **pH** | | **EC** | | **Cl** | **ESP%** | | **Moisture (%)** | **Emerson Class No.** |
| | **#** | **Rate** | **dS/m** | **Rate** | **mg/kg** | **%** | **Rate** | | |
| 0-0.1 | 6.5 | Slightly acid | 0.063 | Very low | 20 | 0.3 | Non-sodic | 2.3 | 3 |
| 0.2-0.3 | 6.8 | Neutral | 0.012 | Very low | <10 | 0.5 | Non-sodic | 5.1 | 4 |
| 0.5-0.6 | 6.9 | Neutral | 0.01 | Very low | <10 | 0.7 | Non-sodic | 4.3 | 3 |
| 0.8-0.9 | 7.2 | Neutral | 0.012 | Very low | <10 | 1 | Non-sodic | 7.2 | 3 |
| **Depth (m)** | **CEC** | | | **Exchangeable Cations (meq/100g)** | | | | **Ca/Mg Ratio** | |
| | **meq / 100g** | | **Rate** | **Ca** | **Mg** | **K** | **Na** | | |
| 0-0.1 | 12.5 | | Moderate | 6.4 | 5.2 | 0.9 | <0.1 | 1.2 | |
| 0.2-0.3 | 11.3 | | Low | 6.1 | 4.9 | 0.2 | <0.1 | 1.2 | |
| 0.5-0.6 | 10.4 | | Low | 5.5 | 4.6 | 0.2 | <0.1 | 1.2 | |
| 0.8-0.9 | 18 | | Moderate | 10 | 7.5 | 0.3 | 0.2 | 1.3 | |
| **Percentage in Topsoil** | | | | 51.20% | 41.60% | 7.20% | 0.30% | - | |

The Barry SMU has a slightly acidic pH (6.5) which increases gradually with depth, becoming neutral at 0.2 m (6.8), and increasing to pH 7.2 with depth. EC is very low throughout the profile, ranging from 0.063 dS/m in the topsoil, to 0.012 dS/m in the lower subsoil. Chloride concentrations reflect this result, ranging from 20 mg/kg to <10 mg/kg mg/kg with depth.

CEC varies with depth from moderate in the topsoil, to low in the mid-stratum, to moderate in the lower subsoil. This result is reflected in the concentrations of exchangeable cations, which are higher in the topsoil and lower subsoil than they are in the mid-level horizons. Ca, Mg, K and Na are all within the desirable range for plant growth, at all depths. Throughout the profile, calcium dominates magnesium, with a Ca/Mg ratio of 1.2 to 1.3 at all depths. This assists in decreasing any risk of dispersion in the soil, though plants could benefit from additional calcium.

ESP is considered non-sodic at all depths, ranging from 0.3% in the topsoil layer to 1.0% in the lower subsoil. This is beneficial for plant life and ensures that the unit should remain relatively stable when wet. This conclusion is supported by the unit's Emerson Class Numbers, which vary from 3 to 4 throughout the profile, suggesting that if left undisturbed, this unit should not become dispersive.

**Table 8 Surface Soil (0-10cm) Properties of the Barry SMU**

| Particle Size Analysis % | | | | Emerson Class No. | Nitrate (mg/kg) | Sulphate (mg/kg) | Organic Matter (%) |
|---|---|---|---|---|---|---|---|
| Gravel | Sand | Silt | Clay | | | | |
| 2 | 42 | 42 | 14 | 3 | 1.7 | <10 | 3.3 |
| Extractable Nutrients (mg/kg) | | | | Extractable Metals (mg/kg) | | | |
| P | K | B | | Cu | Fe | Mn | Zn |
| 64 | 596 | 0.4 | | <1.00 | 53.4 | 37.2 | 2.88 |

The surface soil (A/A1) is dominated by sand (42%) and silt (42%), with 14% clay and 2% gravel. It has weak to moderate structure and is hard setting. The surface soil is non-sodic, with a Ca/Mg ratio of 1.2, and a high organic matter content of 3.3%. This information paired with the topsoil's Emerson Class Number of 3 suggests that the surface soil is unlikely to suffer from dispersion when wetted. The water-holding capacity of the topsoil is relatively good, due to the organic matter content and presence of clay sized particles. This is evidenced by the increase in moisture content with depth (as seen in Table 7).

Nutrient levels are variable, with deficient nitrate (1.7 mg/kg), and adequate concentrations of phosphorous (64 mg/kg) and potassium (569 mg/kg). Boron (0.4 mg/kg) and sulphate (<10 mg/kg) are both below guideline levels for supporting plant life. Extractable metal concentrations also vary in their suitability. While zinc is at an appropriate concentration (2.88 mg/kg), manganese (37.2 mg/kg) and iron (53.4 mg/kg) are both slightly higher than desirable, while copper is below detectable concentration (<1.0 mg/kg). These variable nutrient and metals concentrations are likely to limit the types of vegetation supported by the Barry SMU.

## 4.3 CHARLEVUE SOIL MANAGEMENT UNIT

**Soil Unit Description:** Hard setting soil associated with plains and rises. Textures within this unit grade from sandy clay loams or light clays in the surface soil, to medium heavy clays in the subsoil horizons. Dominant vegetation includes *Eucalyptus populnea* and *Eucalyptus crebra,* with *Flindersia dissosperma* (sometimes dominant) and *Cassia spinarum* in the shrub layer.

**Australian Soil Classification:** Red or Brown Dermosol

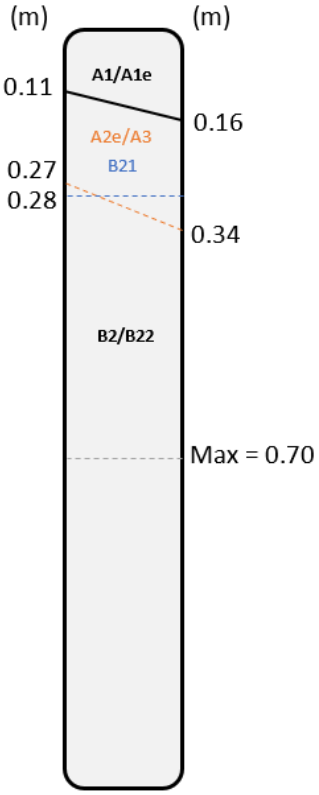
**Photo Plate 3 Charlevue SMU Vegetation**

**Table 9 Charlevue Soil Unit Description**

| Parameter | Soil Unit Description |
|---|---|
| **Profile Site Numbers** | DP6, DP10, DP11 |
| **Observation Site Numbers** | DO6, DO24, DO25, DO27, DO244 |
| **Landform** | Plains and rises |
| **Land System** | Melbadale |
| **Slope** | 1 to 3% |
| **Geology** | Qa-QLD (Qa) – Quaternary clay, silt, sand and gravel; flood-plain alluvium |
| **Vegetation** | *Eucalyptus populnea* and *Eucalyptus crebra*, with *Flindersia dissosperma* and *Cassia spinarum* in the shrub layer. |
| **Runoff** | Very slow to rapid |
| **Permeability** | Slowly permeable |
| **Drainage** | Poorly drained |

**Profile Description – Representative Sites:** DP6, DP10 and DP11

**Charlevue SMU**




The **surface soil** (A1/A1e) is a dark brown to brown (7.5YR3/3, 7.5YR4/3, 10YR3/3) sandy clay loam to light medium clay, with weak to moderate structure. It may exhibit conspicuous bleaching, and has a field pH of 5.5 to 5.8. Clear or sharp change to;

The **lower surface soil** (A2e/A3) was not present as all profile sites. It is a light to medium clay with moderate structure, sometimes exhibiting conspicuous bleaching. Field pH is 5.5 to 6.0, with a sharp or abrupt change to;

The **upper subsoil** (B21) was only present at one profile site. It is a dark brown (7.5YR3/4) medium clay with weak lenticular structure and a field pH of 6.5. Clear change to;

The **lower subsoil** (B2/B22) is a reddish or yellowish brown (5YR4/4, 10YR4/6) medium heavy clay with weak to moderate structure. It has a field pH of 6.5 to 7.0.

## Chemical and Physical Analysis

**Table 10 Chemical Properties of the Charlevue SMU**

| Representative site: DP6 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Depth (m)** | **pH** | | **EC** | | **Cl** | **ESP%** | | **Moisture (%)** | **Emerson Class No.** |
| | **#** | **Rate** | **dS/m** | **Rate** | **mg/kg** | **%** | **Rate** | | |
| 0-0.1 | 5.4 | Strongly acid | 0.28 | Medium | 420 | 19.8 | Strongly sodic | 9.1 | 4 |
| 0.2-0.3 | 6.4 | Slightly acid | 0.43 | Medium | 680 | 15.1 | Strongly sodic | 11.8 | 2 |
| 0.5-0.6 | 7.9 | Moderately alkaline | 0.46 | High | 630 | 29.4 | Strongly sodic | 10.7 | 1 |

| **Depth (m)** | **CEC** | | **Exchangeable Cations (meq/100g)** | | | | **Ca/Mg Ratio** |
|---|---|---|---|---|---|---|---|
| | **meq / 100g** | **Rate** | **Ca** | **Mg** | **K** | **Na** | |
| 0-0.1 | 6.3 | Low | 1.7 | 3.1 | 0.1 | 1.2 | 0.5 |
| 0.2-0.3 | 11.4 | Low | 3.2 | 6.4 | <0.1 | 1.7 | 0.5 |
| 0.5-0.6 | 13.1 | Moderate | 2.7 | 6.5 | <0.2 | 3.8 | 0.4 |
| **Percentage in Topsoil** | | | 26.98% | 49.21% | 1.59% | 19.80% | - |

The Charlevue SMU has a variable pH, ranging from 5.4 (strongly acid) in the topsoil to 7.9 (moderately alkaline) in the lower subsoil. EC is medium in the surface soil (0.28 to 0.43 dS/m), and increases to high in the subsoil (0.46 dS/m). Chloride is considered to be high from 0.2 m depth downwards (>600 mg/kg), which can cause toxicity by interfering with plants' osmotic capacity.

CEC increases with depth, ranging from low (6.3 meq/100g) in the topsoil, to moderate (13.1 meq/100g) in the subsoil layer. This result is reflected in the concentrations of exchangeable cations, which also generally increase with depth. Potassium concentrations were lower than desirable, and though calcium and magnesium fell within the appropriate concentration ranges, necessary percentages were unbalanced throughout the profile. In the topsoil, exchangeable cations are dominated by magnesium at 49.21%, which translates to a Ca/Mg ratio of 0.5. Subsoil layers see a decrease in this ratio, with magnesium (6.5 meq/100g) dominating over calcium (2.7 meq/100g). Due to the high clay content of this soil, this is likely to increase the risk of dispersion in this soil unit.

ESP is considered strongly sodic throughout the profile, ranging from 19.8% in the topsoil layer to 29.4% in the lower subsoil. Due to the high clay content in this soil, this is likely to increase the dispersive tendencies of the unit with depth. This result is reflected in the unit's Emerson Class Numbers, which range from 4 in the surface soil (non-dispersive) to 1 in the lower subsoil (highly dispersive).

**Table 11 Surface Soil (0-10 cm) Properties of the Charlevue SMU**

| Particle Size Analysis % | | | | Emerson Class No. | Nitrate (mg/kg) | Sulphate (mg/kg) | Organic Matter (%) |
|---|---|---|---|---|---|---|---|
| Gravel | Sand | Silt | Clay | | | | |
| 5 | 54 | 38 | 3 | 4 | 0.4 | 20 | 1 |
| Extractable Nutrients (mg/kg) | | | | Extractable Metals (mg/kg) | | | |
| P | K | | B | Cu | Fe | Mn | Zn |
| 12 | <200 | | 0.8 | <1.00 | 29.7 | 5.45 | <1.00 |

The surface soil (A1/A1e) for the Charlevue SMU is dominated by sand (54%) and silt (38%), with 5% gravel and 3% clay. It has weak to moderate structure, and a hard setting surface condition. The topsoil is strongly sodic, with a Ca/Mg ratio of 0.5, and an organic matter content of 1.0%. This information would usually suggest that dispersion would be a considerable risk for the topsoil, though chemical results presented an Emerson Class Number of 4 (non-dispersive). This is likely due to the high sand content in the topsoil layer, which decreases with depth as clay content (and dispersive tendency) increases.

Nutrient levels in the topsoil layer are generally poor, with nitrate (0.4 mg/kg), phosphorous (12 mg/kg) and potassium (<200 mg/kg) below suitable levels. Sulphate (20 mg/kg) and boron (0.8 mg/kg) are within acceptable ranges for supporting plant life. Extractable metals vary in their suitability. Both copper and zinc are below reportable amounts, while manganese (5.45 mg/kg) and iron (29.7 mg/kg) are present in suitable concentrations.

Strongly acidic soils such as these can limit the availability of these nutrients to plants, by affecting their solubility, speciation, and toxicity.

## 4.4 COOINDA SOIL MANAGEMENT UNIT

**Soil Unit Description:** Hard setting soil associated with plains. Texture development within this unit is gradual, changing from a sandy clay loam in the topsoil, to a sandy light clay at mid-depth, and a medium heavy clay in the deeper subsoil. Dominant vegetation includes *Eucalyptus populnea* and *Flindersia dissosperma* (sometimes dominant), with *Cassia spinarum* in the shrub layer.

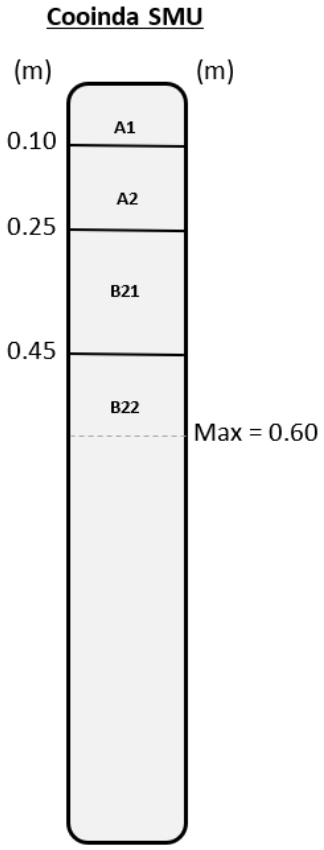
**Australian Soil Classification:** Brown Dermosol

**Photo Plate 4 Cooinda SMU Vegetation**

**Table 12 Cooinda Soil Unit Description**

| Parameter | Soil Unit Description |
|---|---|
| **Profile Site Numbers** | DP2 |
| **Observation Site Numbers** | N/A |
| **Landform** | Plains and flats |
| **Land System** | Melbadale |
| **Slope** | 2% |
| **Geology** | Qa-QLD (Qa) – Quaternary clay, silt, sand and gravel; flood-plain alluvium |
| **Vegetation** | Eucalyptus populnea and Flindersia dissosperma (sometimes dominant), with Cassia spinarum in the shrub layer. |
| **Runoff** | Moderate |
| **Permeability** | Slowly permeable |
| **Drainage** | Imperfectly drained |

**Profile Description – Representative Sites:** DP2




The **surface soil** (A1) is a dark yellowish brown (10YR3/6) sandy clay loam with strong play structure. It has a small percentage (<2%) of small sub-rounded coarse fragments. The field pH is 6.0. Clear change to;

The **lower surface soil** (A2) is a dark brown (7.5YR3/4) sandy light clay with moderate polyhedral structure. It also has a small percentage (<2%) of small sub-rounded coarse fragments, with a field pH of 5.5. Gradual change to;

The **upper subsoil** (B21) is a dark yellowish brown (10YR4/4) sandy light clay with moderate polyhedral structure. It has a small percentage (<2%) of small sub-rounded coarse fragments (these are consistent throughout the entire profile), with a field pH of 6.0. Sharp change to;

The **lower subsoil** (B22) is a dark yellowish brown (10YR4/6) medium heavy clay with moderate lenticular structure. It has a small percentage (<2%) of small sub-rounded coarse fragments, with a field pH of 7.0.

**Chemical and Physical Analysis**

**Table 13 Chemical Properties of the Cooinda SMU**

| Representative site: DP2 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Depth (m)** | **pH** | | **EC** | | **Cl** | **ESP%** | | **Moisture (%)** | **Emerson Class No.** |
| | **#** | **Rate** | **dS/m** | **Rate** | **mg/kg** | **%** | **Rate** | | |
| 0-0.1 | 5.6 | Moderately acid | 0.015 | Very low | <10 | 0.9 | Non-sodic | 4.2 | 3 |
| 0.2-0.3 | 5.7 | Moderately acid | 0.013 | Very low | 10 | 2.1 | Non-sodic | 6.0 | 3 |
| 0.5-0.6 | 6.8 | Neutral | 0.043 | Very low | 40 | 10.9 | Sodic | 10.0 | 3 |
| **Depth (m)** | **CEC** | | **Exchangeable Cations (meq/100g)** | | | | | **Ca/Mg Ratio** | |
| | **meq / 100g** | **Rate** | **Ca** | **Mg** | **K** | **Na** | | | |
| 0-0.1 | 4.4 | Very low | 1.9 | 2.0 | 0.4 | <0.1 | | 1.0 | |
| 0.2-0.3 | 4.6 | Very low | 1.5 | 2.6 | 0.2 | <0.1 | | 0.6 | |
| 0.5-0.6 | 9.8 | Low | 1.9 | 6.7 | 0.1 | 1.1 | | 0.3 | |
| **Percentage in Topsoil** | | | 43.18% | 45.45% | 9.09% | 0.9% | | - | |

The pH of the Cooinda SMU ranges from moderately acid (5.6) in the topsoil, to neutral (6.8) in the lower subsoil. EC is very low throughout the profile, with topsoil values of 0.015 dS/m, increasing to 0.043 dS/m in the subsoil. Chloride levels reflect EC, increasing from less than 10 mg/kg to 40 mg/kg with depth.

CEC increases down the soil profile, ranging from very low (4.4 meq/100g) in the topsoil to low (9.8 meq/100g) in the subsoil. An increase in clay content with depth likely contributes to this increase in CEC. Exchangeable cations are dominated by magnesium and calcium in the topsoil, then magnesium in the subsoil, resulting in a Ca/Mg ratio that decreases with depth from 1.0 to 0.3. Magnesium concentrations (meq/100g) are within acceptable ranges at all depths, though all other cations are either too low (calcium and potassium) or too high (sodium) to be considered appropriate for healthy plant growth.

ESP ranges from non-sodic (0.9%) in the topsoil layer, to sodic (10.9%) in the lower subsoil. Due to the moderate clay content within this soil, this ESP may impact the dispersive tendencies of the soil unit. This result is reflected in the unit's Emerson Class Numbers, which remain at the same level throughout the profile (3), suggesting that the soil unit may become dispersive if physically disturbed.

**Table 14 Surface Soil (0-10cm) Properties of the Cooinda SMU**

| Particle Size Analysis % | | | | Emerson Class No. | Nitrate (mg/kg) | Sulphate (mg/kg) | Organic Matter (%) |
|---|---|---|---|---|---|---|---|
| Gravel | Sand | Silt | Clay | | | | |
| 7 | 51 | 30 | 12 | 3 | 1.2 | <10 | 1 |
| Extractable Nutrients (mg/kg) | | | | Extractable Metals (mg/kg) | | | |
| P | K | B | | Cu | Fe | Mn | Zn |
| 15 | <200 | 0.4 | | <1.00 | 76.9 | 61.6 | 1.82 |

The surface soil (A1) for the Cooinda SMU is dominated by sand (51%), with 30% silt, 12% clay, and 7% gravel. It has a strong platy structure and is hard setting. The topsoil is non-sodic, with a Ca/Mg ratio of 1.0, and an organic matter content of 1.0%. This information paired with the topsoil's Emerson Class Number of 3 suggests that the soil may suffer from dispersion if physically disturbed. The mixture of particle sizes seen here will assist in stabilising the topsoil horizon, as pore spaces between sand grains may be infilled with the sand and silt fractions.

Nutrient levels are low, with nitrate (1.2 mg/kg), phosphorous (15 mg/kg) and potassium (<200 mg/kg) all below the guideline levels for plant life. Boron (0.4 mg/kg) and sulphate (<10 mg/kg) were also lower than desired. Extractable metals were found below suitable concentrations with zinc (1.82 mg/kg) the only trace element detected within the desirable range. Iron (76.9 mg/kg) and manganese (61.6 mg/kg) were both high enough to potentially impact plant health, while copper (<1.0 mg/kg) was below the desirable concentration.

## 4.5 ELLESMERE SOIL MANAGEMENT UNIT

**Soil Unit Description:** Hard setting soil associated with isolated hills of weathered tertiary surfaces (laterite). Textures within this unit grade from fine sandy loams in the surface soil to medium clays in the subsoil horizons. Dominant vegetation is *Acacia shirleyi*, with *Erythroxylon australe* in the shrub layer.

**Australian Soil Classification:** Red Dermosol.

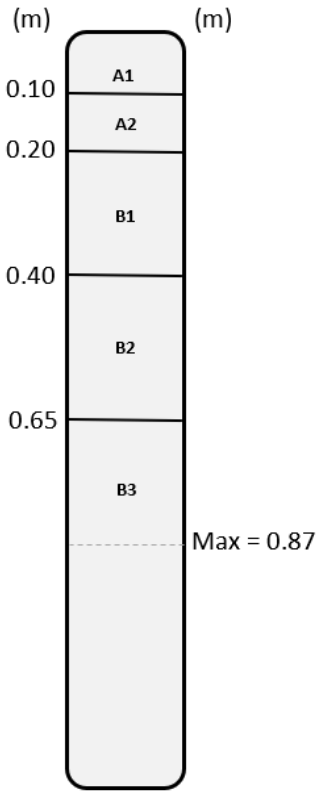
**Photo Plate 5 Ellesmere SMU Vegetation**

**Table 15 Ellesmere Soil Unit Description**

| Parameter | Soil Unit Description |
|---|---|
| **Profile Site Numbers** | DP40 |
| **Observation Site Numbers** | N/A |
| **Landform** | Isolated hills |
| **Land System** | Melbadale |
| **Slope** | 3-5% |
| **Geology** | Gyranda Subgroup (Pwy) – Late Permian sedimentary unit comprised of siltstone and shale with minor tuff and volcanilithic sandstone (lower part) |
| **Vegetation** | *Acacia shirleyi*, with *Erythroxylon australe* in the shrub layer. |
| **Runoff** | Slow |
| **Permeability** | Slowly permeable |
| **Drainage** | Moderately well drained |

**Profile Description – Representative Sites:** DP40

**Ellesmere SMU**




The **surface soil** (A1) is a dark brown (7.5YR3/4) fine sandy loam with moderate platy structure. It has a field pH of 5.0, with a gradual change to;

The **lower surface soil** (A2) is a dark brown (7.5YR3/4) sandy clay loam with grainy structure. It has a field pH is 4.5, with a gradual change to;

The **upper subsoil** (B1) is a brown (7.5YR4/4) light clay with grainy structure and a field pH of 4.5. Gradual change to;

The **mid-subsoil** (B2) is a yellowish red (5YR4/6) medium clay with moderate polyhedral structure. It has a field pH of 5.5, with a clear change to;

The **lower subsoil** (B3) is a light brown (7.5YR6/3) medium clay with moderate polyhedral structure. It has a field pH of 5.5.

**Chemical and Physical Analysis**

**Table 16 Chemical Properties of the Ellesmere SMU**

| Representative site: DP40 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Depth (m)** | **pH** | | **EC** | | **Cl** | **ESP%** | | **Moisture (%)** | **Emerson Class No.** |
| | **#** | **Rate** | **dS/m** | **Rate** | **mg/kg** | **%** | **Rate** | | |
| 0-0.1 | 4.6 | Very strongly acid | 0.02 | Very low | <10 | <0.1 | Non-sodic | 1.4 | 3 |
| 0.2-0.3 | 4.6 | Very strongly acid | 0.011 | Very low | <10 | 6.4 | Sodic | 3.4 | 3 |
| 0.5-0.6 | 5.1 | Strongly acid | 0.017 | Very low | <10 | 10.5 | Sodic | 11.8 | 4 |
| 0.8-0.9 | 5.5 | Strongly acid | 0.026 | Very low | <10 | 13.8 | Sodic | 10.0 | 4 |

| **Depth (m)** | **CEC** | | **Exchangeable Cations (meq/100g)** | | | | **Ca/Mg Ratio** |
|---|---|---|---|---|---|---|---|
| | **meq / 100g** | **Rate** | **Ca** | **Mg** | **K** | **Na** | |
| 0-0.1 | 2.3 | Very low | 0.4 | 0.2 | 0.2 | <0.1 | 2 |
| 0.2-0.3 | 2.2 | Very low | <0.1 | 0.2 | 0.1 | <0.1 | <0.1 |
| 0.5-0.6 | 5.7 | Very low | <0.1 | 1.7 | 0.1 | 0.2 | <0.1 |
| 0.8-0.9 | 6.9 | Low | <0.1 | 3.4 | 0.1 | 0.6 | <0.1 |
| **Percentage in Topsoil** | | | 17.39% | 8.70% | 8.70% | <0.1 | - |

The Ellesmere SMU is a highly acidic soil unit, ranging from 4.6 (very strongly acid) in the topsoil to 5.5 (strongly acid) in the lower subsoil layer. EC is very low throughout the profile, changing from 0.02 dS/m in the topsoil, to 0.026 dS/m in the lower subsoil. Chloride concentrations are very low, consistently presenting at <10 mg/kg.

CEC increases progressively with depth, ranging from very low in the topsoil (2.3 meq/100g) to low in the subsoil (6.9 meq/100g). Corresponding exchangeable cation concentrations are also low, the only values within the appropriate range being magnesium in the bottom two horizons, and potassium in the topsoil. Calcium dominated magnesium in the surface soil layer (Ca/Mg = 2.0), though this was reversed in the subsoil (Ca/Mg = <0.1), where Mg comprises 49.28% of the exchangeable cations, with Ca below reportable levels. These low levels of exchangeable cations may be limiting plant growth.

While sodium concentrations are within the commonly measured levels at all depths, ESP ranges from <0.1% (non-sodic) in the topsoil layer to 13.8% (sodic) in the lower subsoil, becoming sodic at 0.2 m depth. This unit has a moderate clay content in the subsoil layers, though has a very low/low CEC. For this reason, the impact of sodicity is less pronounced than it would be in a soil with high CEC, as sodium atoms cannot effectively separate the clay particles within the soil. This interpretation is reflected in the unit's Emerson Class Numbers, which range from 3 in the surface soil (dispersive if disturbed) to 4 in the subsoil layers (non-dispersive).

**Table 17 Surface Soil (0-10 cm) Properties of the Ellesmere SMU**

| Particle Size Analysis % | | | | Emerson Class No. | Nitrate (mg/kg) | Sulphate (mg/kg) | Organic Matter (%) |
|---|---|---|---|---|---|---|---|
| Gravel | Sand | Silt | Clay | | | | |
| 3 | 68 | 19 | 10 | 3 | 1.6 | <10 | 5 |
| Extractable Nutrients (mg/kg) | | | | Extractable Metals (mg/kg) | | | |
| P | K | | B | Cu | Fe | Mn | Zn |
| 6 | 532 | | 0.4 | <1.00 | 327 | 3.13 | <1.00 |

The surface soil (A1) is dominated by sand (68%), with 19% silt, 10% clay, and 3% gravel. It has a moderate, platy structure and is hard setting. The topsoil is non-sodic, with a Ca/Mg ratio of 2.0, and a high organic matter content of 5%. This information paired with the topsoil's Emerson Class Number of 3, suggests that the surface soil is unlikely to suffer from dispersion if it is not physically disturbed.

Nutrient levels for this SMU are variable. Nitrate (1.6 mg/kg) and phosphorous (6 mg/kg) were both below desirable levels, while potassium (535 mg/kg) was extremely high for both grazing and cropping land uses. Both sulphate (<10 mg/kg) and boron (0.4 mg/kg) were lower than desired. Extractable metals were generally unsuitable, with only manganese (3.13 mg/kg) within the appropriate range. Copper and zinc were both below reportable levels, while iron (327 mg/kg) concentrations were significantly elevated.

Elevated iron levels such as these can cause toxicity to plants and limit their photosynthetic efficiency. They can also limit the uptake of phosphorous, which is already below the ideal concentration. In addition to this, acidic pH values such as those seen in this SMU can limit the availability of all metals and nutrients to plants, by increasing toxicity, reducing solubility and altering elemental speciation.

## 4.6 GEOFFREY SOIL MANAGEMENT UNIT

**Soil Unit Description:** This unit consists of texture contrast soils with soft surface conditions, associated with undulating plains and rises. Textures range from loamy sands to sandy light clays, overlying sandy medium clays with conspicuous orange or red mottling. Where these soils were exposed due to insufficient groundcover, extensive washouts and large erosion gullies were observed. In these areas, overland flow had removed coarse sandy material, leaving the easily eroded clays exposed to surface runoff. The Geoffrey SMU was often cleared, though when present dominant vegetation included *Eucalyptus crebra*, *Melaleuca leucadendra*, *Casuarina cunninghamiana* and *Corymbia clarksoniana*, with *Alphitonia excelsa*, *Petalostigma pubecens*, and *Acacia rhodoxylon* in the shrub layer.

**Australian Soil Classification:** Brown Sodosol.

**Photo Plate 6 Geoffrey SMU Vegetation (showing cleared and vegetated sections)**

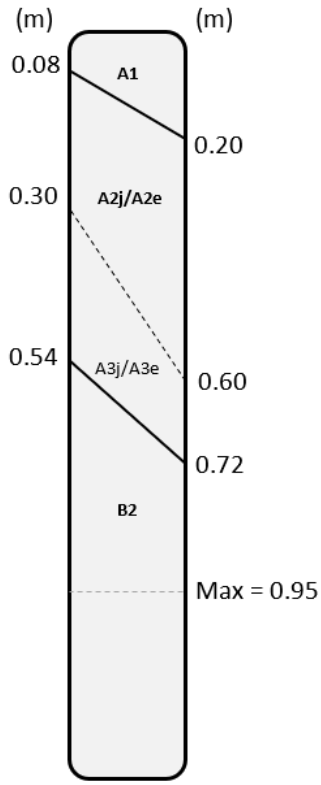
**Table 18 Geoffrey Soil Unit Description**

| Parameter | Soil Unit Description |
|---|---|
| **Profile Site Numbers** | DP1, DP5, DP7, DP8, DP9, DP12, DP13, DP15, DP18, DP19, DP20, DP30, DP32, DP33, DP38, DP39, DP42, DP44, DP45, DP49, DP53, DP54, DP55, DP56, DP57, DP58 |
| **Observation Site Numbers** | DO2, DO3, DO9, DO11-DO14, DO22, DO29, DO30, DO33, DO46, DO51-DO53, DO58, DO59, DO61-DO65, DO70, DO71, DO77, DO78, DO80-DO82, DO86, DO88-DO94, DO103, DO109, DO111-DO116, DO200, DO213, DO216-DO218, DO221, DO226-DO230, DO232, DO238-DO241, DO245-DO247, DO249, DO251, DO252, DO254, DO256-DO258, DO260-DO263, DO265 |
| **Landform** | Undulating plains and hills |
| **Land System** | Melbadale |
| **Slope** | 1 to 5% |
| **Geology** | Duaringa Formation (Tu) – Eocene-Oligocene mudstone, sandstone, conglomerate, siltstone, oil shale, lignite and basalt |

| Parameter | Soil Unit Description |
|---|---|
| **Vegetation** | *Eucalyptus crebra, Melaleuca leucadendra, Casuarina cunninghamiana* and *Corymbia clarksoniana*, with *Alphitonia excelsa*, *Petalostigma pubecens*, and Acacia rhodoxylon in the shrub layer. |
| **Runoff** | Slow to Rapid |
| **Permeability** | Very slowly permeable |
| **Drainage** | DP1, DP5, DP7, DP8, DP9, DP12, DP13, DP15, DP18, DP19, DP20, DP30, DP32, DP33, DP38, DP39, DP42, DP44, DP45, DP49, DP53, DP54, DP55, DP56, DP57, DP58 |

**Profile Description – Representative Sites:** DP1, DP5, DP7, DP30, DP32

**Geoffrey SMU**




The **surface soil** (A1) is a pale brown to brown (10YR6/3, 7.5YR4/4, 7.5YR4/3) sand to fine sandy loam with massive or grainy structure. This horizon has a field pH of 5.5 to 6.0, with a gradual change to;

The **mid-surface soil** (A2j/A2e) is a brown (7.5YR4/3, 7.5YR5/4, 10YR5/3) sand to fine sandy clay loam with sporadic or conspicuous bleaching. It has a massive to grainy structure and a field pH of 5.5 to 6.0. At some sites, this horizon had an abrupt change to B2, though at other sites had a gradual change to;

The **lower surface soil** (A3j/A3e) was not present at all sites. It is a sporadically or conspicuously bleached pale brown to pink (10YR6/3, 5YR7/3) sand to light sand. It has a grainy structure with a field pH of 6.0 to 6.5. Where present, this horizon has an abrupt change to;

The **subsoil** (B2) is very easy to differentiate from the overlying horizons. It is a yellowish brown to greyish brown (10YR6/4, 10YR5/2, 10YR4/6) medium clay, with moderate lenticular structure. Field pH is 6.0 to 7.5. This horizon continues to great depths, and exhibits distinct yellow, orange and red mottles.

**Chemical and Physical Analysis**

**Table 19 Chemical Properties of the Geoffrey SMU**

| Representative site: DP1 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Depth (m)** | **pH** | | **EC** | | **Cl** | **ESP%** | | **Moisture (%)** | **Emerson Class No.** |
| | **#** | **Rate** | **dS/m** | **Rate** | **mg/kg** | **%** | **Rate** | | |
| 0-0.1 | 5.8 | Moderately acid | 0.026 | Very low | 20 | 1.0 | Non-sodic | 2.7 | 4 |
| 0.2-0.3 | 5.6 | Moderately acid | 0.006 | Very low | <10 | 1.8 | Non-sodic | 0.8 | 4 |
| 0.5-0.6 | 6.0 | Moderately acid | 0.004 | Very low | <10 | 8.2 | Sodic | 0.8 | 4 |
| 0.8-0.9 | 8.1 | Moderately alkaline | 0.137 | Low | 110 | 22.1 | Strongly sodic | 9.0 | 1 |

| **Depth (m)** | **CEC** | | **Exchangeable Cations (meq/100g)** | | | | **Ca/Mg Ratio** |
|---|---|---|---|---|---|---|---|
| | **meq / 100g** | **Rate** | **Ca** | **Mg** | **K** | **Na** | |
| 0-0.1 | 1.7 | Very low | 0.7 | 0.7 | 0.3 | <0.1 | 1.0 |
| 0.2-0.3 | 0.8 | Very low | 0.2 | 0.2 | 0.2 | <0.1 | 1.0 |
| 0.5-0.6 | 0.4 | Very low | 0.1 | 0.2 | <0.1 | <0.1 | 0.5 |
| 0.8-0.9 | 8.8 | Low | 0.9 | 5.9 | <0.2 | 2.0 | <0.2 |
| **Percentage in Topsoil** | | | 41.18% | 41.18% | 17.65% | 1.00% | - |

Due to the stark difference in textures between the topsoil and subsoil layers, pH for the Geoffrey SMU changes quite dramatically down the soil profile. Sandy, massive horizons (0.0 to 0.6 m) are moderately acid, with pH increasing with depth from 5.8 to 6.0. The clay B2 horizon has a pH value over two units higher (8.1) and is classified as 'moderately alkaline'. This is likely due to the increased CEC of the clay in the B2 horizon compared with the sand in the upper horizons (A1, A2 and A3). In addition to this, salts are held in the subsoil layers, resulting in an increase in EC, chloride, and sodicity (evidenced by the ESP) in the B2 layer.

The clay-rich subsoil present a higher CEC, due to its elevated clay content. It is likely that if exposed, the subsoil (B2) would become dispersive, while the surface soil horizons (A1, A2 and A3) would remain non-dispersive. This interpretation is supported by the unit's Emerson Class numbers, which change from 4 (non-dispersive) for the topsoil layers, to 1 (extremely dispersive) for the subsoil. The dispersive tendencies of the B2 horizon may be further exacerbated by the low Ca/Mg ratio in this layer (<0.2).

Low concentrations of exchangeable cations were observed in this unit. In the surface soil, calcium and magnesium were relatively equally represented, though concentrations of these cations were extremely limited. Increased levels of some of the major cations were observed in the subsoil, these were dominated by magnesium (67.1%) and sodium (22.1%), with calcium and potassium at similar levels to observed levels in the A horizons. These low levels of calcium in comparison to magnesium in the B2 horizon further increases the susceptibility of this layer to dispersion upon wetting.

The Geoffrey soil unit also lends itself to storage of water above the B2 horizon due to the low permeability of the clay sub-soil layers..

**Table 20 Surface Soil (0-10cm) Properties of the Geoffrey SMU**

| Particle Size Analysis % | | | | Emerson Class No. | Nitrate (mg/kg) | Sulphate (mg/kg) | Organic Matter (%) |
|---|---|---|---|---|---|---|---|
| **Gravel** | **Sand** | **Silt** | **Clay** | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 65 | 25 | 9 | 4 | 3 | <10 | 1.8 |
| **Extractable Nutrients (mg/kg)** | | | | **Extractable Metals (mg/kg)** | | | |
| **P** | **K** | | **B** | **Cu** | **Fe** | **Mn** | **Zn** |
| 8 | <200 | | 0.2 | <1.00 | 166 | 16.0 | 2.16 |

The surface soil (A1) is dominated by sand (65%) with 25% silt, 9% clay, and 1% gravel. It has grainy texture, and a soft surface condition. The topsoil is non-sodic, with a Ca/Mg ratio of 1.0, and an organic matter content of 1.8%. The soil has an Emerson Class of 4, indicating that the topsoil unit is unlikely to become dispersive when wetted. Sandy soils such as these are often less susceptible to erosion, due to the large particle size of the sand grains, and their low CEC.

Topsoil nutrients for the Geoffrey SMU are generally quite limited, with nitrate (3 mg/kg), phosphorous (8 mg/kg) and potassium (<200 mg/kg) below desirable levels. Boron (0.2 mg/kg) and sulphate (<10 mg/kg) are also lower than guideline recommendations for suitable plant growth medium. For extractable metals, manganese (16.0 mg/kg) and zinc (2.16 mg/kg) are within the desirable range, though iron (166 mg/kg) is elevated, and copper (<1.0 mg/kg) is below reportable levels. These low levels of nutrients are likely due to the low CEC and leaching capacity of sand, paired with the nutrient content of the parent material.

## 4.7 JAMES SOIL MANAGEMENT UNIT

**Soil Unit Description:** Hard setting red soils associated with hills and rises. Textures within this unit vary depending on slope, with lesser developed soils found on crests (sandy clay loams to clay loams) and more developed/deeper soils found on mid slopes (clay loams to light medium clays). Dominant vegetation includes *Acacia rhodoxylon, Eucalyptus crebra,* and *Corymbia clarksoniana.*

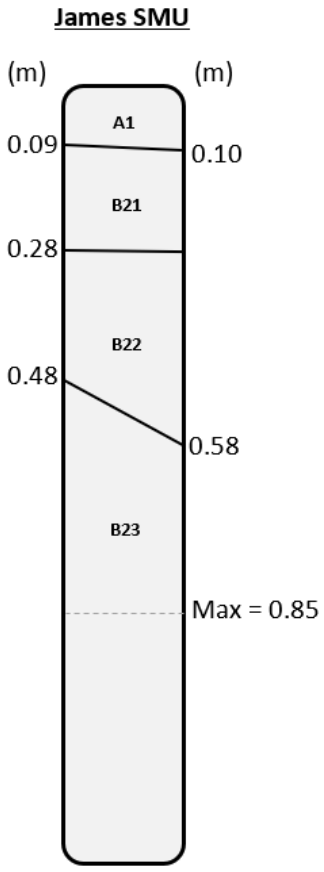
**Australian Soil Classification:** Red Dermosol.

**Photo Plate 7 James SMU Vegetation**

**Table 21 James Soil Unit Description**

| Parameter | Soil Unit Description |
|---|---|
| **Profile Site Numbers** | DP17, DP16.1 |
| **Observation Site Numbers** | DO39, DO40, DO42, DO253 |
| **Landform** | Hills and rises |
| **Land System** | Melbadale |
| **Slope** | 4 to 6% |
| **Geology** | Td-QLD (Td) – Tertiary duricrusted palaeosols at the top of deep weathering profiles, including ferricrete and silcrete; duricrusted old land surfaces. |
| **Vegetation** | *Acacia rhodoxylon, Eucalyptus crebra,* and *Corymbia clarksoniana*. |
| **Runoff** | Moderate to rapid |
| **Permeability** | Moderately permeable |
| **Drainage** | Moderately to well drained |

**Profile Description – Representative Sites:** DP17 & DP16.1




The **surface soil** (A1) is a dark reddish brown (5YR3/4) sandy clay loam to clay loam with weak to moderate platy structure. Profiles with higher relief may have a small number of sub-rounded coarse fragments. This horizon has a pH of 6.0, with a gradual change to;

The **upper subsoil** (B21) varies in texture depending on relief within the landscape. Profiles with high relief (crests) exhibit a dark red (2.5YR3/6) clay loam, with a grainy structure and a significant amount (10-20%) of small sub-rounded coarse fragments. Lower relief profiles (slopes) are a dark reddish-brown (5YR3/4) light medium clay with weak angular blocky structure and no coarse fragments. Both variations of this horizon have a pH of 6.0, with a gradual change to;

The **mid-subsoil** (B22) is also variable in texture depending on relief. High relief (crest) examples are dark red in colour (2.5YR3/6) with a clay loam texture and a large amount (50-90%) of small sub-rounded coarse fragments. Lower relief profiles (slopes) are also dark red in colour (2.5YR3/6) with light clay texture, and no coarse fragments. Both versions of this horizon have a pH of 6.0, and moderate structure, with lower relief profiles gradually changing to;

The **lower subsoil** (B23) is only present on the lower slopes of the James SMU, where deeper clays have had the opportunity to develop. It is dark red in colour (2.5YR3/6), with a light medium clay texture, moderate lenticular structure and no coarse fragments. Field pH is 6.5.

**Chemical and Physical Analysis**

**Table 22 Chemical Properties of the James SMU**

| Representative site: DP17 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Depth (m)** | **pH** | | **EC** | | **Cl** | **ESP%** | | **Moisture (%)** | **Emerson Class No.** |
| | **#** | **Rate** | **dS/m** | **Rate** | **mg/kg** | **%** | **Rate** | | |
| 0-0.1 | 6.2 | Slightly acid | 0.013 | Very low | <10 | 0.4 | Non-sodic | 1.5 | 8 |
| 0.2-0.3 | 6.1 | Slightly acid | 0.006 | Very low | <10 | 0.7 | Non-sodic | 7.0 | 3 |
| 0.5-0.6 | 6.4 | Slightly acid | 0.015 | Very low | <10 | 1.4 | Non-sodic | 10.2 | 4 |

| **Depth (m)** | **CEC** | | **Exchangeable Cations (meq/100g)** | | | | **Ca/Mg Ratio** |
|---|---|---|---|---|---|---|---|
| | **meq / 100g** | **Rate** | **Ca** | **Mg** | **K** | **Na** | |
| 0-0.1 | 4.3 | Very low | 2.0 | 1.8 | 0.4 | <0.1 | 1.1 |
| 0.2-0.3 | 5.9 | Very low | 3.1 | 2.4 | 0.3 | <0.1 | 1.3 |
| 0.5-0.6 | 5.8 | Very low | 2.4 | 3.2 | <0.1 | <0.1 | 0.8 |
| **Percentage in Topsoil** | | | 46.51% | 41.86% | 9.30% | 0.40% | - |

pH in the James SMU is slightly acidic throughout the profile, with very little variation. It increases gradually with depth from 6.2 in the topsoil, to 6.4 in the lower subsoil. EC is very low at all depths, ranging from 0.013 dS/m in the topsoil to 0.015 dS/m in the subsoil. Chloride levels reflect this result, presenting at <10 mg/kg throughout the profile.

CEC remains fairly consistent with depth, ranging from 4.3 meq/100g (very low) in the topsoil to 5.8 meq/100g (very low) in the subsoil. Despite this, concentrations of available cations are within the acceptable ranges, with the exception of potassium in the lower subsoil, which is below reportable levels. In the topsoil, exchangeable cations are dominated by calcium (46.51%) and magnesium (41.86%) in roughly equal amounts (Ca/Mg = 1.1). The mid-stratum layer sees this ratio increase to 1.3, before dropping in the subsoil layer to 0.8.

ESP is considered non-sodic throughout the profile, ranging from 0.4% in the topsoil layer to 1.4% in the lower subsoil. This ESP isn't likely to impact the dispersive tendencies of the soil unit. This interpretation is confirmed by the unit's Emerson Class Numbers, which range from 8 (non-dispersive) in the surface soil, to 3 (dispersive if disturbed) in the mid-stratum, to 4 (non-dispersive) in the subsoil layer.

**Table 23 Surface Soil (0-10 cm) Properties of the James SMU**

| Particle Size Analysis % | | | | Emerson Class No. | Nitrate (mg/kg) | Sulphate (mg/kg) | Organic Matter (%) |
|---|---|---|---|---|---|---|---|
| Gravel | Sand | Silt | Clay | | | | |
| 6 | 56 | 21 | 17 | 8 | 1.1 | <10 | 2.8 |
| **Extractable Nutrients (mg/kg)** | | | | **Extractable Metals (mg/kg)** | | | |
| P | K | B | | Cu | Fe | Mn | Zn |
| 14 | <200 | 0.3 | | <1.00 | 21.4 | 18.7 | <1.00 |

The surface soil (A1) is dominated by sand (56%) with 21% silt, 17% clay, and 6% gravel. It has moderate, platy structure, and a hard setting surface. The topsoil is non-sodic, with a Ca/Mg ratio of 1.1, and an organic matter content of 2.8%. This favourable chemistry combination, paired with the topsoil's Emerson Class Number of 8, suggests that the surface soil is unlikely to suffer from dispersion. The water-holding capacity of the topsoil is relatively poor, due to the lack of clay sized particles. This is evidenced by the increase in moisture content with depth (as seen in Table 22).

Nutrient availability within the James SMU is generally limited. Nitrate (1.1 mg/kg), phosphorous (14 mg/kg) and potassium (<200 mg/kg) are all well below the desirable concentrations, with sulphate (<10 mg/kg) and boron (0.3 mg/kg) also low. Extractable metals vary in concentration. While, iron (21.4 mg/kg) and manganese (18.7 mg/kg) are both within the suitable range for plant life, copper and zinc are below reportable levels.

It is noted that the soil profile examined here represents a mid-slope site on the James SMU, with profiles higher in the landscape (e.g. hill crests) typically possessing shallower subsoils, lower CECs and reduced nutrient concentrations.

## 4.8 KOSH SOIL MANAGEMENT UNIT

**Soil Unit Description:** Hard setting soil associated with alluvial plains, plains and low rises. Textures within this unit are gradational, changing from sandy clay loams and light clays in the topsoil, to medium heavy clays in the lower subsoil. Commonly, this unit was cleared for grazing, with regrowth consisting of scrub species including *Vachellia nilotica*, *Cassia spinarum, Capparis lasiantha, Cassia brewsteri*, and various Eucalyptus shrubs. When present, vegetation included *Eucalyptus tereticornis, Acacia hemiglauca, Acacia salicina, Lysiphyllum hookeri, Eucalyptus crebra* and *Eucalyptus populnea*.

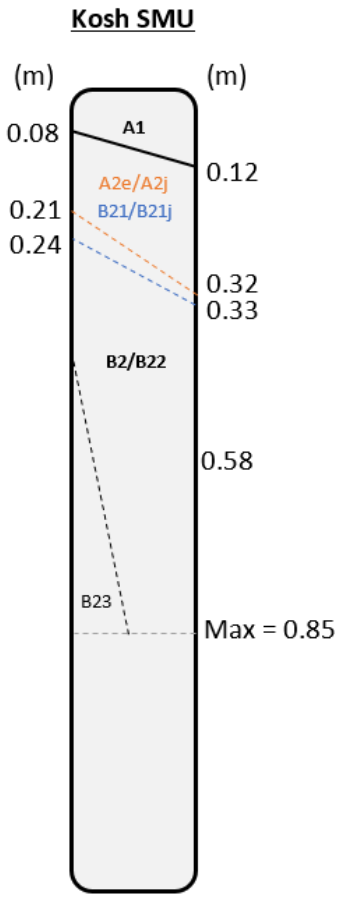
**Australian Soil Classification:** Brown Dermosol

**Photo Plate 8 Kosh SMU Vegetation (cleared)**

**Table 24 Kosh Soil Unit Description**

| Parameter | Soil Unit Description |
|---|---|
| **Profile Site Numbers** | DP16.2, DP21, DP22, DP23, DP25, DP27, DP31, DP34, DP35, DP41, DP47, DP59 |
| **Observation Site Numbers** | DO34, DO35, DO37, DO38, DO67, DO73, DO201, DO204, DO231, DO250, DO255 |
| **Landform** | Alluvial plains, plains and rises |
| **Land System** | Dingo |
| **Slope** | 1 to 4% |
| **Geology** | Qa-QLD (Qa) – Quaternary clay, silt, sand and gravel; flood-plain alluvium |
| **Vegetation** | Cleared - *Vachellia nilotica, Cassia spinarum, Capparis lasiantha, Cassia brewsteri*<br>Vegetated - *Eucalyptus tereticornis, Acacia hemiglauca, Acacia salicina, Lysiphyllum hookeri, Eucalyptus crebra* and *Eucalyptus populnea*. |
| **Runoff** | Very slow to rapid |
| **Permeability** | Slowly permeable |
| **Drainage** | Poorly drained |

**Profile Description – Representative Sites:** DP23, DP34, DP35, DP47




The **surface soil** (A1) is a brown to dark reddish brown (7.5YR4/3, 10YR3/3, 5YR3/3) sandy clay-loam to medium clay with weak to massive structure. Field pH of 6.0 to 6.5, with clear/gradual change to;

The **lower surface soil** (A2e/A2j) is a sporadically or conspicuously bleached horizon present at approximately half of the profile sites. It is a pale brown to brown (10YR6/3, 7.5YR4/3) sandy clay-loam to medium clay that usually has massive structure (though can be weak angular blocky), with a field pH of 6.0 to 7.0. When present, this layer has a clear or gradual change to;

The **upper subsoil** (B21/B21j) was not present at all sites. When present this horizon can exhibit sporadic bleaching. It is a brown to dark reddish brown (7.5YR4/4, 5YR3/2) medium heavy clay with weak to moderate angular blocky structure. This horizon has a field pH of 6.0 to 7.0, with a clear or gradual change to;

The **subsoil** (B2/B22) is variable in colour, presenting as a dark brown, dark reddish, or yellowish brown colour (7.5YR3/3, 5YR3/3, 10YR5/6). Soil texture is a medium heavy clay, with moderate lenticular structure. pH gradually increased with depth at all sites, ranging from 7.0 to 9.0, sometimes within the same soil profile. This layer can extend to great depths, otherwise exhibiting a gradual change to;

The l**ower subsoil** (B23) was only observed at two sites. It is a dark brown (7.5YR3/4) medium heavy clay with moderate lenticular structure, and a field pH ranging from 6.5 to 7.5 (increasing with depth).

## Chemical and Physical Analysis

**Table 25 Chemical Properties of the Kosh SMU**

| Representative site: DP34 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Depth (m)** | **pH** | | **EC** | | **Cl** | **ESP%** | | **Moisture (%)** | **Emerson Class No.** |
| | **#** | **Rate** | **dS/m** | **Rate** | **mg/kg** | **%** | **Rate** | | |
| 0-0.1 | 6.3 | Slightly acid | 0.036 | Very Low | <10 | 0.6 | Non-sodic | 2.8 | 4 |
| 0.2-0.3 | 7.7 | Slightly alkaline | 0.083 | Very Low | 60 | 13.2 | Sodic | 7.1 | 2 |
| 0.5-0.6 | 8.5 | Strongly alkaline | 0.415 | Medium | 490 | 19.5 | Strongly sodic | 9.0 | 2 |
| **Depth (m)** | **CEC** | | | **Exchangeable Cations (meq/100g)** | | | | **Ca/Mg Ratio** | |
| | **meq / 100g** | **Rate** | | **Ca** | **Mg** | **K** | **Na** | | |
| 0-0.1 | 6.8 | Low | | 4.4 | 1.7 | 0.6 | <0.1 | 2.6 | |
| 0.2-0.3 | 13.3 | Moderate | | 4.4 | 6.9 | 0.2 | 1.8 | 0.6 | |
| 0.5-0.6 | 17.4 | Moderate | | 4.1 | 9.7 | <0.2 | 3.4 | 0.4 | |
| **Percentage in Topsoil** | | | | 64.71% | 25.00% | 8.82% | 0.60% | - | |

The pH within the Kosh SMU is highly variable, changing from 6.3 (slightly acid) in the topsoil to 8.5 (strongly alkaline) in the lower subsoil. EC follows a similar pattern, changing from very low between 0.0 and 0.3 m depth, to medium in the subsoil. Chloride concentration also increases significantly with depth, ranging from <10 mg/kg in the topsoil, to 490 mg/kg in the subsoil layer. High chloride concentrations such as these can impact a plant's osmotic capacity, impacting its ability to access water and nutrients.

CEC increases with depth from low (6.8 meq/100g) to moderate (17.4 meq/100g), likely due to the increased clay content in the subsoil layers. Exchangeable cations within the topsoil are dominated by calcium (64.71%) and magnesium (25.00%), with potassium at 8.82%. These concentrations and ratios are considered appropriate for plant growth, though become less so with depth. While calcium remains relatively consistent throughout the profile, magnesium and sodium concentrations continue to increase, eventually contributing to 55.75% and 19.5% of the total CEC, respectively. The Ca/Mg ratio drops from 2.6 in the topsoil, to 0.4 in the lower subsoil layer. This is detrimental to the ability of the soil to maintain its integrity upon exposure, significantly increasing the subsoil's potential erodibility.

ESP for this SMU increases progressively with depth, changing from non-sodic (0.6%) in the topsoil to strongly sodic (19.5%) in the lower subsoil. Due to the high clay content in the lower horizons, the elevated ESP observed here is likely to impact the dispersive tendencies of the soil unit. This interpretation is reflected in the sample's Emerson Class Numbers, which range from 4 in the surface soil (non-dispersive) to 2 in the subsoil (moderately dispersive).

It is likely that subsoils in this unit would be considerably erosive.

**Table 26 Surface Soil (0-10 cm) Properties of the Kosh SMU**

| Particle Size Analysis % | | | | Emerson Class No. | Nitrate (mg/kg) | Sulphate (mg/kg) | Organic Matter (%) |
|---|---|---|---|---|---|---|---|
| Gravel | Sand | Silt | Clay | | | | |
| 4 | 63 | 24 | 9 | 4 | 2.5 | <10 | 4 |
| Extractable Nutrients (mg/kg) | | | | Extractable Metals (mg/kg) | | | |
| P | K | B | | Cu | Fe | Mn | Zn |
| 13 | <200 | 0.4 | | <1.00 | 32.4 | 17.5 | 1.20 |

The topsoil layer (A1) for the Kosh SMU is dominated by sand-sized particles (63%), with 24% silt, 9% clay, and 4% gravel. It has a weak structure, with a hard setting surface. The surface soil is non-sodic, with a Ca/Mg ratio of 2.6, and an organic matter content of 4%. This means the topsoil has favourable chemistry in terms of dispersion, evidenced by the unit's Emerson Class of 4 (non-dispersive). This topsoil is particularly significant for this SMU, as it protects the underlying sodic clay from erosion.

Nutrient content within this topsoil is quite poor. Nitrate (2.5 mg/kg), phosphorous (13 mg/kg) and potassium (<200 mg/kg) are all below suitable levels, as are sulphate (<10 mg/kg) and boron (0.4 mg/kg). Extractable metal concentrations are adequate, with only copper below the required concentration.

## 4.9 NAMOI SOIL MANAGEMENT UNIT

**Soil Unit Description:** Hard setting soil associated with hills and rises. Textures within this unit are gradational, changing from a sandy clay loam in the topsoil to a light medium clay in the subsoil. Dominant vegetation includes *Eucalyptus crebra,* with *Heteropogon contortus* and juvenile Acacia species.

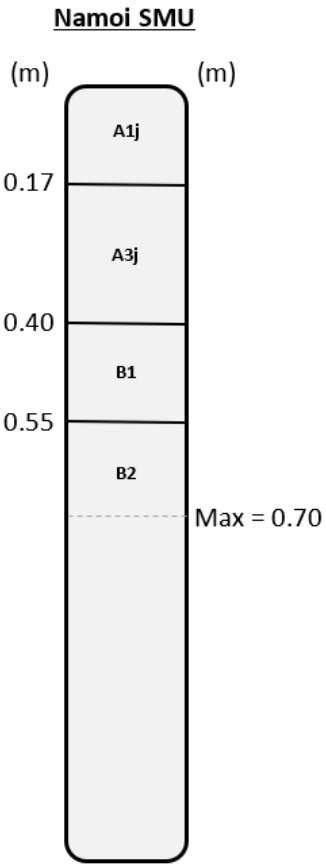
**Australian Soil Classification:** Red Dermosol

**Photo Plate 9 Namoi SMU Vegetation**

**Table 27 Namoi Soil Unit Description**

| Parameter | Soil Unit Description |
|---|---|
| **Profile Site Numbers** | DP3 |
| **Observation Site Numbers** | DO1 |
| **Landform** | Hills and rises |
| **Land System** | Melbadale |
| **Slope** | 4% |
| **Geology** | Rewan Group (Rr) – Early Triassic – Middle Triassic sedimentary unit comprised of lithic sandstone, pebbly lithic sandstone, green to reddish brown mudstone and minor volcanilithic pebble conglomerate (at base) |
| **Vegetation** | *Eucalyptus crebra*, with *Heteropogon contortus* and juvenile Acacia species. |
| **Runoff** | Rapid |
| **Permeability** | Slowly permeable |
| **Drainage** | Moderately well drained |

**Profile Description – Representative Sites:** DP3.




The **surface soil** (A1j) is a dark brown (7.5YR3/4) sandy clay-loam with sporadic bleaching. It has a moderate lenticular structure, and a field pH of 5.0. Clear change to;

The **lower surface soil** (A3j) is a reddish brown (5YR4/4) sandy clay-loam+ with sporadic bleaching. It has a weak angular blocky structure, and a field pH of 5.5. Gradual change to;

The **upper subsoil** (B1) is a yellowish red (5YR4/6) light clay with weak angular blocky structure, and a field pH of 6.0. Gradual change to;

The **lower subsoil** (B2) is a yellowish red (5YR5/8) light medium clay with moderate polyhedral structure, and a field pH of 6.5. It may contain a small number (<2%) of subangular coarse fragments and faint red mottling.

**Chemical and Physical Analysis**

**Table 28 Chemical Properties of the Namoi SMU**

| Representative site: DP3 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Depth (m)** | **pH** | | **EC** | | **Cl** | **ESP%** | | **Moisture (%)** | **Emerson Class No.** |
| | **#** | **Rate** | **dS/m** | **Rate** | **mg/kg** | **%** | **Rate** | | |
| 0-0.1 | 5.7 | Moderately acid | 0.011 | Very Low | <10 | 0.6 | Non-sodic | 2.8 | 3 |
| 0.2-0.3 | 5.5 | Strongly acid | 0.008 | Very Low | <10 | 1.8 | Non-sodic | 3.2 | 3 |
| 0.5-0.6 | 6.1 | Slightly acid | 0.007 | Very Low | <10 | 4.1 | Non-sodic | 6.6 | 3 |
| **Depth (m)** | **CEC** | | | **Exchangeable Cations (meq/100g)** | | | | **Ca/Mg Ratio** | |
| | **meq / 100g** | **Rate** | | **Ca** | **Mg** | **K** | **Na** | | |
| 0-0.1 | 2.0 | Very low | | 1.0 | 0.6 | 0.2 | <0.1 | 1.7 | |
| 0.2-0.3 | 1.9 | Very low | | 0.8 | 0.8 | <0.1 | <0.1 | 1.0 | |
| 0.5-0.6 | 3.0 | Very low | | 0.7 | 2.1 | <0.1 | 0.1 | 0.3 | |
| **Percentage in Topsoil** | | | | 50.00% | 30.00% | 10.00% | 0.60% | - | |

The Namoi SMU has a pH that is most acidic in the upper subsoil (5.5), with a moderately acidic topsoil (5.7), and a slightly acidic lower subsoil (6.1). EC is very low at all depths, ranging from 0.01 dS/m in the topsoil, to 0.007 dS/m in the subsoil horizon. Chloride concentration reflects this result, presenting at <10 mg/kg at all depths.

CEC is also very low throughout the profile, changing from 2.0 meq/100g in the surface horizons, to 3.0 meq/100g in the subsoil layer. Exchangeable cations were found at concentrations below desirable, with calcium at 1.0 mg/kg, and magnesium at 0.6 mg/kg. Topsoil potassium however (0.2 mg/kg), meets the required concentration. Calcium levels decrease with depth, while magnesium increases, such that the lower subsoil has a Ca/Mg ratio of 0.3. This could exacerbate soil dispersion if ESP was high, though in this case should not reduce soil cohesion. Overall, exchangeable cation concentrations do not reflect the optimal ranges expected of a healthy soil, which may be affecting plant health within this SMU.

ESP is considered non-sodic throughout the profile, ranging from 0.6 to 4.1% with depth. The entire profile has an Emerson Class of 3, meaning that the soil should remain non-dispersive unless it is physically disturbed.

**Table 29 Surface Soil (0-10 cm) Properties of the Namoi SMU**

| Particle Size Analysis % | | | | Emerson Class No. | Nitrate (mg/kg) | Sulphate (mg/kg) | Organic Matter (%) |
|---|---|---|---|---|---|---|---|
| Gravel | Sand | Silt | Clay | | | | |
| 3 | 64 | 21 | 12 | 3 | 1.7 | <10 | 0.8 |
| Extractable Nutrients (mg/kg) | | | | Extractable Metals (mg/kg) | | | |
| P | K | B | | Cu | Fe | Mn | Zn |
| 7 | <200 | 0.2 | | <1.00 | 86.3 | 43.7 | 2.09 |

The surface soil (A1j) has a high concentration of sand (64%), with 21% silt, 12% clay, and 3% gravel. It has moderate, lenticular structure, and is hard setting. The topsoil is non-sodic, with a Ca/Mg ratio of 1.7, and an organic matter content of 0.8%. Low organic matter levels combined with high sand percentages, means that the topsoil for Namoi is likely to have a low water holding capacity. The Emerson Class Number is 3, meaning that the surface soil horizon may become dispersive when wetted, if physically disturbed through stripping or tillage.

Nutrient levels are generally low, with nitrate (1.7 mg/kg), phosphorous (7 mg/kg) and potassium (<200 mg/kg) all below the desirable concentrations. Sulphate (<10 mg/kg) and boron (0.2 mg/kg) are also lower than expected for soils supporting plant growth. Extractable metals are generally unsuitable, with only zinc (2.09 mg/kg) within the acceptable range. Variable concentrations of nutrients and metals could limit vegetation type and plant growth within the Namoi SMU.

## 4.10 NIGEL SOIL MANAGEMENT UNIT

**Soil Unit Description:** Hard setting soil associated with isolated high relief areas of tertiary land surface. Textures within this unit are rudimentary, grading from sands to sandy light clays. Vegetation is variable between sites, but includes *Acacia shirleyi, Acacia rhodoxylon, Eucalyptus crebra, Melaleuca leucadendra, Corymbia clarksoniana,* and *Eucalyptus tessellaris.*

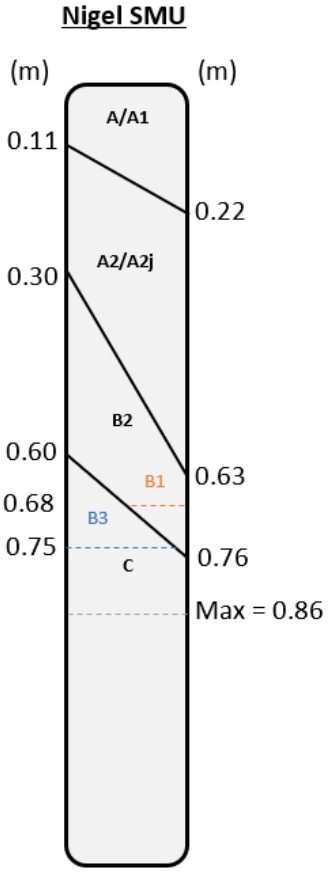
**Australian Soil Classification:** Brown Kandosol

**Photo Plate 10 Nigel SMU Vegetation**

**Table 30 Nigel Soil Unit Description**

| Parameter | Soil Unit Description |
|---|---|
| **Profile Site Numbers** | DP43, DP51, DP52 |
| **Observation Site Numbers** | DO83, DO101, DO107 |
| **Landform** | Hills and rises |
| **Land System** | Melbadale |
| **Slope** | 3 to 5% |
| **Geology** | Gyranda Subgroup (Pwy) – Late Permian sedimentary unit comprised of siltstone and shale with minor tuff and volcanilithic sandstone and rare coal (lower part - Banana Formation) (weathered to laterite) |
| **Vegetation** | *Acacia shirleyi, Acacia rhodoxylon, Eucalyptus crebra, Melaleuca leucadendra, Corymbia clarksoniana,* and *Eucalyptus tessellaris.* |
| **Runoff** | Very slow to rapid |
| **Permeability** | Slowly permeable |
| **Drainage** | Poorly drained |

**Profile Description – Representative Sites:** DP43, DP51 & DP52




The **surface soil** (A/A1) is a dark brown to greyish brown (10YR3/3, 7.5YR3/4, 10YR4/4) sand to loamy sand with massive structure. It has a field pH of 4.8 to 5.5, with a clear or gradual change to;

The **lower surface soil** (A2/A2j) is a dark red to yellowish-red (2.5YR3/6, 5YR4/6, 5YR3/3) sand to clayey sand, which often demonstrates sporadic bleaching. It has a massive/grainy structure and a field pH ranging from 5.0 to 5.5. This horizon exhibits a clear or gradual change to;

The **upper subsoil** (B1) was only present at one profile site. It is a red (2.5YR4/6) loamy sand with grainy structure and a field pH of 5.5. When present, this horizon has a clear change to the C horizon, though when absent, A2/A2j grades gradually to;

The **subsoil** (B2) is a yellowish brown (10YR4/6, 10YR5/6) soil with a clayey sand to sandy light clay texture. Structure in this horizon is weak to massive, with field pH values of 5.5. This unit can have a clear or gradual change to the C horizon, or;

The **lower subsoil** (B3) was only present at one site. It was a dark yellowish brown (10YR4/6) clayey sand with massive structure and a field pH of 6.0. It contained a small amount (<2%) of manganiferous nodules.

The **parent material** (C) was comprised of laterite pebbles with a pH ranging from 5.5 to 6.0.

**Chemical and Physical Analysis**

**Table 31 Chemical Properties of the Nigel SMU**

| Representative site: DP52 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Depth (m)** | **pH** | | **EC** | | **Cl** | **ESP%** | | **Moisture (%)** | **Emerson Class No.** |
| | **#** | **Rate** | **dS/m** | **Rate** | **mg/kg** | **%** | **Rate** | | |
| 0-0.1 | 4.4 | Extremely acid | 0.038 | Very Low | 10 | 1.3 | Non-sodic | 7.3 | 4 |
| 0.2-0.3 | 4.6 | Very strongly acid | 0.01 | Very Low | <10 | <0.1 | Non-sodic | 2.3 | 4 |
| 0.5-0.6 | 4.6 | Very strongly acid | 0.01 | Very Low | <10 | <0.1 | Non-sodic | 2.3 | 4 |
| **Depth (m)** | **CEC** | | | **Exchangeable Cations (meq/100g)** | | | | **Ca/Mg Ratio** | |
| | **meq / 100g** | **Rate** | | **Ca** | **Mg** | **K** | **Na** | | |
| 0-0.1 | 2.8 | Very low | | 0.8 | 0.4 | 0.2 | <0.1 | 2.0 | |
| 0.2-0.3 | 1.7 | Very low | | <0.1 | <0.1 | 0.1 | <0.1 | <0.1 | |
| 0.5-0.6 | 1.6 | Very low | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | |
| **Percentage in Topsoil** | | | | 28.57% | 14.29% | 7.14% | 1.30% | - | |

The Nigel SMU has an extremely low pH throughout the profile, ranging from 4.4 (extremely acidic) in the topsoil to 4.6 (strongly acidic) in the subsoil layers. EC is very low at all depths, a result reflected in chloride results, which are consistently less than or equal to 10 mg/kg.

CEC is also very low, ranging from 2.8 mg/kg in the topsoil to 1.6 mg/kg in the subsoil. This has resulted in very low concentrations of exchangeable cations. Calcium ranges from 0.8 in the topsoil, to <0.1 in the subsoil layers. Magnesium was measured at 0.4 meq/100g in the topsoil, and 0.1 meq/100g in the lower subsoil. Optimal potassium levels should be >0.2 meq/100g, and though this level was met in the topsoil, the concentration dropped to <0.1 meq/100g in the subsoil horizons.

ESP is considered non-sodic at all depths, ranging from 1.3 % in the topsoil layer to <0.1% in the lower subsoil. Therefore, the unit is unlikely to become dispersive when wetted. This interpretation is reflected in the unit's Emerson Class Numbers, which were calculated at 4 for all horizons (non-dispersive).

In addition to this, low pH values can reduce the CEC of the soil, and affect the solubility, availability, and potential toxicity of various macro and micronutrients to plant roots. This means that even if they are present in the soil, some elements (such as calcium, magnesium, and potassium) will become less available to plant roots below a pH of 5.0 and may even become damaging to vegetation (Hazelton & Murphy, 2016).

**Table 32 Surface Soil (0-10 cm) Properties of the Nigel SMU**

| Particle Size Analysis % | | | | Emerson Class No. | Nitrate (mg/kg) | Sulphate (mg/kg) | Organic Matter (%) |
|---|---|---|---|---|---|---|---|
| Gravel | Sand | Silt | Clay | | | | |
| 1 | 76 | 17 | 6 | 4 | 11.2 | <10 | 4.6 |
| Extractable Nutrients (mg/kg) | | | | Extractable Metals (mg/kg) | | | |
| P | K | B | | Cu | Fe | Mn | Zn |
| 7 | <200 | 0.2 | | <1.00 | 331 | 3.21 | <1.00 |

The surface soil (A/A1) for the Nigel SMU is dominated by sand (76%) with 17% silt, 6% clay and 1% gravel. It is hard setting and has a massive structure. The topsoil is non-sodic, with a Ca/Mg ratio of 2.0, and a relatively high organic matter content of 4.6%. This indicates that the soil is unlikely to disperse upon wetting, shown by the surface soil's Emerson Class Number of 4 (non-dispersive). Although dispersion is not likely to become an issue, this structureless topsoil indicates that the soil may slake upon wetting, losing air filled porosity and allowing it to collapse under its own weight.

Nutrient levels are generally poor, with nitrate present at optimum levels (11.2 mg/kg), while phosphorous (7 mg/kg) and potassium (<200 mg/kg) outside of the guideline levels for supporting plant life. Boron (0.2 mg/kg) and sulphate (<10 mg/kg) are also lower than desired and may be causing nutrient deficiency.

Extractable metals are quite unbalanced, with copper and zinc at <1.00 mg/kg, and iron much higher than expected in a healthy soil. At 3.21 mg/kg, manganese is the only trace element within the desirable range.

This SMU is characterised by extremely low nutrient levels, exacerbated by limited availability to plant roots caused by the extremely acidic pH throughout the profile. The physical characteristics of this soil, however, are considered suitable in terms of stability.

## 4.11 NORMANBY SOIL MANAGEMENT UNIT

**Soil Unit Description:** Deep red earth with soft surface condition, associated with plains, and the flat areas of upper slopes. Textures within this unit are relatively consistent throughout the profile, ranging from loamy sands to sandy light medium clays. Vegetation is mostly cleared, but when present includes *Eucalyptus crebra* and *Alectryon oleifolius.*

**Australian Soil Classification:** Red Kandosol

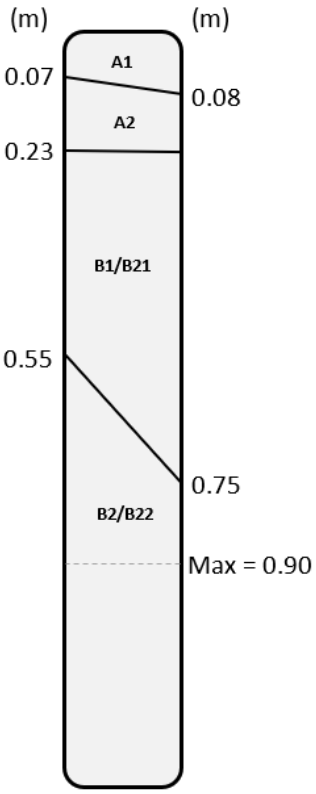
**Photo Plate 11 Normanby SMU Vegetation**

**Table 33 Normanby Soil Unit Description**

| Parameter | Soil Unit Description |
|---|---|
| **Profile Site Numbers** | DP48, DP50 |
| **Observation Site Numbers** | DO208 |
| **Landform** | Plains and upper slopes |
| **Land System** | Melbadale |
| **Slope** | 2 to 3% |
| **Geology** | Duaringa Formation (Tu) – Eocene-Oligocene mudstone, sandstone, conglomerate, siltstone, oil shale, lignite and basalt (iron-rich) |
| **Vegetation** | Cleared with *Eucalyptus crebra* and *Alectryon oleifolius.* |
| **Runoff** | Slow |
| **Permeability** | Moderately to highly permeable |
| **Drainage** | Moderately to well drained |

**Profile Description – Representative Sites:** DP48 & DP50

**Normanby SMU**




The **surface soil** (A1) is a reddish brown (2.5YR4/4, 5YR4/3) loamy sand to sandy loam, with grainy structure. It has a field pH of 6.0 to 6.5 and a clear or gradual change to;

The **lower surface soil** (A2) is a reddish brown to dark reddish brown (2.5YR3/3, 2.5YR4/3) loamy sand to sandy loam with a grainy/massive structure. It has a field pH of 6.0 to 6.5, and a gradual change to;

The **upper subsoil** (B1/B21) is a red (10R4/6, 2.5YR4/6) loamy sand to sandy loam. It has massive/grainy structure and a pH ranging from 6.0 to 6.5. Gradual change to;

The **lower subsoil** (B2/B22) is a red to dark red (10YR4/6, 2.5YR3/6) sandy loam to sandy light medium clay. It has weak lenticular structure and a field pH ranging from 6.0 to 7.0.

**Chemical and Physical Analysis**

**Table 34 Chemical Properties of the Normanby SMU**

| Representative site: DP50 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Depth (m)** | **pH** | | **EC** | | **Cl** | **ESP%** | | **Moisture (%)** | **Emerson Class No.** |
| | **#** | **Rate** | **dS/m** | **Rate** | **mg/kg** | **%** | **Rate** | | |
| 0-0.1 | 6.7 | Neutral | 0.036 | Very Low | <10 | <0.1 | Non-Sodic | 6.1 | 4 |
| 0.2-0.3 | 6.6 | Neutral | 0.006 | Very Low | <10 | <0.1 | Non-Sodic | 1.7 | 4 |
| 0.5-0.6 | 6.1 | Slightly Acid | 0.003 | Very Low | <10 | <0.1 | Non-Sodic | 1.5 | 4 |

| **Depth (m)** | **CEC** | | **Exchangeable Cations (meq/100g)** | | | | **Ca/Mg Ratio** |
|---|---|---|---|---|---|---|---|
| | **meq / 100g** | **Rate** | **Ca** | **Mg** | **K** | **Na** | |
| 0-0.1 | 2.4 | Very Low | 1.3 | 0.6 | 0.4 | <0.1 | 2.2 |
| 0.2-0.3 | 2.1 | Very Low | 1.4 | 0.4 | 0.3 | <0.1 | 3.5 |
| 0.5-0.6 | 1.6 | Very Low | 0.9 | 0.5 | <0.1 | <0.1 | 1.8 |
| **Percentage in Topsoil** | | | 54.17% | 25.00% | 16.67% | 4.17% | - |

The Normanby soil unit has a neutral to slightly acidic pH throughout the soil profile, decreasing with depth from 6.7 to 6.1. EC is very low throughout the profile, ranging from 0.036 dS/m in the topsoil to 0.003 dS/m in the subsoil. Chloride levels reflect this result, presenting at less than 10 mg/kg at all depths.

CEC measurements are considered very low, ranging from 2.4 meq/100g to 1.6 meq/100g with depth. Exchangeable cation concentrations reflected this result, with calcium, magnesium and potassium concentrations below the desirable level at all depths. The ratios between each cation, however, were appropriate. In addition to this, calcium dominated magnesium at all depths, the Ca/Mg ratio ranging from 2.2 in the topsoil, to 3.5 in the mid-stratum, to 1.8 in the lower subsoil, further reducing the likelihood that this SMU will suffer from dispersion

Of the exchangeable cations, very little was sodium, with ESP values consistently below reportable levels (<0.1%), indicating that the soil is likely to be non-dispersive. This interpretation is supported by the unit's Emerson Class Numbers, which are considered non-dispersive (4) at all depths.

Although this soil is non-dispersive and suitable in terms of pH and salinity, the low levels of exchangeable cations limit the soil in terms of its ability to provide a suitable medium for plant growth. In addition to this, the high sand content within this SMU puts it at risk of slumping if the slope angle is too high.

**Table 35 Surface Soil (0-10 cm) Properties of the Normanby SMU**

| Particle Size Analysis % | | | | Emerson Class No. | Nitrate (mg/kg) | Sulphate (mg/kg) | Organic Matter (%) |
|---|---|---|---|---|---|---|---|
| Gravel | Sand | Silt | Clay | | | | |
| 1 | 83 | 9 | 7 | 4 | 10.3 | <10 | 1.1 |
| Extractable Nutrients (mg/kg) | | | | Extractable Metals (mg/kg) | | | |
| P | K | B | | Cu | Fe | Mn | Zn |
| 6 | 275 | <0.2 | | <1.00 | 29.1 | 13.0 | <1.00 |

The surface soil (A1) for the Normanby unit is dominated by sand (83%) with 9% silt, 7% clay and 1% gravel. It had a grainy structure, and a soft surface condition. The topsoil is non-sodic, with a Ca/Mg ratio of 2.2, and an organic matter content of 1.1%. This information, paired with the topsoil's Emerson Class Number of 4, suggests that the surface soil is unlikely to become dispersive when wetted. The red colour of the soil indicates that drainage and permeability are both highly active in this soil unit.

Nutrient levels within this soil are generally low. Nitrate concentration is within the acceptable bounds at 10.3 mg/kg, as is potassium at 275 mg/kg. Phosphorous, boron and sulphate, however, are all below the desirable level, potentially causing nutrient deficiency. Extractable metal concentrations vary in their suitability, with copper and zinc below reportable levels, and iron and manganese within the appropriate range for plant life.

The limited nutrient holding capacity of this soil can be attributed to its low clay content and low organic matter levels.

## 4.12 WALLACE SOIL MANAGEMENT UNIT

**Soil Unit Description:** Shallow, self-mulching, cracking clay associated with upper slope flats. Textures within this unit grade from medium heavy clays to heavy clays, with the B3/C horizon met at approximately 0.24 m depth. The Wallace SMU is extensively cleared, with the boundary of the unit corresponding to an increase in standing vegetation. The dominant grass species is likely *Aristida latifolia*, with confirmation required during the wet season when an accurate identification can be made.

**Australian Soil Classification:** Black Vertosol.

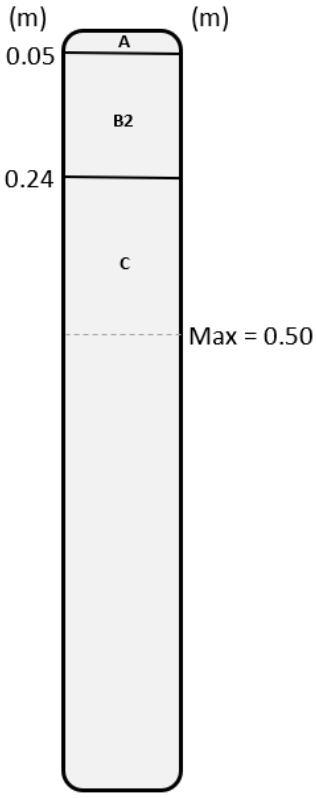
**Photo Plate 12 Wallace SMU Vegetation**

**Table 36 Wallace Soil Unit Description**

| Parameter | Soil Unit Description |
|---|---|
| **Profile Site Numbers** | DP4 |
| **Observation Site Numbers** | DO5, DO18, DO248 |
| **Landform** | Flats on upper slopes |
| **Land System** | Melbadale |
| **Slope** | 1% |
| **Geology** | Qa-QLD (Qa) – Quaternary clay, silt, sand and gravel; flood-plain alluvium |
| **Vegetation** | Cleared with *Aristida latifolia* (unconfirmed) |
| **Runoff** | Slow |
| **Permeability** | Moderately permeable |
| **Drainage** | Moderately well drained |

**Profile Description – Representative Sites:** DP4

**Wallace SMU**




The **surface soil** (A) is a very dark brown (7.5YR2.5/2) medium heavy clay with weak lenticular structure and a pH of 6.5. Gradual change to;

The **subsoil** (B2) is a very dark brown (7.5YR2.5/2) heavy clay with moderate sub-angular blocky structure. It has a small amount (<2%) of sub-angular coarse fragments, and a field pH of 6.5. Clear change to;

The **parent material** (C) is a dark grey (7.5YR4/1) rocky material of sedimentary origin, with a field pH of 6.5.

**Chemical and Physical Analysis**

**Table 37 Chemical Properties of the Wallace SMU**

| Representative site: DP4 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Depth (m)** | **pH** | | **EC** | | **Cl** | **ESP%** | | **Moisture (%)** | **Emerson Class No.** |
| | **#** | **Rate** | **dS/m** | **Rate** | **mg/kg** | **%** | **Rate** | | |
| 0-0.1 | 6.8 | Neutral | 0.09 | Low | 30 | 0.3 | Non-sodic | 5.4 | 3 |
| 0.2-0.3 | 7.4 | Slightly alkaline | 0.038 | Very Low | 10 | 0.6 | Non-sodic | 13.8 | 4 |
| **Depth (m)** | **CEC** | | **Exchangeable Cations (meq/100g)** | | | | | **Ca/Mg Ratio** | |
| | **meq / 100g** | **Rate** | **Ca** | **Mg** | **K** | **Na** | | | |
| 0-0.1 | 39 | High | 18.7 | 18.3 | 1.8 | 0.1 | | 1.0 | |
| 0.2-0.3 | 44 | Very high | 27.3 | 16.1 | 0.3 | 0.3 | | 1.7 | |
| **Percentage in Topsoil** | | | 47.95% | 46.92% | 4.62% | 0.30% | | - | |

The Wallace SMU is a well-rounded soil unit, which would be appropriate for an agricultural land use, but for its shallow soil depth. Soil pH ranges from 6.8 in the topsoil (neutral) to 7.4 in the subsoil (slightly alkaline). Salinity in this soil is not a concern, with EC ranging from low (0.09 dS/m) to very low (0.038 dS/m), with chloride well below toxic levels.

The high clay content and organic matter in this soil is associated with an elevated CEC, ranging from high in the topsoil (39 meq/100g) to very high in the subsoil (44 meq/100g). This has resulted in relatively high concentrations of available cations, dominated by calcium (18.7 to 27.3 meq/100g) and magnesium (18.3 to 16.1 meq/100g), with suitable levels of potassium (1.8 to 0.3 meq/100g). Calcium was present in higher quantities than magnesium at all depths, with the Ca/Mg ratio ranging from 1.0 to 1.7. This reduces the likelihood of any dispersive tendencies within the soil.

ESP is extremely low and considered non-sodic throughout the profile, ranging from 0.3% to 0.6%, meaning that this soil in unlikely to become dispersive upon wetting. Emerson Class numbers support this fact, ranging from 3 in the surface soil (dispersive if physically disturbed) to 4 in the subsoil (non-dispersive).

Water-holding capacity appears to increase with depth and clay content, as evidenced by the increase in moisture % with depth seen in Table 37.

**Table 38 Surface Soil (0-10 cm) Properties of the Wallace SMU**

| Particle Size Analysis % | | | | Emerson Class No. | Nitrate (mg/kg) | Sulphate (mg/kg) | Organic Matter (%) |
|---|---|---|---|---|---|---|---|
| Gravel | Sand | Silt | Clay | | | | |
| 4 | 14 | 52 | 30 | 3 | 6.6 | 10 | 4.1 |
| Extractable Nutrients (mg/kg) | | | | Extractable Metals (mg/kg) | | | |
| P | K | B | | Cu | Fe | Mn | Zn |
| 169 | 652 | 0.5 | | 1.61 | 63.4 | 53.4 | 1.02 |

The surface soil (A) for the Wallace SMU is dominated by silt sized particles (52%), with 30% clay, 14% sand, and 4% gravel. It has a weak lenticular structure, and a fine, self-mulching surface. The topsoil is non-sodic, with a Ca/Mg ratio of 1.0, and an organic matter content of 4.1%. This information paired with the soil's Emerson Class Number of 3, suggests that is will remain non-dispersive unless physically disturbed. This potential dispersion is likely influenced by the relatively low Ca/Mg ratio of the topsoil unit.

Nutrient levels in this topsoil are generally good. Nitrate (6.6 mg/kg) was outside of the acceptable bounds for agriculture, though phosphorous (169 mg/kg), potassium (652 mg/kg), boron (0.5 mg/kg) and sulphate (10 mg/kg) were well within the desired concentrations. For the extractable metals, only zinc (1.02 mg/kg) was found to be at an appropriate level, with copper (1.61 mg/kg) lower than desired, and iron (63.4 mg/kg) and manganese (53.4 mg/kg) higher than necessary.

High clay content, low sodicity, and desirable nutrient concentrations make this unit one of the best growth mediums in the survey area. This fact is observable in the field as the SMU area supports a healthy sward of highly palatable grass species that are rare or absent in most other SMUs. The shallow soil depth and low nitrate concentration are both limiting factors for agricultural use of this soil, though as grazing land it is highly suitable.

# 5.0 LAND SUITABILITY

The aim of this land suitability assessment is to evaluate the suitability of the Project for agricultural land uses including cattle grazing and dryland cropping, prior to the development of the mine. Land suitability assessment considers environmental factors including climate, soils, geology, geomorphology, erosion, topography and the effects of past land use. The classification does not always represent the current land use. Rather, it indicates the potential of the land to be used for a range of agricultural activities.

The assessment for land suitability (cattle grazing and dryland cropping) has been carried out in accordance with the methodologies described in:

- DSITI & DNRM (2015). *Guidelines for Agricultural Land Evaluation in Queensland* (2nd edition). Queensland Government, Brisbane, Queensland; and
- DSITI & DNRM (2013). *Regional Land Suitability Frameworks for Queensland*, Chapter 10 – Suitability Framework for the Inland Fitzroy and Southern Burdekin area. Queensland Government. Brisbane, Queensland.

The five land suitability classes used for assessing the land are defined in Table 39. Land is considered less suitable as the severity of limitations for a land use increase. The land suitability class reflects the score of the most limiting attribute for a given SMU. An increase in limitations may reflect either:

- Reduced potential for production; and/or
- Increased inputs to achieve and acceptable level of production;
- Increased inputs to prepare the land for successful production; and/or
- Increased inputs required to prevent land degradation.

**Table 39 Agricultural and Conservation Land Classes**

| Agricultural Land Class | Type | Description |
|---|---|---|
| Class 1 | Agricultural | **Suitable land** with negligible limitations. This is highly productive land requiring only simple management practices to maintain economic production. |
| Class 2 | Agricultural | **Suitable land** with minor limitations which either reduce production or require more than the simple management practices of class 1 land to maintain economic production. |
| Class 3 | Agricultural | **Suitable land** with moderate limitations which either further lower production or require more than those management practices of class 2 land to maintain economic production. |
| Class 4 | Agricultural | **Marginal land**, which is presently considered unsuitable due to severe limitations. The long-term significance of these limitations on the proposed land use is unknown or not quantified. The use of this land is dependent upon undertaking additional studies to determine whether the effect of the limitation(s) can be reduced to achieve sustained economic production. |
| Class 5 | Agricultural | **Unsuitable land** with extreme limitations that preclude its use. |

Key: green shading suitable
red shading unsuitable

## 5.1 CATTLE GRAZING

Limitations for the assessment of grazing land suitability on improved pastures as outlined in the *Land Suitability Assessment Technique* (DME 1995) Guidelines (Table 2.2 and 2.3) are:

- Water availability;
- Nutrient deficiency;
- Soil physical factors;
- Salinity;
- Rockiness;
- Micro relief;
- pH;
- ESP;
- Wetness;
- Topography;
- Water erosion;
- Flooding; and
- Vegetation

Numerous parameters outlined in this assessment require calculation of the 'rootzone'. The rootzone is the depth to hard or weathered rock, or the depth to a significant salt bulge within the soil profile. A depth of 0.6 m has been assumed as the rootzone for any profile in which weathered rock, and/or a salt bulge was absent as outlined in the guidelines (DME 1995).

**Class 1** and **class 2** land is considered suitable for grazing improved pastures with maximum grazing productivity achieved in most seasons. **Class 3** land is considered suitable for grazing improved pastures however it is less productive than **Classes 1** and **2**. **Class 4** land is categorised as marginal for grazing improved pastures although it is largely considered suitable for grazing native pastures of variable quality. **Class 5** land is unsuitable for any form of pasture improvement and is limited to low productivity grazing of native pastures. Due to the poor soil quality **Class 5** land may require destocking in poor seasons.

### 5.1.1 Water Availability

Plant available water capacity (PAWC) for each soil management unit was calculated with reference to Table 2.3 of the *Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques* (DME 1995). PAWC cut-off levels for each of the land suitability classes are as follows:

**Class 1:** >125 mm

**Class 2:** 100-125 mm

**Class 3:** 75-100 mm

**Class 4:** 50-75 mm

**Class 5:** <50 mm

These cut-off levels are not based on a specific species of pasture, but on pasture as a general land use. The soils are assessed on the depth to weathered rock, or other root inhibiting factor such as a salt bulge or significant sodicity. The availability of water in soils is vital for both plants and soil organisms as they require water to survive.

**Table 40 Plant Available Water Capacity**

| Soil Management Unit | Limiting Features | PAWC (mm) | Land Suitability Class |
|---|---|---|---|
| Anderson | Gradational earth reaching 75-125 cm depth with no weathered rock/salt bulge (no rock/salt layer reached at 97cm). | 100-125 | 2 |
| Barry | Gradational earths reaching >125 cm depth with no weathered rock/salt layer (no rock/salt layer reached at 105 cm – alluvial units typically deep and non-sodic). | 125-150 | 1 |
| Charlevue | Gradational earth reaching 50-75 cm depth with no weathered rock/salt layer (EC >0.9 dS/m or Cl >900 mg/kg) (max core depth 70 cm). | 75-100 | 3 |
| Cooinda | Gradational earth reaching 50-75cm depth with no weathered rock/salt layer (EC >0.9 dS/m or Cl >900 mg/kg) (max core depth 60 cm). | 75-100 | 3 |
| Ellesmere | Gradational earth reaching 75-125cm depth with no weathered rock/salt layer (EC >0.9 dS/m or Cl >900 mg/kg) (max core depth 60 cm). | 100-125 | 2 |
| Geoffrey | Sands and sandy loams 45-90 cm deep | 75-100 | 3 |
| James | Gradational earths reaching 75-125 cm depth with no weathered rock/salt layer (EC >0.9 dS/m or Cl >900 mg/kg) (max core depth 85 cm). | 100-125 | 2 |
| Kosh | Non-cracking clay reaching 75-125 cm depth with no weathered rock/salt layer (EC >0.9 dS/m or Cl >900 mg/kg) (max core depth 85 cm). | 100-125 | 2 |
| Namoi | Non-cracking clay reaching 75-125cm depth with no weathered rock/salt layer (EC >0.9 dS/m or Cl >900 mg/kg) (max core depth 70cm). | 100-125 | 2 |
| Nigel | Clayey sands with 75-125 cm depth to weathered rock (parent material at 76 cm). | 100-125 | 2 |
| Normanby | Loamy sands >90 cm deep. | 75-100 | 3 |
| Wallace | Cracking clays with alkaline pH, and 20-40 cm depth to weathered or hard rock. | 75-100 | 3 |

Key: > greater than

### 5.1.2 Nutrient Deficiency

The nutrient status of each Soil Management Unit identified has been assessed against Table 2.2 of the *Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques* (DME 1995). The land suitability classes identified for each Soil Management Unit are presented in Table 41. Note that bicarbonate P was only analysed within the topsoil layer (0-10 cm). Soil nutrients are vital for plant and animal growth and metabolism.

**Table 41 Land Suitability Classes for Cattle Grazing based on Nutrient Status**

| Soil Management Unit | Limiting Features | Land Suitability Class |
|---|---|---|
| Anderson | Eucalypt vegetation and downs with bicarbonate P >10 mg/kg. | 2 |
| Barry | Eucalypt vegetation and downs with bicarbonate P >10 mg/kg. | 2 |
| Charlevue | Eucalypt vegetation and downs with bicarbonate P >10 mg/kg. | 2 |
| Cooinda | Eucalypt vegetation and downs with bicarbonate P >10 mg/kg. | 2 |
| Ellesmere | Other soils with Bicarbonate P 5-10 mg/kg. | 3 |
| Geoffrey | Other soils with Bicarbonate P 5-10 mg/kg. | 3 |
| James | Eucalypt vegetation and downs with bicarbonate P >10 mg/kg. | 2 |
| Kosh | Eucalypt vegetation and downs with bicarbonate P >10 mg/kg. | 2 |
| Namoi | Other soils with Bicarbonate P 5-10 mg/kg. | 3 |
| Nigel | Soil overlying rock at shallow depth, with bicarbonate P 5-10 mg/kg. | 4 |
| Normanby | Sands and loams at least 0.75 m deep with bicarbonate P 5-10 ppm. | 4 |
| Wallace | Former scrub soils with bicarbonate P >10 mg/kg. | 1 |

Key: ppm parts per million

### 5.1.3 Soil Physical Factors

Table 2.2 of the *Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques* (DME 1995) has been used to assess the physical factors of each Soil Management Unit identified. Results are presented in Table 42. The physical condition of soils plays a direct role with seed germination and emergence. Adverse conditions such as hard setting or crusting of surface soils reduces plant establishment through creating a barrier, reducing seed soil contact.

**Table 42 Land Suitability Classes for Cattle Grazing based on Soil Physical Factors**

| Soil Management Unit | Limiting Features | Land Suitability Class |
|---|---|---|
| Anderson | Rigid soils with a hard setting surface when dry | 2 |
| Barry | Rigid soils with a hard setting surface when dry | 2 |
| Charlevue | Rigid soils with a hard setting surface when dry | 2 |
| Cooinda | Rigid soils with a hard setting surface when dry | 2 |
| Ellesmere | Rigid soils with a hard setting surface when dry | 2 |
| Geoffrey | Rigid soils with a loose, soft or firm surface when dry. | 1 |
| James | Rigid soils with a hard setting surface when dry | 2 |
| Kosh | Rigid soils with a hard setting surface when dry | 2 |
| Namoi | Rigid soils with a hard setting surface when dry | 2 |

| Soil Management Unit | Limiting Features | Land Suitability Class |
|---|---|---|
| Nigel | Rigid soils with a hard setting surface when dry | 2 |
| Normanby | Rigid soils with a loose, soft or firm surface when dry. | 1 |
| Wallace | Cracking clays with coarse peds (>10 mm) | 3 |

### 5.1.4 Salinity

Table 2.2 of the *Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques* (DME 1995) has been used to determine the land suitability class against salinity parameters. Given salinity can inhibit plant growth; the highest EC recorded is considered the most limiting factor and dictates the rating given to each Soil Management Unit. The results are provided in Table 43. Significant levels of salinity present in the rootzone can negatively impact plant growth and production.

**Table 43 Land Suitability Classes for Cattle Grazing based on Salinity**

| Soil Management Unit | Limiting Features | Land Suitability Class |
|---|---|---|
| Anderson | Rootzone EC <0.15 mS/cm, Rootzone Cl <300 ppm | 1 |
| Barry | Rootzone EC <0.15 mS/cm, Rootzone Cl <300 ppm | 1 |
| Charlevue | Rootzone EC 0.15-0.3 mS/cm, and rootzone Cl 300-600 mg/kg | 2 |
| Cooinda | Rootzone EC <0.15 mS/cm, Rootzone Cl <300 ppm | 1 |
| Ellesmere | Rootzone EC <0.15 mS/cm, Rootzone Cl <300 ppm | 1 |
| Geoffrey | Rootzone EC <0.15 mS/cm, Rootzone Cl <300 ppm | 1 |
| James | Rootzone EC <0.15 mS/cm, Rootzone Cl <300 ppm | 1 |
| Kosh | Rootzone EC <0.15 mS/cm, Rootzone Cl <300 ppm | 1 |
| Namoi | Rootzone EC <0.15 mS/cm, Rootzone Cl <300 ppm | 1 |
| Nigel | Rootzone EC <0.15 mS/cm, Rootzone Cl <300 ppm | 1 |
| Normanby | Rootzone EC <0.15 mS/cm, Rootzone Cl <300 ppm | 1 |
| Wallace | Rootzone EC <0.15 mS/cm, Rootzone Cl <300 ppm | 1 |

### 5.1.5 Rockiness

The land suitability for each Soil Management Unit based on rockiness was assessed in regard to Table 2.2 of the *Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques* (DME 1995). Results are presented in Table 44. The impacts of rockiness are more extreme for cropping than for grazing. In regard to grazing, rock outcrops reduce the area available to grow pasture, indirectly impacting the carrying capacity of the land.

**Table 44 Land Suitability Classes for Cattle Grazing**

| Soil Management Unit | Limiting Features | Land Suitability Class |
|---|---|---|
| Anderson | <20% course surface gravel and rock outcrop | 1 |
| Barry | <20% course surface gravel and rock outcrop | 1 |
| Charlevue | <20% course surface gravel and rock outcrop | 1 |
| Cooinda | <20% course surface gravel and rock outcrop | 1 |
| Ellesmere | <20% course surface gravel and rock outcrop | 1 |
| Geoffrey | <20% course surface gravel and rock outcrop | 1 |
| James | 20 to 50% course surface gravel and rock outcrop | 2 |
| Kosh | <20% course surface gravel and rock outcrop | 1 |
| Namoi | <20% course surface gravel and rock outcrop | 1 |
| Nigel | <20% course surface gravel and rock outcrop | 1 |
| Normanby | <20% course surface gravel and rock outcrop | 1 |
| Wallace | <20% course surface gravel and rock outcrop | 1 |

### 5.1.6 Microrelief

The microrelief for each Soil Management Unit identified has been assessed against Table 2.2 of the *Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques* (DME 1995), presented in Table 45. Microrelief refers to local relief (up to several metres) around the plane of the land (NCST 2009). Impacts of microrelief on the suitability of land for cattle grazing are only experienced when soil is severely melon holed. Ponding of water in the depressions can reduce pasture yield, indirectly impacting the land's carrying capacity.

**Table 45 Land Suitability Classes for Cattle Grazing based on microrelief**

| Soil Management Unit | Limiting Features | Land Suitability Class |
|---|---|---|
| Anderson | Melon holes cover <20% surface area | 1 |
| Barry | Melon holes cover <20% surface area | 1 |
| Charlevue | Melon holes cover <20% surface area | 1 |
| Cooinda | Melon holes cover <20% surface area | 1 |
| Ellesmere | Melon holes cover <20% surface area | 1 |
| Geoffrey | Melon holes cover <20% surface area | 1 |
| James | Melon holes cover <20% surface area | 1 |
| Kosh | Melon holes cover <20% surface area | 1 |
| Namoi | Melon holes cover <20% surface area | 1 |
| Nigel | Melon holes cover <20% surface area | 1 |
| Normanby | Melon holes cover <20% surface area | 1 |
| Wallace | Melon holes cover <20% surface area | 1 |

### 5.1.7 pH

The land suitability class for pH has been assessed against Table 2.2 of the *Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques* (DME 1995), and presented in Table 46. Soil pH determines the availability of nutrients for plant intake. Where the soil material is strongly acidic, problems with aluminium and manganese toxicity may occur, limiting root growth and plant productivity. Strongly acidic soils may require input of lime or dolomite to increase soil pH. Strongly alkaline soils will restrict the availability of some elements (Fe, Cu, Zn) and may be an indicator of sodicity. Ameliorates may be added to the soil to correct pH and increase nutrient availability.

**Table 46 Land Suitability Classes for Cattle Grazing based on pH**

| Soil Management Unit | Limiting Features | Land Suitability Class |
|---|---|---|
| Anderson | pH 4.5-5.0 | 3 |
| Barry | pH 6.6-8.0 | 2 |
| Charlevue | pH 5.6-6.6 | 1 |
| Cooinda | pH 5.6-6.6 | 1 |
| Ellesmere | pH 4.5-5.0 | 3 |
| Geoffrey | pH 5.6-6.6 | 1 |
| James | pH 5.6-6.6 | 1 |
| Kosh | pH 6.6-8.0 | 2 |
| Namoi | pH 5.6-6.6 | 1 |
| Nigel | pH 4.5-5.0 | 3 |
| Normanby | pH 5.6-6.6 | 1 |
| Wallace | pH 6.6-8.0 | 2 |

### 5.1.8 Exchangeable Sodium Percentage (ESP)

The ESP of each Soil Management Unit identified has been assessed against Table 2.2 of the *Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques* (DME 1995). ESP is used to determine the erosion potential of soils. The land suitability class identified for each Soil Management Unit based on ESP in the upper 100 mm of soil is presented in Table 47.

**Table 47 Land Suitability Classes for Cattle Grazing based on ESP**

| Soil Management Unit | Limiting Features | Land Suitability Class |
|---|---|---|
| Anderson | ESP (10 cm) <5% | 1 |
| Barry | ESP (10 cm) <5% | 1 |
| Charlevue | ESP (10 cm) 15-30% | 4 |
| Cooinda | ESP (10 cm) <5% | 1 |
| Ellesmere | ESP (10 cm) <5% | 1 |
| Geoffrey | ESP (10 cm) <5% | 1 |
| James | ESP (10 cm) <5% | 1 |

| Soil Management Unit | Limiting Features | Land Suitability Class |
|---|---|---|
| Kosh | ESP (10 cm) <5% | 1 |
| Namoi | ESP (10 cm) <5% | 1 |
| Nigel | ESP (10 cm) <5% | 1 |
| Normanby | ESP (10 cm) <5% | 1 |
| Wallace | ESP (10 cm) <5% | 1 |

### 5.1.9 Wetness

The land suitability class identified for each Soil Management Unit based on wetness has been assessed against Table 2.2 of the *Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques* (DME 1995), and is presented in Table 48. The wetness limitation refers to any excess water both in or on the soil profile. The adverse effects of excess water include reducing plant growth, impeding oxygen supply to plant roots (possibly leading to denitrification) and increased risk of plant disease.

**Table 48 Land Suitability Classes for Cattle Grazing based on Wetness**

| Soil Management Unit | Limiting Features | Land Suitability Class |
|---|---|---|
| Anderson | Elevated plains | 1 |
| Barry | Undulating terrain | 1 |
| Charlevue | Rigid soils with strongly sodic subsoil (ESP≥15) within 60 cm of the surface | 2 |
| Cooinda | Elevated plains | 1 |
| Ellesmere | Undulating terrain | 1 |
| Geoffrey | Undulating terrain | 1 |
| James | Undulating terrain | 1 |
| Kosh | Rigid soils with strongly sodic subsoil (ESP≥15) within 60 cm of the surface | 2 |
| Namoi | Elevated plains | 1 |
| Nigel | Elevated plains | 1 |
| Normanby | Elevated plains | 1 |
| Wallace | Elevated plains | 1 |

### 5.1.10 Water Erosion

The land suitability class identified for each Soil Management Unit based on water erosion has been assessed against Table 2.2 of the *Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques* (DME 1995), and presented in Table 49. Erosion of topsoil reduces the productivity of the land through the loss of key nutrients in the soil's upper horizons.

**Table 49 Land Suitability Classes for Cattle Grazing based on Water Erosion**

| Soil Management Unit | Limiting Features | Land Suitability Class |
|---|---|---|
| Anderson | Slopes 3-12% on non-sodic rigid soils | 2 |
| Barry | Slopes <3% on non-sodic rigid soils | 1 |
| Charlevue | Slopes 1-3% on sodic rigid soils | 2 |
| Cooinda | Slopes <3% on non-sodic rigid soils | 1 |
| Ellesmere | Slopes 3-12% on non-sodic rigid soils | 2 |
| Geoffrey | Slopes 3-12% on non-sodic rigid soils | 2 |
| James | Slopes 3-12% on non-sodic rigid soils | 2 |
| Kosh | Slopes 3-12% on non-sodic rigid soils | 2 |
| Namoi | Slopes 3-12% on non-sodic rigid soils | 2 |
| Nigel | Slopes 3-12% on non-sodic rigid soils | 2 |
| Normanby | Slopes <3% on non-sodic rigid soils | 1 |
| Wallace | Slopes <3% on non-sodic rigid soils | 1 |

### 5.1.11 Flooding

The land suitability class identified for each Soil Management Unit based on flooding risk has been assessed against Table 2.2 of the *Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques* (DME 1995), and is presented in Table 50. Flooding may result in plant death or reduced growth. In severe cases were land is inundated for a prolonged period stock loss and loss of grazing production may also occur.

**Table 50 Land Suitability Classes for Cattle Grazing based on Flooding**

| Soil Management Unit | Limiting Features | Land Suitability Class |
|---|---|---|
| Anderson | No flooding | 1 |
| Barry | Periodic flooding | 2 |
| Charlevue | No flooding | 1 |
| Cooinda | No flooding | 1 |
| Ellesmere | No flooding | 1 |
| Geoffrey | Periodic flooding | 2 |
| James | No flooding | 1 |
| Kosh | Periodic flooding | 2 |
| Namoi | No flooding | 1 |
| Nigel | No flooding | 1 |
| Normanby | No flooding | 1 |
| Wallace | No flooding | 1 |

### 5.1.12 Vegetation Regrowth (management limitation)

The land suitability class identified for each Soil Management Unit based on vegetation regrowth has been assessed against Table 2.2 of the *Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques* (DME 1995), and is presented in Table 51. Vegetation communities may contain poisonous species or woody weeds that will limit the productivity of grazing pastures to varying degrees and increase the need for land management. The density of tree species and presence of a woody shrub layer may also limit the carrying capacity of the land.

**Table 51 Land Suitability Classes for Cattle Grazing based on Vegetation**

| Soil Management Unit | Limiting Features | Land Suitability Class |
|---|---|---|
| Anderson | Eucalypt woodlands with wattle understorey | 4 |
| Barry | Mountain coolabah and ironbark open woodlands | 1 |
| Charlevue | Box and ironbark woodlands without wattle understorey | 2 |
| Cooinda | Box woodlands without wattle understorey | 2 |
| Ellesmere | Acacia scrub without melonholes | 1 |
| Geoffrey | Bloodwood and ironbark open woodlands | 1 |
| James | Box and ironbark woodlands with wattle understorey | 4 |
| Kosh | Box and ironbark woodlands without wattle understorey (cleared) | 2 |
| Namoi | Ironbark open woodlands | 1 |
| Nigel | Acacia scrub without melonholes | 1 |
| Normanby | Ironbark open woodlands | 1 |
| Wallace | (cleared) | - |

### 5.1.13 Summary of Land suitability for Cattle Grazing

**Table 52 Summary of Land Suitability Limitations for Cattle Grazing**

| Limitation | Anderson | Barry | Charlevue | Cooinda | Ellesmere | Geoffrey | James | Kosh | Namoi | Nigel | Normanby | Wallace |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Water availability** | 2 | 1 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 3 |
| **Nutrient deficiency** | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 4 | 4 | 1 |
| **Soil physical factors** | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 1 | 3 |
| **Salinity** | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Rockiness** | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 |
| **Microrelief** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **pH** | 3 | 2 | 1 | 1 | 3 | 1 | 1 | 2 | 1 | 3 | 1 | 2 |
| **ESP (10cm) %** | 1 | 1 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Wetness** | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 |
| **Water Erosion** | 2 | 1 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 |
| **Flooding** | 1 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 1 | 1 |
| **Vegetation Regrowth** | 4 | 1 | 2 | 2 | 1 | 1 | 4 | 2 | 1 | 1 | 1 | - |
| **Overall Suitability Rating** | 4 | 2 | 4 | 3 | 3 | 3 | 4 | 2 | 3 | 4 | 4 | 3 |

Key: green shading suitable
red shading unsuitable

On the Project, the suitability of land for cattle grazing is most limited by nutrient deficiency, ESP, and vegetation. Low nutrient levels and high sodicity in the soils may limit livestock production through a reduction in pasture growth and nutritive value of pasture species. Vegetation regrowth species can also impact the suitability of the land if they contain woody or poisonous species. In addition to this, high density regrowth and a woody shrub layer may reduce the carrying capacity of the land, making it unsuitable for grazing.

While no Class 1 land was identified for the Project, examination of the land suitability limitations for cattle grazing (Table 52) indicate 1080.5 ha of the Project is suitable for cattle grazing with minor limitations (Class 2), while 4320.2 ha is suitable for cattle grazing with moderate limitations (Class 3). The remaining area (749.0 ha) was comprised of Class 4 land, with no Class 5 land identified.

SMUs Barry and Kosh are classified as Class 2 land which is suitable for cattle grazing with minor limitations. In most seasons, younger cattle on Class 2 land will perform well, with minimal inputs required (e.g. fertiliser, land preparation or maintenance) to achieve a weight grade similar to cattle raised on Class 1 land. Land graded as Class 3 (SMUs Cooinda, Ellesmere, Geoffrey, Namoi and Wallace) may require some inputs to achieve this same weight grade, with emphasis on remediating nutrient deficiency and hard setting soil surfaces.

SMUs Anderson, Charlevue, James, Nigel and Normanby are classified as Class 4 land, which is considered suitable for improved pastures (though with severe limitations). Class 4 land will generally require significant inputs in the form of fertiliser or land management, which may not be justified given the limited benefits this land can offer. Given changes to knowledge, economics or technology this land could be sustainably managed, though does not currently hold significant economic value for improved pastures. These areas may be suitable for grazing native pastures of variable quality, though would likely have a reduced output when compared with land Classes 1, 2 and 3.

Figure 7 shows the distribution of land suitability classes for cattle grazing across the Project.

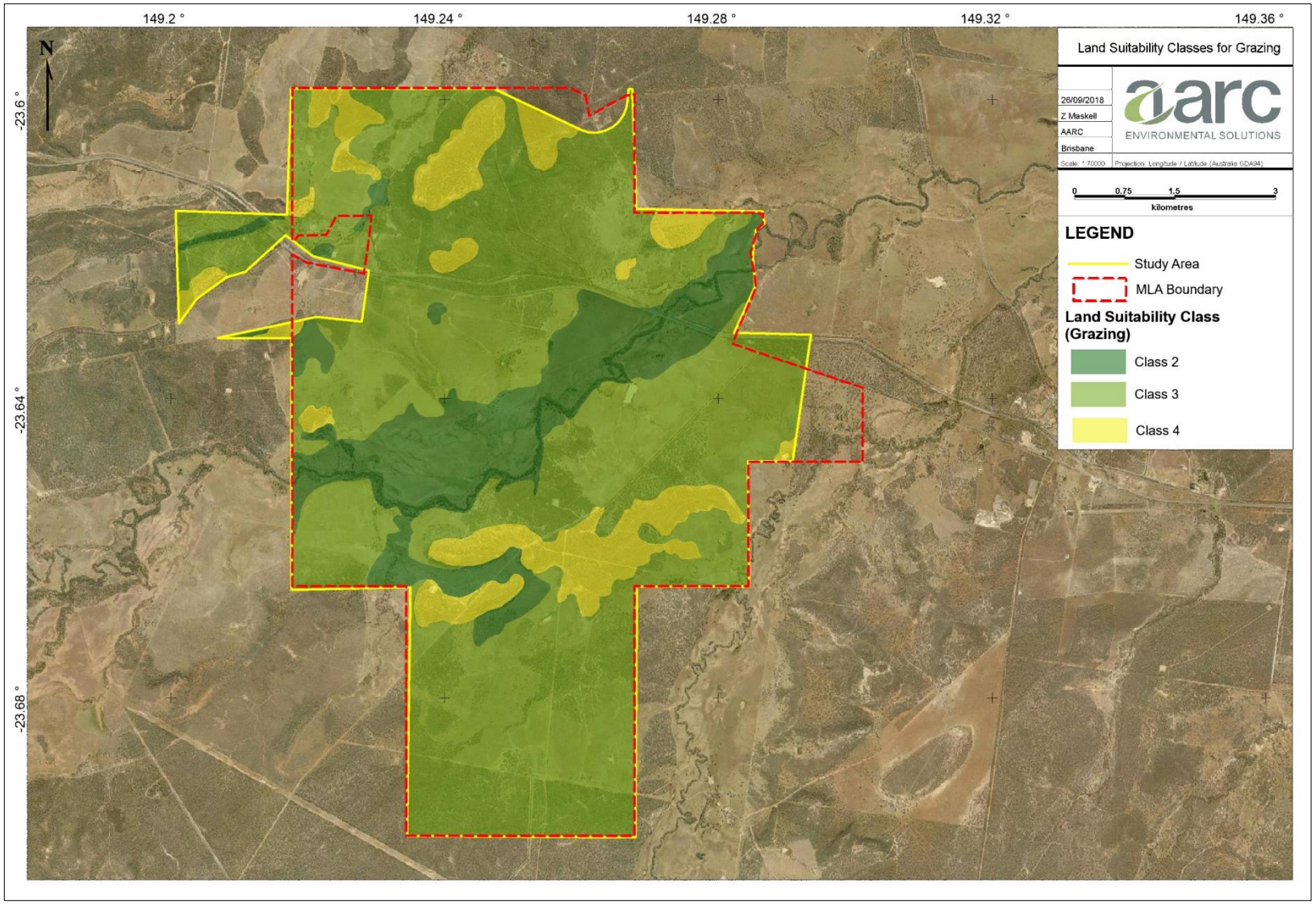



**Figure 7 Cattle Grazing Land Suitability Classes**

## 5.2 DRYLAND CROPPING

The Project lies within the Inland Fitzroy and Southern Burdekin area. Limitations for the assessment of dryland cropping suitability are specific to the Projects region and include:

- Water Erosion;
- Erosion hazard, subsoil erodibility;
- Soil water availability;
- Narrow moisture range;
- Surface conditions;
- Rockiness;
- Microrelief; and
- Wetness.

Several of these limitations contain subclasses based on the varying land management practices required for different crops. This suitability assessment will present findings based on the lowest land suitability rating returned across all of the suitability subclasses.

Assessment of the SMUs suitability for dryland cropping has been conducted in accordance with the methodology described within the *Guidelines for Agricultural Land Evaluation in Queensland* (DSITIA & DNRM 2015) and the *Regional Land Suitability Frameworks for Queensland* – Chapter 10 (DSITIA & DNRM 2013). The Suitability framework for the Inland Fitzroy and Southern Burdekin area focusses on assessing the potential for cultivating twelve specific crops including:

- Barley;
- Chickpea;
- Maize;
- Millet;
- Mungbean;
- Oats;
- Safflower;
- Sorghum;
- Soybean;
- Sunflower;
- Triticale; and
- Wheat.

Numerous parameters outlined in this assessment require calculation of the 'rootzone'. The rootzone is the depth to hard or weathered rock, or the depth to a significant salt bulge within the soil profile. A depth of 0.6 m has been assumed as the rootzone for any profile in which weathered rock, and/or a salt bulge was absent as outlined in the guidelines (DME 1995).

### 5.2.1 Water Erosion

The land suitability class identified for each SMU based on water erosion was determined using the *Regional Land Suitability Frameworks for Queensland* – Chapter 10, Table E, and is presented in Table 53. Dispersive properties were allocated based on Emerson Class Number and sodicity for each SMU. Erosion of topsoil reduces the productivity of the land through the loss of key nutrients in the soil's upper horizons.

**Table 53 Land Suitability Classes for Dryland Cropping based on Water Erosion**

| Soil Management Unit | Limiting Features | Land Suitability Class |
|---|---|---|
| Anderson | Slopes of 5-8% with non-dispersive weakly coherent soil in the surface 200 mm | 4 |
| Barry | Slope of 1-3% with non-dispersive weakly coherent soil in the surface 200 mm | 3 |
| Charlevue | Slope of 1-3% with dispersive soil in the surface 200 mm | 5 |
| Cooinda | Slope of 1-3% with non-dispersive weakly coherent soil in the surface 200 mm | 3 |

| Soil Management Unit | Limiting Features | Land Suitability Class |
|---|---|---|
| Ellesmere | Slope of 3-5% with non-dispersive weakly coherent soil in the surface 200 mm | 4 |
| Geoffrey | Slopes of 3-5% with non-dispersive moderate to strongly coherent soil in the surface 200 mm | 3 |
| James | Slopes of 5-8% with non-dispersive moderate to strongly coherent soil in the surface 200 mm | 3 |
| Kosh | Slope of 1-3% with non-dispersive moderate to strongly coherent soil in the surface 200 mm | 2 |
| Namoi | Slopes of 3-5% with non-dispersive weakly coherent soil in the surface 200 mm | 4 |
| Nigel | Slopes of 3-5% with non-dispersive moderate to strongly coherent soil in the surface 200 mm | 3 |
| Normanby | 1-3% with non-dispersive moderate to strongly coherent soil in the surface 200 mm | 2 |
| Wallace | Slopes of 0.5-1% with non-dispersive weakly coherent soil in the surface 200 mm | 2 |

### 5.2.2 Erosion hazard, Subsoil Erodibility

The land suitability class identified for each Soil Management Unit based on erosion hazard and subsoil erodibility was determined using the *Regional Land Suitability Frameworks for Queensland* – Chapter 10, Table Es, and is presented in Table 54. Subsoil was assessed based on soils ESP, EC, CEC and Ca/Mg ratio. Soils with high ESP and low EC have a tendency to disperse (DME 1995). Low Ca/Mg ratios also indicate dispersive properties of soil. CEC is required to interpreting the ESP value as the lower the CEC value, the less significant the role of the ESP.

**Table 54 Land Suitability Classes for Dryland Cropping based on Erosion Hazard and Subsoil Erodibility**

| Soil Management Unit | Limiting Features | Land Suitability Class |
|---|---|---|
| Anderson | Slopes of 5-8% with no subsoil (200-1000 mm) dispersion | 3 |
| Barry | Slope of 1-3% with low to moderate dispersive subsoil (200-1000 mm) and clay content greater than 20% | 3 |
| Charlevue | Slope of 1-3% with strongly dispersive subsoil (200-1000 mm) on 2 or more tests and clay content greater than 20% | 4 |
| Cooinda | Slope of 1-3% with low to moderate dispersive subsoil (200-1000 mm) and clay content greater than 20% | 3 |
| Ellesmere | Slope of 3-5% with strongly dispersive subsoil (200-1000 mm) on 2 or more tests and clay content greater than 20% | 5 |
| Geoffrey | Slopes of 3-5% with strongly dispersive subsoil (200-1000 mm) on 2 or more tests and clay content greater than 20% | 5 |
| James | Slopes of 5-8% with no subsoil (200-1000 mm) dispersion | 3 |
| Kosh | Slope of 1-3% with strongly dispersive subsoil (200-1000 mm) on 2 or more tests and clay content greater than 20% | 4 |
| Namoi | Slopes of 3-5% with low to moderate dispersive subsoil (200-1000 mm) and clay content greater than 20% | 3 |

| Soil Management Unit | Limiting Features | Land Suitability Class |
|---|---|---|
| Nigel | Slopes of 3-5% with no subsoil (200-1000 mm) dispersion | 3 |
| Normanby | 1-3% with no subsoil (200-1000 mm) dispersion | 1 |
| Wallace | Slopes of 0.5-1% with no subsoil (200-1000 mm) dispersion | 1 |

### 5.2.3 Soil Water Availability

The land suitability class identified for each Soil Management Unit based on soil water availability was determined using the *Regional Land Suitability Frameworks for Queensland* – Chapter 10, Table M, and is presented in Table 55. PAWC values were estimated with reference to Table 2.3 of the *Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques* (DME 1995). These cut-off levels are not based on a particular cropping species, but on cropping as a general land use. The soils are assessed on the depth to weathered rock, or other root inhibiting factors such as a salt bulge or significant sodicity. PAWC cut-off levels for each of the land suitability classes are as follows:

**Class 1:** >125 mm

**Class 2:** 100-125 mm

**Class 3:** 75-100 mm

**Class 4:** 50-75 mm

**Class 5:** <50 mm

These values were used to delegate land suitability classes for different groups of crop species, as outlined in *Regional Land Suitability Frameworks for Queensland* - Chapter 10, Table M.

**Table 55 Land Suitability Classes for Dryland Cropping based on Soil Water Availability**

| Soil Management Unit | PAWC (mm) | Land Suitability Class (Group A) | Land Suitability Class (Group B) | Land Suitability Class (Group C) |
|---|---|---|---|---|
| Anderson | 100-125 | 3 | 3 | 4 |
| Barry | 125-150 | 2 | 2 | 3 |
| Charlevue | 75-100 | 3 | 4 | 5 |
| Cooinda | 75-100 | 3 | 4 | 5 |
| Ellesmere | 100-125 | 3 | 3 | 4 |
| Geoffrey | 75-100 | 3 | 4 | 5 |
| James | 100-125 | 3 | 3 | 4 |
| Kosh | 100-125 | 3 | 3 | 4 |
| Namoi | 100-125 | 3 | 3 | 4 |
| Nigel | 100-125 | 3 | 3 | 4 |
| Normanby | 100-125 | 3 | 3 | 4 |
| Wallace | 75-100 | 3 | 4 | 5 |

### 5.2.4 Narrow Moisture Range

The land suitability class identified for each SMU based on narrow moisture range was determined using the *Regional Land Suitability Frameworks for Queensland* – Chapter 10, Table Pm, and is presented in Table 56. The narrow moisture range of a soil plays a role in determining the soil's capacity for cultivation within the restraints of machinery.

**Table 56 Land Suitability Classes for Dryland Cropping based on Narrow Moisture Range**

| Soil Management Unit | Limiting Features | Land Suitability Class |
|---|---|---|
| Anderson | Narrow moisture range for cultivation – imperfectly drained to moderately well drained; hard setting when dry and not 'spewy' when wet. | 3 |
| Barry | Narrow moisture range for cultivation – imperfectly drained to moderately well drained; hard setting when dry and not 'spewy' when wet. Hard setting pedal clays. | 3 |
| Charlevue | Narrow moisture range for cultivation – imperfectly drained to moderately well drained; hard setting when dry and not 'spewy' when wet. Hard setting pedal clays. | 3 |
| Cooinda | Narrow moisture range for cultivation – imperfectly drained to moderately well drained; hard setting when dry and not 'spewy' when wet. Hard setting pedal clays. | 3 |
| Ellesmere | Moderate moisture range for cultivation – moderately well drained to rapidly drained; predominantly hard setting when dry and not 'spewy' when wet. Moderately well drained hard setting loamy surfaced soils. | 2 |
| Geoffrey | Wide moisture range for cultivation – moderately well drained to rapidly drained; not hard setting when dry and not 'spewy' (i.e. boggy) when wet. Deep sands and thick sandy surfaced texture contrast soils | 1 |
| James | Moderate moisture range for cultivation – moderately well drained to rapidly drained; predominantly hard setting when dry and not 'spewy' when wet. Moderately well drained hard setting loamy surfaced soils. | 2 |
| Kosh | Narrow moisture range for cultivation – imperfectly drained to moderately well drained; hard setting when dry and not 'spewy' when wet. Hard setting pedal clays. | 3 |
| Namoi | Moderate moisture range for cultivation – moderately well drained to rapidly drained; predominantly hard setting when dry and not 'spewy' when wet. Moderately well drained hard setting loamy surfaced soils. | 2 |
| Nigel | Narrow moisture range for cultivation – imperfectly drained to moderately well drained; hard setting when dry and 'spewy' when wet. Loamy surfaced (less than 0.4 m). | 3 |
| Normanby | Moderate moisture range for cultivation – moderately well drained to rapidly drained; not hard setting when dry and not 'spewy' when wet. Well drained earths. | 2 |
| Wallace | Narrow moisture range for cultivation – imperfectly drained to moderately well drained; hard setting, firm or weakly self-mulching when dry and not 'spewy' when wet. Hard setting or weakly self-mulching, pedal clays. | 3 |

### 5.2.5 Surface Condition

The land suitability class identified for each SMU based on surface condition was determined using the *Regional Land Suitability Frameworks for Queensland* – Chapter 10, Table Ps, and is presented Table 57. The physical condition of soils plays a direct role with seed germination and emergence. Adverse conditions such as hard setting or crusting of surface soils reduces plant establishment through creating a barrier, reducing seed soil contact.

**Table 57 Land Suitability Classes for Dryland Cropping based on Surface Condition**

| Soil Management Unit | Limiting Features | Land Suitability Class |
|---|---|---|
| Anderson | Loamy, fine sand, silty or clayey surface soils that are hard setting, massive or crusting. | 4 |
| Barry | Clay soils with hard setting, firm pedal or weakly self-mulching surface horizons. | 3 |
| Charlevue | Clay soils with hard setting, firm pedal or weakly self-mulching surface horizons. | 3 |
| Cooinda | Clay soils with hard setting, firm pedal or weakly self-mulching surface horizons. | 3 |
| Ellesmere | Soils with soft, firm or only weakly hard setting, sandy to loamy surface horizons | 2 |
| Geoffrey | Soils with soft, firm or only weakly hard setting, sandy to sandy loam surface horizons | 2 |
| James | Clay soils with hard setting, firm pedal or weakly self-mulching surface horizons. | 3 |
| Kosh | Loamy, fine sand, silty or clayey surface soils that are hard setting, massive or crusting. | 4 |
| Namoi | Clay soils with hard setting, firm pedal or weakly self-mulching surface horizons. | 3 |
| Nigel | Loamy, fine sand, silty or clayey surface soils that are hard setting, massive or crusting. | 4 |
| Normanby | Soils with soft or loose sandy to sandy loam surface horizons | 1 |
| Wallace | Coarse self-mulching clays (peds greater than 5–10 mm); poor seed soil contact due to separation of large peds with drying | 3 |

### 5.2.6 Rockiness

The land suitability class identified for each SMU based on rockiness was determined using the *Regional Land Suitability Frameworks for Queensland* – Chapter 10, Table R, and is presented in Table 58. Rocky outcrops and soils containing coarse fragments hinder cultivation of crops and may damage harvesting machinery.

**Table 58 Land Suitability Classes for Dryland Cropping based on Rockiness**

| Soil Management Unit | Limiting Features | Land Suitability Class (Group A) | Land Suitability Class (Group B) |
|---|---|---|---|
| Anderson | Gravels less than 20 mm and abundance less than 10% | 1 | 1 |
| Barry | Gravels less than 20 mm and abundance less than 10% | 1 | 1 |
| Charlevue | Gravels less than 20 mm and abundance less than 10% | 1 | 1 |

| Soil Management Unit | Limiting Features | Land Suitability Class (Group A) | Land Suitability Class (Group B) |
|---|---|---|---|
| Cooinda | Gravels less than 20 mm and abundance less than 10% | 1 | 1 |
| Ellesmere | Gravels less than 20 mm and abundance less than 10% | 1 | 1 |
| Geoffrey | Gravels less than 20 mm and abundance less than 10% | 1 | 1 |
| James | Gravels less than 20 mm and abundance 20-50% | 2 | 3 |
| Kosh | Gravels less than 20 mm and abundance less than 10% | 1 | 1 |
| Namoi | Gravels less than 20 mm and abundance less than 10% | 1 | 1 |
| Nigel | Gravels less than 20 mm and abundance less than 10% | 1 | 1 |
| Normanby | Gravels less than 20 mm and abundance less than 10% | 1 | 1 |
| Wallace | Gravels less than 20 mm and abundance less than 10% | 1 | 1 |

### 5.2.7 Microrelief

The land suitability class identified for each SMU based on microrelief was determined using the *Regional Land Suitability Frameworks for Queensland* – Chapter 10, Table Tm, and is presented in Table 59. Suitability classes for microrelief are based on the degree to which land needs to be levelled for dryland cropping.

**Table 59 Land Suitability Classes for Dryland Cropping based on Microrelief**

| Soil Management Unit | Limiting Features | Land Suitability Class (Group A) |
|---|---|---|
| Anderson | No microrelief across the majority (greater than 70%) of the land surface | 1 |
| Barry | No microrelief across the majority (greater than 70%) of the land surface | 1 |
| Charlevue | No microrelief across the majority (greater than 70%) of the land surface | 1 |
| Cooinda | No microrelief across the majority (greater than 70%) of the land surface | 1 |
| Ellesmere | No microrelief across the majority (greater than 70%) of the land surface | 1 |
| Geoffrey | No microrelief across the majority (greater than 70%) of the land surface | 1 |
| James | No microrelief across the majority (greater than 70%) of the land surface | 1 |
| Kosh | No microrelief across the majority (greater than 70%) of the land surface | 1 |
| Namoi | No microrelief across the majority (greater than 70%) of the land surface | 1 |
| Nigel | No microrelief across the majority (greater than 70%) of the land surface | 1 |
| Normanby | No microrelief across the majority (greater than 70%) of the land surface | 1 |
| Wallace | No microrelief across the majority (greater than 70%) of the land surface | 1 |

### 5.2.8 Wetness

The land suitability class identified for each Soil Management Unit based on wetness was determined using the *Regional Land Suitability Frameworks for Queensland* – Chapter 10, Table W, and is presented in Table 60. Soil that becomes waterlogged due to poor permeability and drainage may reduce plant growth, oxygen supply to roots and cause plants to become more susceptible to disease.

**Table 60 Land Suitability Classed for Dryland Cropping based on Wetness**

| Soil Management Unit | Limiting Features | Land Suitability Class (Group A) | Land Suitability Class (Group B) | Land Suitability Class (Group C) |
|---|---|---|---|---|
| Anderson | Moderately well drained and moderately permeable | 1 | 1 | 2 |
| Barry | Moderately well drained and highly permeable | 1 | 1 | 2 |
| Charlevue | Poorly drained | 5 | 5 | 5 |
| Cooinda | Imperfectly drained and slowly permeable | 4 | 4 | 4 |
| Ellesmere | Moderately well drained and slowly permeable | 2 | 2 | 2 |
| Geoffrey | Imperfectly drained and slowly permeable | 4 | 4 | 4 |
| James | Moderately well drained and moderately permeable | 1 | 1 | 2 |
| Kosh | Poorly drained | 5 | 5 | 5 |
| Namoi | Moderately well drained and slowly permeable | 2 | 2 | 2 |
| Nigel | Poorly drained | 5 | 5 | 5 |
| Normanby | Moderately well drained and highly permeable | 1 | 1 | 2 |
| Wallace | Moderately well drained and moderately permeable | 1 | 1 | 2 |

### 5.2.9 Summary of Land Suitability for Dryland Cropping

**Table 61 Summary of Land Suitability Limitations for Dryland Cropping**

| Limitation | | Anderson | Barry | Charlevue | Cooinda | Ellesmere | Geoffrey | James | Kosh | Namoi | Nigel | Normanby | Wallace |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Water Erosion** | | 4 | 3 | 5 | 3 | 4 | 3 | 3 | 2 | 4 | 3 | 2 | 2 |
| **Erosion Hazard, Subsoil Erodibility** | | 3 | 3 | 4 | 3 | 5 | 5 | 3 | 4 | 3 | 3 | 3 | 1 |
| **Soil Water Availability** | **A** | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | **B** | 3 | 2 | 4 | 4 | 3 | 4 | 3 | 3 | 3 | 3 | 3 | 4 |
| | **C** | 4 | 3 | 5 | 5 | 4 | 5 | 4 | 4 | 4 | 4 | 4 | 5 |
| **Narrow Moisture Range** | | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 2 | 3 | 2 | 3 |
| **Surface Condition** | | 4 | 3 | 3 | 3 | 2 | 2 | 3 | 4 | 3 | 4 | 1 | 3 |
| **Rockiness** | **A** | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 |
| | **B** | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 1 |
| **Microrelief** | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Wetness** | **A** | 1 | 1 | 5 | 4 | 2 | 4 | 1 | 5 | 2 | 5 | 1 | 1 |
| | **B** | 1 | 1 | 5 | 4 | 2 | 4 | 1 | 5 | 2 | 5 | 1 | 1 |
| | **C** | 2 | 2 | 5 | 4 | 2 | 4 | 2 | 5 | 2 | 5 | 2 | 2 |
| **Overall Suitability Rating** | | 4 | 3 | 5 | 5 | 5 | 5 | 4 | 5 | 4 | 5 | 4 | 5 |

Key: green shading suitable
red shading unsuitable

Land suitability for dryland cropping on the Project is most limited by soil water availability, soil wetness, erosion, and surface condition. Plants require suitable quantities of water to reach optimum production, and therefore maximum rooting depth, with the ability of the soil to take in water (wetness) playing a large part in crop survival. Topsoil and subsoil erosion also limit the ability of the soil to support crops. Soil preparation for sowing in the form of tillage may increase the risk of soil dispersion through slaking caused by the manipulation of soil aggregates by machinery. Surface condition also limits the soil classes, with hard setting soils found across most SMUs. Surface condition directly impacts seedling emergence and establishment by reducing seed-soil contact.

In Central Queensland, Class 1, 2 and 3 lands for dryland cropping are required to have the capacity to store sufficient levels of moisture to sustain a crop cycle from planting to harvesting with minimal rainfall. Class 4 lands are considered marginal for dryland cropping, requiring significant levels of rainfall for crop success. Class 5 lands are unsuitable for dryland cropping due to severe limitations.

Examination of the land suitability limitations for dryland cropping (Table 61) indicates that 156.5 ha of the Project is suitable for cropping with moderate limitations (Class 3), and 409.1 ha of land is marginally suitable for cropping (Class 4). The remaining 5584.1 ha of land is unsuitable (Class 5) due to land and soil limitations.

Only the Barry SMU is classified as Class 3, presenting soil characteristics suitable for cropping with moderate limitations. Although listed above as Class 3, it is not genuinely expected that this landform would be suitable for dryland cropping on the Project site. This is due to its presence being limited to a narrow corridor along associated with Charlevue Creek.

SMUs Anderson, James, Namoi, and Normanby are listed as Class 4 and therefore marginally suitable for broadacre cropping. The major limitations for these SMUs are associated with soil water availability, erosion, wetness and surface condition.

SMUs Charlevue, Cooinda, Ellesmere, Geoffrey, Kosh, Nigel, and Wallace are classified as Class 5 land which is considered unsuitable for broadacre cropping. This is due to their vulnerability to subsoil erodibility, the soil water holding capacity, and the impact these limitations would have on potential crops.

Figure 8 shows the distribution of land suitability classes for broadacre cropping across the Project.

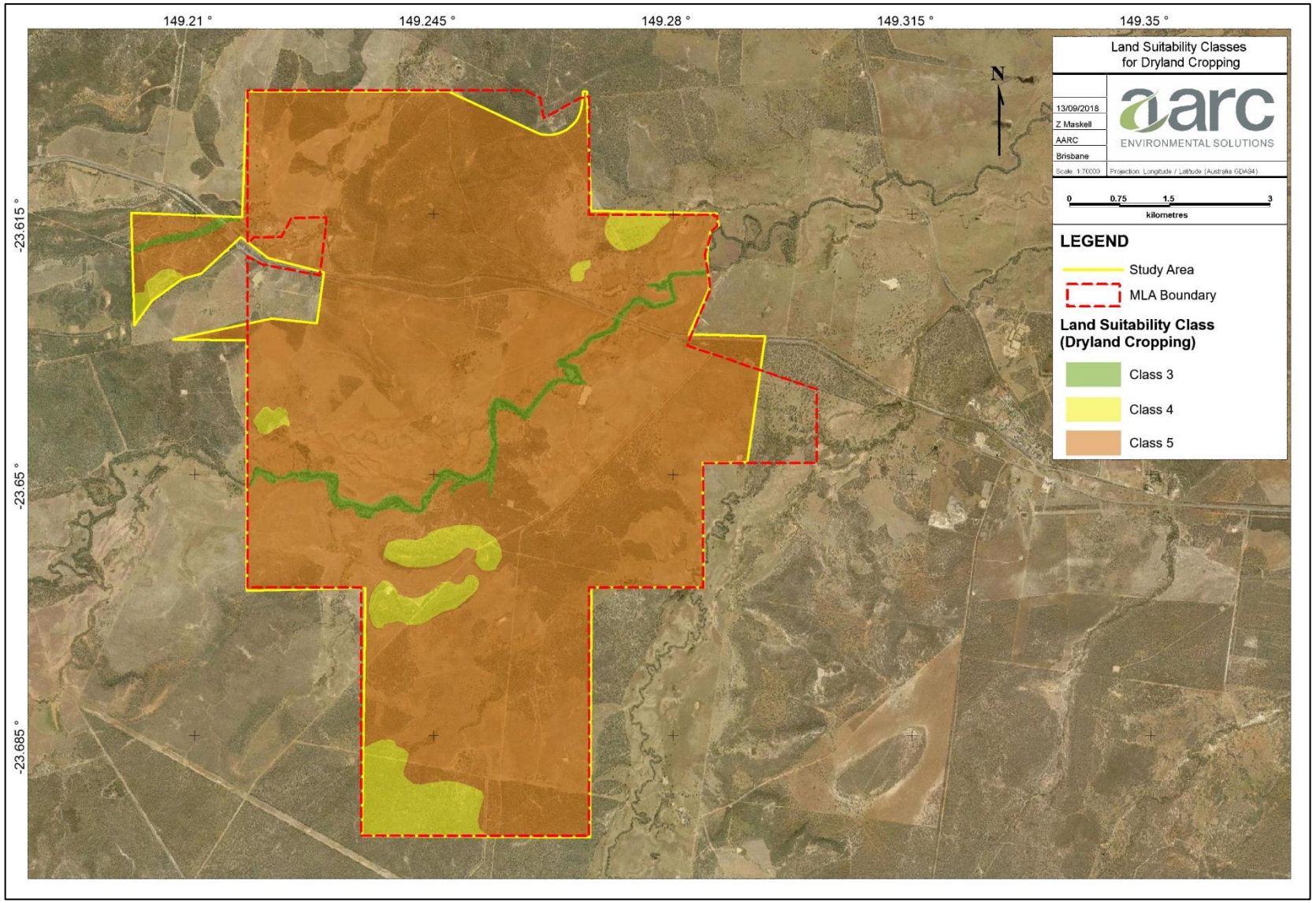



**Figure 8 Dryland Cropping Land Suitability Classes**

# 6.0 SOIL HANDLING RECOMMENDATIONS

## 6.1 TOPSOIL SUITABILITY AND STRIPPING

Useable soil resources are mainly confined to the surface horizons, with the upper part of the surface horizons containing seedstock, micro-organisms, and nutrients necessary for plant growth. Soil microbial activity, organic matter, and other parameters affecting soil fertility, generally decrease with depth. The following section lists each SMU and the recommended maximum depth to which suitable material may be stripped for stockpiling and future rehabilitation. Stripping recommendations were determined based on SMU characteristics and the presence of inherent limitations (such as pH, salinity and sodicity).

Generally, stripping should be timed to occur in conjunction with favourable climatic conditions to reduce compaction and erosion issues. Stripping should generally occur in a single stage, however, where stripping depths exceed 0.30 m it is recommended that two-stage stripping methods are employed to reduce mixing between topsoil and subsoils. Where possible, topsoil will be directly placed in prepared rehabilitation areas and used immediately rather than stockpiled.

Table 62 summarises the maximum recommended depths to which each SMU should be stripped, a detailed discussion of each unit's stripping depth is outlined in the following sections.

**Table 62 Maximum Topsoil Stripping Depths for all Soil Management Units**

| SMU | Topsoil Stripping Depth (m) |
|---|---|
| Anderson | 0.0 |
| Barry | 0.9 |
| Charlevue | 0.0 |
| Cooinda | 0.6* |
| Ellesmere | 0.0 |
| Geoffrey | 0.5* |
| James | 0.6 |
| Kosh | 0.5* |
| Namoi | 0.6* |
| Nigel | 0.0 |
| Normanby | 0.9* |
| Wallace | Surface → C Horizon |

Note: Stripping depths with as asterisk (*) may require nutrient supplements or soil ameliorants for successful use in rehabilitation.

**Anderson Soil Management Unit** **(Stripping Depth 0.0 m)**

The Anderson SMU is unsuitable for rehabilitation use. This soil is very strongly acid at the surface (pH 4.6) remaining so with depth, where it increases slightly to 4.8. pH values such as these would restrict plant growth and productivity, by reducing the availability of plant nutrients and causing root damage. The addition of lime would neutralise the acidic pH, though this SMU would require vast amounts to accommodate healthy plant growth. The cost of such an exercise would be high, and therefore this SMU is not recommended for use during rehabilitation.

**Barry Soil Management Unit** **(Stripping Depth 0.9 m)**

The Barry SMU presents no chemical limitations to stripping in the top 0.9 m of the profile. CEC is moderate to low throughout the profile, and exchangeable sodium is below critical values at all depths. The pH ranges from slightly acid to neutral, with Ca/Mg ratios >1.0 in all horizons (further reducing risk of dispersion). Although deficient in nitrate and sulphate (which could be applied as a fertiliser or foliar spray), this soil contains adequate concentrations of most macro and micronutrients. Organic matter is also above 2%. Overall, this SMU is considered a good soil resource for rehabilitation. It is however, associated with Charlevue Creek – a major waterway within the Project. Disturbance of this soil type should be avoided where possible, with the exception of required road crossings where erosion should be closely managed in the disturbed landform.

**Charlevue Soil Management Unit** **(Stripping Depth 0.0 m)**

The Charlevue SMU has severe chemical limitations that prevent it from becoming an adequate soil resource. pH for this unit is strongly acid in the topsoil (5.4), and though this increases to moderately alkaline with depth (7.9), mixing the horizons to make it usable would be a futile effort, due to the sodicity of the soil. The unit has strongly sodic soil at all depths, ranging from 15.1 to 29.4%. This paired with very low Ca/Mg ratios has resulted in a soil that is prone to dispersion, particularly below 0.2 m where the Emerson Class Number changes from 4, to 2, to 1. The evidence shows that the soil is in fact non-dispersive in the topsoil horizon, though this is where pH is most acidic (and therefore unusable).

The soil could be improved through the use of lime, which would increase the pH and replace some of the sodium with calcium (reducing ESP), but this would be a costly procedure. In addition to this, the unit is low in nutrients, and fertilisers would also need to be added to make it a viable soil resource. It is recommended that this soil should not be utilised in rehabilitation.

**Cooinda Soil Management Unit** **(Stripping Depth 0.6 m)**

The Cooinda SMU has some limitations in terms of its usability as a soil resource. The pH ranges from moderately acid in the surface soil (5.6 to 5.7) to neutral in the subsoil (6.8). Sodicity also changes from non-sodic (0.9 to 2.1%) in the topsoil, to sodic (10.9%) in the subsoil layer. The actual concentration of sodium in the subsoil layer is quite low (1.1%), though sodicity is presented as high due to the low CEC, giving an Emerson Class number of 3 (dispersive if disturbed) for all layers. Adequate mixing of the A and B horizons from 0.0 to 0.6 m could balance out these inconsistencies in pH and sodicity, creating a soil that is a better growth medium. In addition to this, nutrient levels for this SMU are particularly low. The addition of fertiliser would benefit this soil greatly. Any ameliorated soils should be tested for pH, sodicity, and nutrient content before use.

**Ellesmere Soil Management Unit** **(Stripping Depth 0.0 m)**

The Ellesmere SMU has severe chemical limitations in terms of pH, which ranges from very strongly acid in the surface soil (4.6) to strongly acid in the lower subsoil (5.5). pH levels such as these will reduce the availability of some plant nutrients, and increase the toxicity of other elements to plants. This

could be amended through the addition of liming agents, though the pH is so low that uneconomic quantities would be required to remediate the problem. In addition to this, nutrient levels are so low in this unit that the incorporation of fertilizers is not likely to be economically viable. This SMU should not be utilised as a soil resource in rehabilitation.

**Geoffrey Soil Management Unit** **(Stripping Depth 0.5 m)**

The Geoffrey SMU is the largest soil unit within the mapping area. Comprised of deep sands overlying sodic, dispersive clays (Emerson Class of 1), this soil is prone to erosion if subsoils are exposed. In addition to this, nutrient levels in the sandier horizons are somewhat limited in terms of their capacity to support plant life.

Topsoil stripping should aim to segregate the A and B horizons of this soil unit, which are easily distinguishable to trained operators. Where possible, stockpiling of the B horizon should be avoided (i.e. directly placed), or closely managed, due to the dispersive nature of the subsoil.

Due to the sandy nature of the A horizons, it is recommended that soil horizons in the natural landscape are restored during rehabilitation. The clay rich subsoils should be placed first on the rehabilitated landform, followed by the sandy A horizon over the top to recreate the A and B horizons. Placement of the subsoil layer is expected to retain soil moisture necessary for successful revegetation.

Furthermore, it is recommended that where possible this SMU is used in flatter areas of the final landform to limit potential erosion issues.

**James Soil Management Unit** **(Stripping Depth 0.6 m)**

This SMU presents no chemical limitations to stripping in the top 0.6 m of the profile. CEC is very low throughout the profile, and ESP is classified as non-sodic at all depths. The pH is slightly acid, though should not present a problem for plant establishment. Although the Ca/Mg ratio is >1.0 until 0.5 m, as the sodicity is so low, this should not enhance dispersion. As nutrient availability is quite limited, this SMU would benefit from the addition of fertilisers or foliar applications.

**Kosh Soil Management Unit** **(Stripping Depth 0.5 m)**

The Kosh SMU is one of the larger soil units in the study area, and given its size, the best unit for grazing cattle. It presents a challenge due to the ESP unit, which although non-sodic in the topsoil (0.6%), becomes strongly sodic (19.5%) and erosive in the subsoil horizon. Paired with a reduction in Ca/Mg ratios, the subsoil is likely to become highly dispersive at depth. If utilised in rehabilitation, care will need to be taken to ensure that only the top 0.5 m of soil is stripped for reuse. In addition to this, this SMU could benefit from the addition of fertilisers, particularly those containing NPK. The addition of organic matter (potentially sourced from mulched vegetation removed prior to stripping) would act in increasing the CEC and water holding capacity of the soil.

Left undisturbed, this SMU remains the best area for grazing cattle within the Project. It also presents a significant challenge in stripping, and removing soils. Where possible, it should be left undisturbed.

**Namoi Soil Management Unit** **(Stripping Depth 0.6 m)**

The Namoi SMU has chemical limitations related to soil pH, which fluctuates from slightly acid (6.1) to strongly acid (5.5) throughout the soil profile. However, it is non-dispersive, and therefore may benefit from mixing with other soil units and/or the addition of lime to reduce pH. Adding lime to this soil would also assist in improving the Ca/Mg ratio of the soil, encouraging increased plant growth. Topsoil could also benefit from the addition of fertiliser.

**Nigel Soil Management Unit** **(Stripping Depth 0.0 m)**

The Nigel SMU is not recommended to be used in rehabilitation, due to severe limitations related to soil pH. The surface horizon is extremely acidic (4.4), becoming very strongly acidic with depth (4.6). Values such as these are likely to decrease the availability of nutrients to plants, and damage plant roots. Although pH may be amended using liming agents, the size of this unit paired with the cost of such a venture makes the use of lime unsuitable for this unit. The Nigel SMU also has low nutrient levels, and is not considered suitable for use in rehabilitation.

**Normanby Soil Management Unit** **(Stripping Depth 0.9 m)**

The Normanby SMU has no chemical limitations in terms of stripping and rehabilitation. pH in the surface soil is neutral, and although it becomes slightly acidic at 0.5 m depth, the subsoil is still considered within the suitable range for plant life. Salinity is not an issue in this soil, with EC and chloride values both exceedingly low. Dispersion is also not a likely risk in this SMU, which has non-sodic sandy loams extending to great depths in the profile. Nutrient content in this soil however, is generally low, and the soil may be augmented with fertilisers if used in rehabilitation. In addition to this, the high sand content in this soil means that rehabilitated surfaces should not exceed a 3% slope, to reduce the risk of slumping.

**Wallace Soil Management Unit** **(Stripping Depth Surface → C Horizon)**

The Wallace SMU is a high-quality soil with excellent potential as a topdressing medium. pH ranges from neutral (6.8) to slightly alkaline (7.4), salinity and sodicity are low, and exchangeable cations are within suitable limits for plant growth. Nutrient content is also quite robust, particularly the unit's NPK concentrations. The main limiting factor for this soil is the shallow depth, which was 0.2 m at the sampled location for this SMU. At this depth, the solum grades abruptly into pale grey parent material (C horizon). Identification of this demarcation is easy due to the stark contrast in colour between the black clay soil and the underlying parent material. As the depth to the C horizon may vary slightly across this unit, the stripping depth of 0.2 m may be an underestimate. Stripping depths are better defined within this SMU as the depth of media that exists above the C horizon, rather than a static depth.

The Wallace SMU would be an excellent resource to use when improving the quality of topsoil within other units, by mixing this material with others that may have limited nutrient/water holding capacity or nutrient content (such as those seen in the Geoffrey SMU).

## 6.2 TOPSOIL STOCKPILING

Stockpiling of topsoil for extended periods can lead to physiochemical changes in the soil and impact on the viability of the soil seed bank. Management recommendations to reduce the risk of soil degradation and improve the chances of rehabilitation success include the following:

- Where possible, topsoil should be directly placed in prepared rehabilitation areas rather than stockpiled. This will assist in maintaining a viable seedbank and will promote revegetation, thus, reducing potential for erosion;
- Topsoil should also be planted over as soon as possible after being placed in prepared rehabilitation areas. This will assist in preventing erosion of the topsoil, and making the best use of the soil's available nutrients;
- If soil is stored, stockpiles should generally be less than 2 m high and be contoured and positioned to encourage water to drain, and discourage erosion;

- If the stockpiles require grass cover, they will need to be ripped and seeded with a quick establishment pasture, to limit erosion, and maintain a viable seed bank. This should be done if the period of stockpiling is greater than one growing season or six months. Topsoil should ideally be stockpiled for the minimum time, with studies in the Hunter Valley having shown that the majority of deterioration occurs in the first year (Keipert et al. 2005). Establishment of weeds on the stockpiles will also need to be monitored and controlled;

- Where soil has been stockpiled for extended periods, soil testing is recommended. If required, fertilizers, soil ameliorants, and seeding is recommended.

Table 63 shows the estimated volumes of soil per SMU, given the stripping depths outlined in section 6.1, and areas listed in section 4.0.

**Table 63 Estimated Soil Volumes**

| SMU | Topsoil Stripping Depth (m) | SMU Area ($m^2$) | Potential Soil Volume ($m^3$) |
|---|---|---|---|
| Anderson | 0.0 | 377800 | 0 |
| Barry | 0.9 | 1564600 | 1,408,140 |
| Charlevue | 0.0 | 2328600 | 0 |
| Cooinda | 0.6 | 349400 | 209,640 |
| Ellesmere | 0.0 | 145900 | 0 |
| Geoffrey | 0.5 | 40608942 | 20,304,471 |
| James | 0.6 | 1451900 | 871,140 |
| Kosh | 0.5 | 9240180 | 924,018 |
| Namoi | 0.6 | 1776000 | 1,065,600 |
| Nigel | 0.0 | 2846400 | 0 |
| Normanby | 0.9 | 484960 | 436,464 |
| Wallace | Minimum 0.2 (Surface → C Horizon) | 320400 | 64,080 |

Key: $m^2$ metres squared
$M^3$ metres cubed

## 6.3 TOPSOIL PLACEMENT

Where possible, placement of topsoil at a thickness of approximately 0.3 m is recommended across the rehabilitated area to create a growth medium of sufficient depth to hold water and support revegetation. If available, subsoils that have been identified as having a high clay content with low erosivity risk can be returned first at a depth of up to 0.5 m, prior to the addition of sandier topsoil. This may assist in providing a more suitable growth medium that holds water for long periods of time.

It is recommended that topsoil is deep ripped, into the underlying spoil surface, to encourage surface water infiltration and minimise soil loss due to erosions. On slopes of spoil dumps, ripping should be undertaken along the contour.

For the Geoffrey SMU, it is recommended that soil horizons in the natural landscape are restored during rehabilitation. The clay rich subsoils should be placed first on the rehabilitated landform, followed by the sandy A horizon over the top to recreate the A and B horizons. Placement of the subsoil layer is expected to retain soil moisture necessary for successful revegetation.

Grass and woody vegetation remaining after land clearing can be incorporated into the rehabilitation design at strategic locations to help limit runoff/erosion (by slowing down overland flow), retain active biological activity, and provide habitat for returning fauna. Additionally, mulched organic material incorporated into the soil (particularly the topsoil) will increase organic carbon levels over time, further stabilising the soil and landscape.

# 7.0 POTENTIAL IMPACTS AND MANAGEMENT

## 7.1 LAND SUITABILITY

The development of the Project will disturb land through the construction of infrastructure and operation of the mine. This disturbance will impact the land suitability of the Project throughout the life of the mine and after its closure. Pre-mining land suitability classes were outlined in Section 5.0 and are summarised below in Table 64.

**Table 64 Summary of the Size and Suitability Classes for all SMUs**

| SMU | Land Suitability Class (Grazing) | Land Suitability Class (Cropping) | Total Area (ha) |
|---|---|---|---|
| Anderson | 4 | 4 | 37.78 |
| Barry | 2 | 3 | 156.5 |
| Charlevue | 4 | 5 | 232.9 |
| Cooinda | 3 | 5 | 34.94 |
| Ellesmere | 3 | 5 | 14.59 |
| Geoffrey | 3 | 5 | 4061 |
| James | 4 | 4 | 145.2 |
| Kosh | 2 | 5 | 924.0 |
| Namoi | 3 | 4 | 177.6 |
| Nigel | 4 | 5 | 284.6 |
| Normanby | 4 | 4 | 48.50 |
| Wallace | 3 | 5 | 32.04 |

Key: green shading suitable
red unsuitable

The majority of areas in the final landform will aim to restore a post-mining land use of grazing. The exceptions being water management features such as ponds and drains, which will be returned to a land use of native ecosystems or equivalent. This includes the final pit lake and high walls, that will be restored to achieve a fauna habitat land use. These areas are expected to be unsuitable for grazing and will achieve a reduced land suitability score of 5.

It should be noted that mining activities, including the stripping, stockpiling, handling, and compaction of soil, have the potential to impact its physical, chemical and biological properties. Therefore, the pre-mining land suitability for cattle grazing may be reduced for some rehabilitated landforms. Many of the potential impacts on soil can be mitigated through:

- Good topsoil management practices (See Section 6.0);
- The addition of fertilizers and soil ameliorants; and
- Timely seeding with suitable species.

Where the final landforms represent a relatively flat landscape (e.g. slopes less than 5%) it is envisaged that the post-mining land suitability for cattle grazing will generally reflect that of the pre-mining landscape.

Other areas, such as steeper outer slopes of spoil (e.g. slopes of greater than 10%) may be subject to erosion and as such may be less suited to cattle grazing than the pre-mining landscape. A reduced land suitability score is expected on these landforms.

Landform depressions that perennially hold surface water are expected on the rehabilitated spoil dump. These can act as dams for cattle grazing and can assist in trapping water within the surrounding growth medium. These areas typically do not support pasture species, with wetland flora usually established. As such, a reduction in land suitability for cattle grazing is also expected in these surface depressions.

## 7.2 EROSION

Disturbance of vegetation and the topsoil layer can lead to the mobilisation of soil through the process of erosion, particularly water erosion through heavy rainfall or overland flow. The risk of erosion at the Project will be increased by the following activities:

- Clearing of vegetation;
- Topsoil stripping and stockpiling;
- Construction of infrastructure; and
- Exposure of slopes.

Management recommendations to reduce the risk and impacts of erosion include:

- Limiting land clearing to the minimum amount of land required for safe operation of the Project;
- Diversion of overland flow/runoff around disturbed areas;
- Progressive rehabilitation of landforms and direct placement of topsoil to help preserve the seed bank and reduce erosion;
- Seeding of topsoil as soon as possible after placement onto rehabilitated areas, to ensure root masses assist in preventing erosion;
- Topsoil stockpiles should be placed away from drainage areas, roads, machinery, transport corridors, and stock grazing areas;
- Topsoil stockpiles should be seeded or covered with a water-shedding lining to prevent unnecessary erosion of soil; and
- The use of sediment control structures such as retention ponds, to minimise the release of water and suspended sediments into the receiving environment.

## 7.3 EROSION OF REHABILITED LANDFORMS

Erosion of rehabilitated landforms reduces the likelihood of revegetation success, and in extreme cases can compromise the structural integrity of the landform, making it unstable and unsafe. In addition, if not managed correctly, erosion can result in the release of suspended sediments and potential contaminants into the receiving environment.

SMUs within the Project have some dispersive characteristics, and will be potentially subject to erosion, particularly on artificial slopes. The rehabilitated landform design for the Project should consider implementing controls to manage surface runoff on final landform slopes. Such controls include:

- Limiting side slopes of spoil to a maximum slope of 1V:6H (vertical : horizontal) (approximately 16%) or less;

- Construction of contour banks on slopes at a recommended spacing of 80 m for slopes of 1V:6H (MCA 1998). Larger contour drains are generally more stable and longer lasting. It is recommended that drains/berms are a minimum of 5 m wide and a minimum of 500 mm in height. However, construction of larger contours is encouraged. Berms should be constructed of compacted material (IE Aust Erosion and Sediment Control Guidelines(Witheridge et al. 1996));

- Contour banks should convey water to engineered rock-lined spine drains on steep slopes. The size of the rock used should be approximately 300 to 450 mm in diameter. A competent basalt or alternative rock source is recommended. The use of geofabric in construction of rock lined spine drains is also recommended;

- To reduce the need for engineered drains, landform modelling should be centred around gentle concave slopes or terraced profiles. For some materials, designs such as these can significantly reduce runoff velocity and erosion by a magnitude of two or three times, however, the approach can be difficult to implement where space is a limiting factor;

- The incorporation of rock into the topsoil medium can also assist in reducing erodibility, as well as increasing infiltration (Alt et al. 2009); and

- Rehabilitated areas should be ripped to reduce compaction from heavy machinery, encourage infiltration of water and prevent erosion. If engineered waterways are included in the landform, areas should be ripped on a grade (e.g. 0.5%). Otherwise, areas should be ripped on the contour. Ripping depths will vary depending on the type of spoil material, depth of topsoil and equipment used for rehabilitation operations. Typical ripping depths would be 500 to1000 mm.

## 7.4 SOIL DEGRADATION

Stripping, stockpiling and handling of topsoil can potentially have a negative impact on the chemical and physical attributes of the soil. Specifically, the following impacts may occur as a result of mining activities:

- Exposure of saline or sodic subsoils during soil stripping;

- Loss of soil physical structure due to excavation and handling;

- Loss of the soil seedbank; and

- Impacts on soil fertility due to mixing with subsoils, or resulting from changes in chemistry when subsoils are exposed to oxygen.

Physiochemical changes to the soil may impact on the viability of the soil seed bank and reduce the likelihood of successful rehabilitation if not well managed. Management recommendations to reduce the risk of soil degradation and improve the chances of rehabilitation success include:

- Segregation of saline or sodic soils and clear demarcation of stockpiles to ensure appropriate use of the resource;

- Minimising the handling of topsoil;

- Ensuring that when required, stockpiles are generally less than 2 m high and contoured to encourage water to drain; and

- Carrying out routine testing of soil properties prior to use in rehabilitation. If required, fertilizers, soil ameliorants, and application of a seed mix is recommended to increase the likelihood of rehabilitation success.

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# Appendix A Lab Results

| | | DP1 | | | | DP2 | | | DP3 | | | DP4 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | DP1: 0-10 | DP1: 20-30 | DP1: 50-60 | DP1: 80-90 | DP2: 0-10 | DP2: 20-30 | DP2: 50-60 | DP3: 0-10 | DP3: 20-30 | DP3: 50-60 | DP4: 0-10 | DP4: 20-30 |
| **Analyte grouping/Analyte** | **Unit** | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| ***EA002: pH 1:5 (Soils)*** | | | | | | | | | | | | | |
| pH Value | pH Unit | **5.8** | **5.6** | **6.0** | **8.1** | **5.6** | **5.7** | **6.8** | **5.7** | **5.5** | **6.1** | **6.8** | **7.4** |
| | | | | | | | | | | | | | |
| ***EA010: Conductivity*** | | | | | | | | | | | | | |
| Electrical Conductivity @ 25°C | µS/cm | **26** | **6** | **4** | **137** | **15** | **13** | **43** | **11** | **8** | **7** | **90** | **38** |
| | | | | | | | | | | | | | |
| ***EA055: Moisture Content (Dried @ 105-110°C)*** | | | | | | | | | | | | | |
| Moisture Content | % | **2.7** | **0.8** | **0.8** | **9.0** | **4.2** | **6.0** | **10.0** | **2.8** | **3.2** | **6.6** | **5.4** | **13.8** |
| | | | | | | | | | | | | | |
| ***EA058: Emerson Aggregate Test*** | | | | | | | | | | | | | |
| Color (Munsell) | | **Dark Brown** | **Brown** | **Brown** | **Yellowish Brown** | **Dark Brown** | **Brown** | **Yellowish Brown** | **Dark Brown** | **Dark Brown** | **Yellowish Red** | **Very Dark Brown** | **Dark Brown** |
| Texture | | **Loamy Sand** | **Loam** | **Sandy Clay Loam** | **Sandy Clay Loam** | **Sandy Clay Loam** | **Sandy Loam** | **Sandy Clay** | **Sandy Clay Loam** | **Sandy Clay Loam** | **Sandy Clay Loam** | **Sandy Clay Loam** | **Sandy Clay Loam** |
| Emerson Class Number | | **4** | **4** | **4** | **1** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **4** |
| | | | | | | | | | | | | | |
| ***EA150: Soil Classification - National Committee on Soil and Terrain (2009)*** | | | | | | | | | | | | | |
| Silt (2-20 µm) | % | **9** | **----** | **----** | **----** | **20** | **----** | **----** | **11** | **----** | **----** | **39** | **----** |
| Fine Sand (0.02-0.2 mm) | % | **44** | **----** | **----** | **----** | **25** | **----** | **----** | **32** | **----** | **----** | **18** | **----** |
| Coarse Sand (0.2-2.0 mm) | % | **31** | **----** | **----** | **----** | **23** | **----** | **----** | **30** | **----** | **----** | **6** | **----** |
| | | | | | | | | | | | | | |
| ***ED006: Exchangeable Cations on Alkaline Soils*** | | | | | | | | | | | | | |
| Exchangeable Calcium | meq/100g | **0.7** | **0.2** | **0.1** | **0.9** | **1.9** | **1.5** | **1.9** | **1.0** | **0.8** | **0.7** | **18.7** | **27.3** |
| Exchangeable Magnesium | meq/100g | **0.7** | **0.2** | **0.2** | **5.9** | **2.0** | **2.6** | **6.7** | **0.6** | **0.8** | **2.1** | **18.3** | **16.1** |
| Exchangeable Potassium | meq/100g | **0.3** | **0.2** | <0.1 | <0.2 | **0.4** | **0.2** | **0.1** | **0.2** | <0.1 | <0.1 | **1.8** | **0.3** |
| Exchangeable Sodium | meq/100g | <0.1 | <0.1 | <0.1 | **2.0** | <0.1 | <0.1 | **1.1** | <0.1 | <0.1 | **0.1** | **0.1** | **0.3** |
| Cation Exchange Capacity | meq/100g | **1.7** | **0.8** | **0.4** | **8.8** | **4.4** | **4.6** | **9.8** | **2.0** | **1.9** | **3.0** | **39.0** | **44.0** |
| Exchangeable Sodium Percent | % | **1.0** | **1.8** | **8.2** | **22.1** | **0.9** | **2.1** | **10.9** | **0.6** | **1.8** | **4.1** | **0.3** | **0.6** |
| Calcium/Magnesium Ratio | | **1.0** | **1.0** | **0.5** | <0.2 | **1.0** | **0.6** | **0.3** | **1.7** | **1.0** | **0.3** | **1.0** | **1.7** |
| Magnesium/Potassium Ratio | | **1.9** | **1.4** | **----** | **----** | **5.0** | **17.0** | **52.0** | **2.8** | **----** | **----** | **9.9** | **52.8** |
| | | | | | | | | | | | | | |
| ***ED021: Bicarbonate Extractable Potassium (Colwell)*** | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bicarbonate Extractable K (Colwell) | mg/kg | <200 | ---- | ---- | ---- | <200 | ---- | ---- | <200 | ---- | ---- | **652** | ---- |
| | | | | | | | | | | | | | |
| ***ED040S : Soluble Sulfate by ICPAES*** | | | | | | | | | | | | | |
| Sulfate as SO4 2- | mg/kg | <10 | ---- | ---- | ---- | <10 | ---- | ---- | <10 | ---- | ---- | **10** | ---- |
| Sulfur as S | mg/kg | <10 | ---- | ---- | ---- | <10 | ---- | ---- | <10 | ---- | ---- | <10 | ---- |
| Silica | mg/kg | **48** | ---- | ---- | ---- | **68** | ---- | ---- | **44** | ---- | ---- | **165** | ---- |
| | | | | | | | | | | | | | |
| ***ED045G: Chloride by Discrete Analyser*** | | | | | | | | | | | | | |
| Chloride | mg/kg | **20** | <10 | <10 | **110** | <10 | **10** | **40** | <10 | <10 | <10 | **30** | **10** |
| | | | | | | | | | | | | | |
| ***ED091 : Calcium Chloride Extractable Boron*** | | | | | | | | | | | | | |
| Boron | mg/kg | **0.2** | ---- | ---- | ---- | **0.4** | ---- | ---- | **0.2** | ---- | ---- | **0.5** | ---- |
| | | | | | | | | | | | | | |
| ***ED092: DTPA Extractable Metals*** | | | | | | | | | | | | | |
| Copper | mg/kg | <1.00 | ---- | ---- | ---- | <1.00 | ---- | ---- | <1.00 | ---- | ---- | **1.61** | ---- |
| Iron | mg/kg | **166** | ---- | ---- | ---- | **76.9** | ---- | ---- | **86.3** | ---- | ---- | **63.4** | ---- |
| Manganese | mg/kg | **16.0** | ---- | ---- | ---- | **61.6** | ---- | ---- | **43.7** | ---- | ---- | **53.4** | ---- |
| Zinc | mg/kg | **2.16** | ---- | ---- | ---- | **1.82** | ---- | ---- | **2.09** | ---- | ---- | **1.02** | ---- |
| | | | | | | | | | | | | | |
| ***EK057G: Nitrite as N by Discrete Analyser*** | | | | | | | | | | | | | |
| Nitrite as N (Sol.) | mg/kg | <0.1 | ---- | ---- | ---- | **0.2** | ---- | ---- | <0.1 | ---- | ---- | **0.8** | ---- |
| | | | | | | | | | | | | | |
| ***EK058G: Nitrate as N by Discrete Analyser*** | | | | | | | | | | | | | |
| Nitrate as N (Sol.) | mg/kg | **3.0** | ---- | ---- | ---- | **1.2** | ---- | ---- | **1.7** | ---- | ---- | **6.6** | ---- |
| | | | | | | | | | | | | | |
| ***EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser*** | | | | | | | | | | | | | |
| Nitrite + Nitrate as N (Sol.) | mg/kg | **3.0** | ---- | ---- | ---- | **1.4** | ---- | ---- | **1.7** | ---- | ---- | **7.4** | ---- |
| | | | | | | | | | | | | | |
| ***EK080: Bicarbonate Extractable Phosphorus (Colwell)*** | | | | | | | | | | | | | |
| Bicarbonate Ext. P (Colwell) | mg/kg | **8** | **6** | **8** | **6** | **15** | **6** | **6** | **7** | **6** | **7** | **169** | **47** |
| | | | | | | | | | | | | | |
| ***EP004: Organic Matter*** | | | | | | | | | | | | | |
| Organic Matter | % | **1.8** | **2.2** | **0.8** | **0.6** | **1.0** | **1.0** | **1.0** | **0.8** | **0.6** | **0.9** | **4.1** | **1.7** |
| Total Organic Carbon | % | **1.0** | **1.2** | <0.5 | <0.5 | **0.6** | **0.6** | **0.6** | <0.5 | <0.5 | <0.5 | **2.4** | **1.0** |

| | | DP6 | | | DP7 | | | DP14 | | | | DP17 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | DP6: 0-10 | DP6: 20-30 | DP6: 50-60 | DP7: 0-10 | DP7: 20-30 | DP7: 50-60 | DP14: 0-10 | DP14: 20-30 | DP14: 50-60 | DP14: 80-90 | DP17: 0-10 | DP17: 20-30 | DP17: 50-60 |
| **Analyte grouping/Analyte** | **Unit** | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| ***EA002: pH 1:5 (Soils)*** | | | | | | | | | | | | | | |
| pH Value | pH Unit | **5.4** | **6.4** | **7.9** | **5.5** | **6.0** | **7.8** | **6.5** | **6.8** | **6.9** | **7.2** | **6.2** | **6.1** | **6.4** |
| | | | | | | | | | | | | | | |
| ***EA010: Conductivity*** | | | | | | | | | | | | | | |
| Electrical Conductivity @ 25°C | µS/cm | **280** | **431** | **458** | **6** | **10** | **193** | **63** | **12** | **10** | **12** | **13** | **6** | **15** |
| | | | | | | | | | | | | | | |
| ***EA055: Moisture Content (Dried @ 105-110°C)*** | | | | | | | | | | | | | | |
| Moisture Content | % | **9.1** | **11.8** | **10.7** | **2.0** | **1.2** | **9.2** | **2.3** | **5.1** | **4.3** | **7.2** | **1.5** | **7.0** | **10.2** |
| | | | | | | | | | | | | | | |
| ***EA058: Emerson Aggregate Test*** | | | | | | | | | | | | | | |
| Color (Munsell) | | **Yellowish Brown** | **Dark Yellowish Brown** | **Olive Brown** | **Brown** | **Brown** | **Dark Yellowish Brown** | **Dark Brown** | **Dark Brown** | **Dark Brown** | **Dark Brown** | **Dark Brown** | **Dark Reddish Brown** | **Dark Red** |
| Texture | | **Sandy Clay Loam** | **Clay Loam** | **Sandy Clay** | **Sandy Clay Loam** | **Sandy Clay Loam** | **Sandy Clay** | **Sandy Clay** | **Sandy Clay** | **Sandy Clay** | **Sandy Clay** | **Gravelly Sand** | **Sandy Clay** | **Sandy Clay** |
| Emerson Class Number | | **4** | **2** | **1** | **4** | **3** | **2** | **3** | **4** | **3** | **3** | **8** | **3** | **4** |
| | | | | | | | | | | | | | | |
| ***EA150: Soil Classification - National Committee on Soil and Terrain (2009)*** | | | | | | | | | | | | | | |
| Silt (2-20 µm) | % | **5** | **----** | **----** | **17** | **----** | **----** | **24** | **----** | **----** | **----** | **9** | **----** | **----** |
| Fine Sand (0.02-0.2 mm) | % | **48** | **----** | **----** | **32** | **----** | **----** | **37** | **----** | **----** | **----** | **35** | **----** | **----** |
| Coarse Sand (0.2-2.0 mm) | % | **23** | **----** | **----** | **28** | **----** | **----** | **20** | **----** | **----** | **----** | **24** | **----** | **----** |
| | | | | | | | | | | | | | | |
| ***ED006: Exchangeable Cations on Alkaline Soils*** | | | | | | | | | | | | | | |
| Exchangeable Calcium | meq/100g | **1.7** | **3.2** | **2.7** | **0.3** | <0.1 | **0.8** | **6.4** | **6.1** | **5.5** | **10.0** | **2.0** | **3.1** | **2.4** |
| Exchangeable Magnesium | meq/100g | **3.1** | **6.4** | **6.5** | **0.4** | **0.7** | **6.8** | **5.2** | **4.9** | **4.6** | **7.5** | **1.8** | **2.4** | **3.2** |
| Exchangeable Potassium | meq/100g | **0.1** | <0.1 | <0.2 | **0.1** | <0.1 | <0.2 | **0.9** | **0.2** | **0.2** | **0.3** | **0.4** | **0.3** | <0.1 |
| Exchangeable Sodium | meq/100g | **1.2** | **1.7** | **3.8** | <0.1 | **0.2** | **2.9** | <0.1 | <0.1 | <0.1 | **0.2** | <0.1 | <0.1 | <0.1 |
| Cation Exchange Capacity | meq/100g | **6.3** | **15.1** | **13.1** | **1.3** | **1.2** | **10.4** | **12.5** | **11.3** | **10.4** | **18.0** | **4.3** | **5.9** | **5.8** |
| Exchangeable Sodium Percent | % | **19.8** | **0.5** | **29.4** | **4.3** | **21.0** | **27.5** | **0.3** | **0.5** | **0.7** | **1.0** | **0.4** | **0.7** | **1.4** |
| Calcium/Magnesium Ratio | | **0.5** | **11.4** | **0.4** | **0.8** | <0.1 | <0.2 | **1.2** | **1.2** | **1.2** | **1.3** | **1.1** | **1.3** | **0.8** |
| Magnesium/Potassium Ratio | | **27.9** | **----** | **----** | **3.4** | **----** | **----** | **5.7** | **20.4** | **25.6** | **24.8** | **5.0** | **8.2** | **----** |
| | | | | | | | | | | | | | | |
| ***ED021: Bicarbonate Extractable Potassium (Colwell)*** | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bicarbonate Extractable K (Colwell) | mg/kg | <200 | ---- | ---- | <200 | ---- | ---- | **596** | ---- | ---- | ---- | <200 | ---- | ---- |
| | | | | | | | | | | | | | | |
| ***ED040S : Soluble Sulfate by ICPAES*** | | | | | | | | | | | | | | |
| Sulfate as SO4 2- | mg/kg | **20** | ---- | ---- | <10 | ---- | ---- | <10 | ---- | ---- | ---- | <10 | ---- | ---- |
| Sulfur as S | mg/kg | <10 | ---- | ---- | <10 | ---- | ---- | <10 | ---- | ---- | ---- | <10 | ---- | ---- |
| Silica | mg/kg | **299** | ---- | ---- | **248** | ---- | ---- | **77** | ---- | ---- | ---- | **118** | ---- | ---- |
| | | | | | | | | | | | | | | |
| ***ED045G: Chloride by Discrete Analyser*** | | | | | | | | | | | | | | |
| Chloride | mg/kg | **420** | **680** | **630** | <10 | **10** | **200** | **20** | <10 | <10 | <10 | <10 | <10 | <10 |
| | | | | | | | | | | | | | | |
| ***ED091 : Calcium Chloride Extractable Boron*** | | | | | | | | | | | | | | |
| Boron | mg/kg | **0.8** | ---- | ---- | <0.2 | ---- | ---- | **0.4** | ---- | ---- | ---- | **0.3** | ---- | ---- |
| | | | | | | | | | | | | | | |
| ***ED092: DTPA Extractable Metals*** | | | | | | | | | | | | | | |
| Copper | mg/kg | <1.00 | ---- | ---- | <1.00 | ---- | ---- | <1.00 | ---- | ---- | ---- | <1.00 | ---- | ---- |
| Iron | mg/kg | **29.7** | ---- | ---- | **21.7** | ---- | ---- | **53.4** | ---- | ---- | ---- | **21.4** | ---- | ---- |
| Manganese | mg/kg | **5.45** | ---- | ---- | **9.15** | ---- | ---- | **37.2** | ---- | ---- | ---- | **18.7** | ---- | ---- |
| Zinc | mg/kg | <1.00 | ---- | ---- | **2.23** | ---- | ---- | **2.88** | ---- | ---- | ---- | <1.00 | ---- | ---- |
| | | | | | | | | | | | | | | |
| ***EK057G: Nitrite as N by Discrete Analyser*** | | | | | | | | | | | | | | |
| Nitrite as N (Sol.) | mg/kg | <0.1 | ---- | ---- | <0.1 | ---- | ---- | **0.4** | ---- | ---- | ---- | **0.1** | ---- | ---- |
| | | | | | | | | | | | | | | |
| ***EK058G: Nitrate as N by Discrete Analyser*** | | | | | | | | | | | | | | |
| Nitrate as N (Sol.) | mg/kg | **0.4** | ---- | ---- | **0.7** | ---- | ---- | **1.7** | ---- | ---- | ---- | **1.1** | ---- | ---- |
| | | | | | | | | | | | | | | |
| ***EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser*** | | | | | | | | | | | | | | |
| Nitrite + Nitrate as N (Sol.) | mg/kg | **0.4** | ---- | ---- | **0.7** | ---- | ---- | **2.1** | ---- | ---- | ---- | **1.2** | ---- | ---- |
| | | | | | | | | | | | | | | |
| ***EK080: Bicarbonate Extractable Phosphorus (Colwell)*** | | | | | | | | | | | | | | |
| Bicarbonate Ext. P (Colwell) | mg/kg | **12** | <5 | **11** | **15** | **5** | **6** | **64** | **12** | **19** | **27** | **14** | **7** | **8** |
| | | | | | | | | | | | | | | |
| ***EP004: Organic Matter*** | | | | | | | | | | | | | | |
| Organic Matter | % | **1.0** | **1.3** | **1.1** | <0.5 | **0.5** | <0.5 | **3.3** | **3.0** | **2.9** | **2.8** | **2.8** | **2.2** | **2.6** |
| Total Organic Carbon | % | **0.6** | **0.7** | **0.6** | <0.5 | <0.5 | <0.5 | **1.9** | **1.7** | **1.7** | **1.6** | **1.6** | **1.3** | **1.5** |

| | | DP26 | | | DP34 | | | DP40 | | | | DP50 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | DP26: 0-10 | DP26: 20-30 | DP26: 50-60 | DP34: 0-10 | DP34: 20-30 | DP34: 50-60 | DP40: 0-10 | DP40: 20-30 | DP40: 50-60 | DP40: 80-90 | DP50: 0-10 | DP50: 20-30 | DP50: 50-60 |
| **Analyte grouping/Analyte** | **Unit** | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| ***EA002: pH 1:5 (Soils)*** | | | | | | | | | | | | | | |
| pH Value | pH Unit | **4.6** | **4.7** | **4.8** | **6.3** | **7.7** | **8.5** | **4.6** | **4.6** | **5.1** | **5.5** | **6.7** | **6.6** | **6.1** |
| | | | | | | | | | | | | | | |
| ***EA010: Conductivity*** | | | | | | | | | | | | | | |
| Electrical Conductivity @ 25°C | µS/cm | **64** | **28** | **20** | **36** | **83** | **415** | **20** | **11** | **17** | **26** | **36** | **6** | **3** |
| | | | | | | | | | | | | | | |
| ***EA055: Moisture Content (Dried @ 105-110°C)*** | | | | | | | | | | | | | | |
| Moisture Content | % | **1.0** | **4.3** | **8.2** | **2.8** | **7.1** | **9.0** | **1.4** | **3.4** | **11.8** | **10.0** | **6.1** | **1.7** | **1.5** |
| | | | | | | | | | | | | | | |
| ***EA058: Emerson Aggregate Test*** | | | | | | | | | | | | | | |
| Color (Munsell) | | **Very Dark Greyish Brown** | **Brown** | **Yellowish Red** | **Very Dark Greyish Brown** | **Dark Yellowish Brown** | **Dark Yellowish Brown** | **Very Dark Greyish Brown** | **Brown** | **Dark Red** | **Red** | **Dark Reddish Brown** | **Yellowish Red** | **Yellowish Red** |
| Texture | | **Sandy Loam** | **Sandy Clay Loam** | **Sandy Clay** | **Sandy Clay Loam** | **Sandy Clay** | **Sandy Clay** | **Sandy Loam** | **Sandy Clay Loam** | **Sandy Clay** | **Sandy Clay** | **Sandy Loam** | **Loamy Sand** | **Sandy Loam** |
| Emerson Class Number | | **3** | **4** | **4** | **4** | **2** | **2** | **3** | **3** | **4** | **4** | **4** | **4** | **4** |
| | | | | | | | | | | | | | | |
| ***EA150: Soil Classification - National Committee on Soil and Terrain (2009)*** | | | | | | | | | | | | | | |
| Silt (2-20 µm) | % | **7** | **----** | **----** | **16** | **----** | **----** | **9** | **----** | **----** | **----** | **3** | **----** | **----** |
| Fine Sand (0.02-0.2 mm) | % | **27** | **----** | **----** | **28** | **----** | **----** | **40** | **----** | **----** | **----** | **25** | **----** | **----** |
| Coarse Sand (0.2-2.0 mm) | % | **36** | **----** | **----** | **34** | **----** | **----** | **30** | **----** | **----** | **----** | **63** | **----** | **----** |
| | | | | | | | | | | | | | | |
| ***ED006: Exchangeable Cations on Alkaline Soils*** | | | | | | | | | | | | | | |
| Exchangeable Calcium | meq/100g | **0.7** | **0.4** | **0.2** | **4.4** | **4.4** | **4.1** | **0.4** | <0.1 | <0.1 | <0.1 | **1.3** | **1.4** | **0.9** |
| Exchangeable Magnesium | meq/100g | **0.2** | **0.2** | **1.0** | **1.7** | **6.9** | **9.7** | **0.2** | **0.2** | **1.7** | **3.4** | **0.6** | **0.4** | **0.5** |
| Exchangeable Potassium | meq/100g | **0.4** | **0.2** | <0.1 | **0.6** | **0.2** | <0.2 | **0.2** | **0.1** | **0.1** | **0.1** | **0.4** | **0.3** | <0.1 |
| Exchangeable Sodium | meq/100g | <0.1 | <0.1 | <0.1 | <0.1 | **1.8** | **3.4** | <0.1 | <0.1 | **0.2** | **0.6** | <0.1 | <0.1 | <0.1 |
| Cation Exchange Capacity | meq/100g | **2.7** | **2.8** | **4.2** | **6.8** | **13.3** | **17.4** | **2.3** | **2.2** | **5.7** | **6.9** | **2.4** | **2.1** | **1.6** |
| Exchangeable Sodium Percent | % | **3.7** | **2.6** | **4.5** | **0.6** | **13.2** | **19.5** | <0.1 | **6.4** | **10.5** | **13.8** | <0.1 | <0.1 | <0.1 |
| Calcium/Magnesium Ratio | | **3.5** | **2.0** | **0.2** | **2.6** | **0.6** | **0.4** | **2.0** | <0.1 | <0.1 | <0.1 | **2.2** | **3.5** | **1.8** |
| Magnesium/Potassium Ratio | | **0.5** | **1.4** | **----** | **2.7** | **33.5** | **----** | **0.9** | **1.7** | **12.6** | **27.5** | **1.4** | **1.4** | **----** |
| | | | | | | | | | | | | | | |
| ***ED021: Bicarbonate Extractable Potassium (Colwell)*** | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bicarbonate Extractable K (Colwell) | mg/kg | <200 | ---- | ---- | <200 | ---- | ---- | **532** | ---- | ---- | ---- | **275** | ---- | ---- |
| | | | | | | | | | | | | | | |
| ***ED040S : Soluble Sulfate by ICPAES*** | | | | | | | | | | | | | | |
| Sulfate as SO4 2- | mg/kg | **20** | ---- | ---- | <10 | ---- | ---- | <10 | ---- | ---- | ---- | <10 | ---- | ---- |
| Sulfur as S | mg/kg | <10 | ---- | ---- | <10 | ---- | ---- | <10 | ---- | ---- | ---- | <10 | ---- | ---- |
| Silica | mg/kg | **50** | ---- | ---- | **413** | ---- | ---- | **77** | ---- | ---- | ---- | **66** | ---- | ---- |
| | | | | | | | | | | | | | | |
| ***ED045G: Chloride by Discrete Analyser*** | | | | | | | | | | | | | | |
| Chloride | mg/kg | **30** | **10** | **10** | <10 | **60** | **490** | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| | | | | | | | | | | | | | | |
| ***ED091 : Calcium Chloride Extractable Boron*** | | | | | | | | | | | | | | |
| Boron | mg/kg | **0.6** | ---- | ---- | **0.4** | ---- | ---- | **0.4** | ---- | ---- | ---- | <0.2 | ---- | ---- |
| | | | | | | | | | | | | | | |
| ***ED092: DTPA Extractable Metals*** | | | | | | | | | | | | | | |
| Copper | mg/kg | <1.00 | ---- | ---- | <1.00 | ---- | ---- | <1.00 | ---- | ---- | ---- | <1.00 | ---- | ---- |
| Iron | mg/kg | **296** | ---- | ---- | **32.4** | ---- | ---- | **327** | ---- | ---- | ---- | **29.1** | ---- | ---- |
| Manganese | mg/kg | **5.46** | ---- | ---- | **17.5** | ---- | ---- | **3.13** | ---- | ---- | ---- | **13.0** | ---- | ---- |
| Zinc | mg/kg | <1.00 | ---- | ---- | **1.20** | ---- | ---- | <1.00 | ---- | ---- | ---- | <1.00 | ---- | ---- |
| | | | | | | | | | | | | | | |
| ***EK057G: Nitrite as N by Discrete Analyser*** | | | | | | | | | | | | | | |
| Nitrite as N (Sol.) | mg/kg | **0.2** | ---- | ---- | **0.5** | ---- | ---- | **0.2** | ---- | ---- | ---- | <0.1 | ---- | ---- |
| | | | | | | | | | | | | | | |
| ***EK058G: Nitrate as N by Discrete Analyser*** | | | | | | | | | | | | | | |
| Nitrate as N (Sol.) | mg/kg | **10.2** | ---- | ---- | **2.5** | ---- | ---- | **1.6** | ---- | ---- | ---- | **10.3** | ---- | ---- |
| | | | | | | | | | | | | | | |
| ***EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser*** | | | | | | | | | | | | | | |
| Nitrite + Nitrate as N (Sol.) | mg/kg | **10.4** | ---- | ---- | **3.0** | ---- | ---- | **1.8** | ---- | ---- | ---- | **10.3** | ---- | ---- |
| | | | | | | | | | | | | | | |
| ***EK080: Bicarbonate Extractable Phosphorus (Colwell)*** | | | | | | | | | | | | | | |
| Bicarbonate Ext. P (Colwell) | mg/kg | **11** | **65** | **6** | **13** | **7** | **5** | **6** | <5 | **7** | **5** | **6** | <5 | <5 |
| | | | | | | | | | | | | | | |
| ***EP004: Organic Matter*** | | | | | | | | | | | | | | |
| Organic Matter | % | **3.3** | **2.3** | **2.2** | **4.0** | **1.7** | **0.8** | **5.0** | **1.5** | **1.2** | **0.9** | **1.1** | **0.7** | **0.6** |
| Total Organic Carbon | % | **1.9** | **1.3** | **1.2** | **2.3** | **1.0** | <0.5 | **2.9** | **0.9** | **0.7** | <0.5 | | | |

| | | DP52 | | |
|---|---|---|---|---|
| | | DP52: 0-10 | DP52: 20-30 | DP52: 50-60 |
| **Analyte grouping/Analyte** | **Unit** | | | |
| | | | | |
| ***EA002: pH 1:5 (Soils)*** | | | | |
| pH Value | pH Unit | **4.4** | **4.6** | **4.6** |
| | | | | |
| ***EA010: Conductivity*** | | | | |
| Electrical Conductivity @ 25°C | µS/cm | **38** | **10** | **10** |
| | | | | |
| ***EA055: Moisture Content (Dried @ 105-110°C)*** | | | | |
| Moisture Content | % | **7.3** | **2.3** | **2.3** |
| | | | | |
| ***EA058: Emerson Aggregate Test*** | | | | |
| Color (Munsell) | | **Very Dark Brown** | **Dark Brown** | **Strong Brown** |
| Texture | | **Sandy Loam** | **Sandy Loam** | **Sandy Loam** |
| Emerson Class Number | | **4** | **4** | **4** |
| | | | | |
| ***EA150: Soil Classification - National Committee on Soil and Terrain (2009)*** | | | | |
| Silt (2-20 µm) | % | **7** | **----** | **----** |
| Fine Sand (0.02-0.2 mm) | % | **34** | **----** | **----** |
| Coarse Sand (0.2-2.0 mm) | % | **42** | **----** | **----** |
| | | | | |
| ***ED006: Exchangeable Cations on Alkaline Soils*** | | | | |
| Exchangeable Calcium | meq/ 100g | **0.8** | <0.1 | <0.1 |
| Exchangeable Magnesium | meq/ 100g | **0.4** | <0.1 | <0.1 |
| Exchangeable Potassium | meq/ 100g | **0.2** | **0.1** | <0.1 |
| Exchangeable Sodium | meq/ 100g | <0.1 | <0.1 | <0.1 |
| Cation Exchange Capacity | meq/ 100g | **2.8** | **1.7** | **1.6** |
| Exchangeable Sodium Percent | % | **1.3** | <0.1 | <0.1 |
| Calcium/Magnesium Ratio | | **2.0** | **----** | **----** |
| Magnesium/Potassium Ratio | | **1.6** | <0.1 | **----** |
| | | | | |
| ***ED021: Bicarbonate Extractable Potassium (Colwell)*** | | | | |
| Bicarbonate Extractable K (Colwell) | mg/kg | <200 | **----** | **----** |
| | | | | |
| ***ED040S : Soluble Sulfate by ICPAES*** | | | | |

| | | | | |
|---|---|---|---|---|
| Sulfate as SO4 2- | mg/kg | <10 | **----** | **----** |
| Sulfur as S | mg/kg | <10 | **----** | **----** |
| Silica | mg/kg | **61** | **----** | **----** |
| | | | | |
| ***ED045G: Chloride by Discrete Analyser*** | | | | |
| Chloride | mg/kg | **10** | <10 | <10 |
| | | | | |
| ***ED091 : Calcium Chloride Extractable Boron*** | | | | |
| Boron | mg/kg | **0.2** | **----** | **----** |
| | | | | |
| ***ED092: DTPA Extractable Metals*** | | | | |
| Copper | mg/kg | <1.00 | **----** | **----** |
| Iron | mg/kg | **331** | **----** | **----** |
| Manganese | mg/kg | **3.21** | **----** | **----** |
| Zinc | mg/kg | <1.00 | **----** | **----** |
| | | | | |
| ***EK057G: Nitrite as N by Discrete Analyser*** | | | | |
| Nitrite as N (Sol.) | mg/kg | <0.1 | **----** | **----** |
| | | | | |
| ***EK058G: Nitrate as N by Discrete Analyser*** | | | | |
| Nitrate as N (Sol.) | mg/kg | **11.2** | **----** | **----** |
| | | | | |
| ***EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser*** | | | | |
| Nitrite + Nitrate as N (Sol.) | mg/kg | **11.2** | **----** | **----** |
| | | | | |
| ***EK080: Bicarbonate Extractable Phosphorus (Colwell)*** | | | | |
| Bicarbonate Ext. P (Colwell) | mg/kg | **7** | **6** | **6** |
| | | | | |
| ***EP004: Organic Matter*** | | | | |
| Organic Matter | % | **4.6** | **1.6** | **1.2** |
| Total Organic Carbon | % | **2.7** | **0.9** | **0.7** |

# Appendix B Soil Profile Data

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 20/06/2018 | | **Site:** | DP1 | |
| **Location:** | Atkinson | | **Coordinates:** | E 0731029 | N 7377997 |
| **Landform Pattern:** | Plain | | **Micro Relief:** | - | |
| **Landform Element:** | Plain | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Flat | | **S C Fragments:** | - | |
| **Site Disturbance:** | 3 | | **Substrate:** | Sandstone/mudstone | |
| **Erosion:** | Stable | | **Surface Condition:** | Firm | |
| **Landform** | Elevation: | 160 | **Permeability:** | 1 | |
| | Slope (%): | 2 | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 2 | |

**[Geoffrey]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-10 | D | 10YR6/3 (D)<br>10YR4/3 (W) | - | FLS | - | V | - | D2 | 5 | 6 |
| A2E | 10-60 | A | 10YR7/2 (D)<br>10YR5/3 (W) | - | FLS | - | G | - | D1 | 30 | 6 |
| B2 | 60-90 | | 10YR5/2 | FO3 | FSMC | - | M4LE | - | D5 | 60 | 6.5 |
| | | | | | | | | | | 90 | 7.5 |
| | | | | | | | | | | | |

**Vegetation:** E. tesselaris, C. clarksoniana, E. crebra, A. rhodoxylon

**Notes:** Springwood/Luxoc? B2 grey matrix with orange mottles. Elevation? Refer to topo map.

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 21/06/2018 | | **Site:** | DP2 | |
| **Location:** | Atkinson | | **Coordinates:** | E 0729295 | N 7378337 |
| **Landform Pattern:** | Plain | | **Micro Relief:** | - | |
| **Landform Element:** | Plain | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Flat | | **S C Fragments:** | 12SMS | |
| **Site Disturbance:** | 3 | | **Substrate:** | Q. alluvium/colluvium | |
| **Erosion:** | Stable | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 139 | **Permeability:** | 2 | |
| | Slope (%): | 2 | **Drainage:** | 3 | |
| | Relief: | | **Run-off:** | 3 | |

**[Cooinda]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-10 | C | 10YR3/6 | - | SCL | 12SM | S3PL | - | D2 | 5 | 6 |
| A2 | 10-25 | D | 7.5YR3/4 | - | SLC | 12SM | M3PO | - | D2 | 15 | 5.5 |
| B21 | 25-45 | S | 10YR4/4 | - | SLC | 12SM | M3PO | - | D3 | 35 | 6 |
| B22 | 45-60 | | 10YR4/6 | - | MHC | 12SM | M4LE | - | D4 | 55 | 7 |
| | | | | | | | | | | | |

**Vegetation:** E. populnea, F. dissosperma

**Notes:**

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 21/06/2018 | | **Site:** | DP3 | |
| **Location:** | Atkinson | | **Coordinates:** | E 0728011 | N 7378628 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Hill Crest | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Crest | | **S C Fragments:** | - | |
| **Site Disturbance:** | 1 | | **Substrate:** | Laterite or Q. alluvium | |
| **Erosion:** | S | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 139 | **Permeability:** | 2 | |
| | Slope (%): | 4 | **Drainage:** | 4 | |
| | Relief: | | **Run-off:** | 4 | |

**[Namoi]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1j | 0-17 | C | 7.5YR5/4 (D)<br>7.5YR3/4 (W) | - | SCL | - | MLE | - | D3 | 5 | 5 |
| A3j | 17-40 | D | 7.5YR5/6 (D)<br>5YR4/4 (W) | - | SCL+ | - | WAB | - | D3 | 25 | 5.5 |
| B1 | 40-55 | D | 5YR4/6 | - | LC | - | WAB | - | D4 | 45 | 6 |
| B2 | 55-70 | | 5YR5/8 | 2FR1 | LMC | 12SM | MPO | - | D4 | 60 | 6.5 |
| | | | | | | | | | | | |

**Vegetation:** E. crebra (D), A. rhodoxylon, H. contortus

**Notes:** B2 – brown orange matrix

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 21/06/2018 | | **Site:** | DP4 | |
| **Location:** | Atkinson | | **Coordinates:** | E 0730098 | N 7380449 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | **Small cracks (shrink swell)** | |
| **Landform Element:** | Hill slope | | **Rock Outcrops:** | **-** | |
| **Morphological Type:** | Upper slope | | **S C Fragments:** | **-** | |
| **Site Disturbance:** | 4 | | **Substrate:** | **Q. alluvium** | |
| **Erosion:** | Stable | | **Surface Condition:** | **M** | |
| **Landform** | Elevation: | 135 | **Permeability:** | **3** | |
| | Slope (%): | 1 | **Drainage:** | **4** | |
| | Relief: | | **Run-off:** | **2** | |

**[Wallace]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 0-5 | D | 7.5YR2.5/2 | - | MHC | - | W4LE | - | D5 | 3 | 6.5 |
| B2 | 5-24 | C | 7.5YR2.5/2 | - | HC | 11SMS | M5SB | - | D5 | 15 | 6.5 |
| C | 24-50 | | 7.5YR4/1 | - | - | | | - | D6 | 35 | 6.5 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

**Vegetation:** Cleared, one grass species (A. latifolia)

**Notes:** Substrate not likely rock, but tertiary sediments. Slickensides in B2. Shrink swell clay forms small cracks across surface.

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 21/06/2018 | | **Site:** | DP5 | |
| **Location:** | Atkinson | | **Coordinates:** | E 0728662 | N 7379700 |
| **Landform Pattern:** | Plain | | **Micro Relief:** | - | |
| **Landform Element:** | Plain | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Flat | | **S C Fragments:** | - | |
| **Site Disturbance:** | 2 | | **Substrate:** | Sandstone or mudstone | |
| **Erosion:** | Stable | | **Surface Condition:** | S | |
| **Landform** | Elevation: | | **Permeability:** | 2 | |
| | Slope (%): | | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 1 | |

**[Geoffrey]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-12 | D | | - | S | - | V | - | D1 | 5 | 5.5 |
| A2j | 12-30 | D | | - | S | - | V | - | D1 | 15 | 5.5 |
| A3e | 30-54 | A | | - | S | - | G | - | D1 | 40 | 6 |
| B2 | 54-65 | | | 21FYD | SMC | - | M3LE | - | T5 | 60 | 7 |
| | | | | | | | | | | | |

**Vegetation:** C. clarksoniana, M. leucadendra, C. cunninghamiana

**Notes:**

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 21/06/2018 | | **Site:** | DP6 | |
| **Location:** | Atkinson | | **Coordinates:** | E 0730331 | N 7381303 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Hill slope | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Mid slope | | **S C Fragments:** | 21SMS | |
| **Site Disturbance:** | 2 | | **Substrate:** | Sedimentary rock | |
| **Erosion:** | Stable | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 153 | **Permeability:** | 2 | |
| | Slope (%): | | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 4 | |

**[Charlevue]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-11 | C | 10YR5/3 (D)<br>10YR3/3 (W) | - | LMC | - | W2PO | - | D4 | 5 | 5.8 |
| A3 | 11-27 | S | 10YR4/4 | - | MC | - | M2SB | - | D5 | 15 | 6 |
| B2 | 27-60 | | 10YR5/6 | - | MHC | - | M3LE | - | T6 | 40 | 7 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

**Vegetation:** F. dissosperma, E. populnea

**Notes:**

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 21/06/2018 | | **Site:** | DP7 | |
| **Location:** | Atkinson | | **Coordinates:** | E 0732069 | N 7388338 |
| **Landform Pattern:** | Plain | | **Micro Relief:** | - | |
| **Landform Element:** | Plain | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Flat | | **S C Fragments:** | - | |
| **Site Disturbance:** | 2 | | **Substrate:** | Sandstone or mudstone | |
| **Erosion:** | S | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 155 | **Permeability:** | 2 | |
| | Slope (%): | | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 3 | |

**[Geoffrey]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-20 | D | 10YR4/6 | - | SCL | - | W2LE | - | D2 | 10 | 5.5 |
| A2e | 20-34 | A | 7.5YR7/3 (D)<br>7.5YR5/4 (W) | - | FSCL | - | G | - | D1 | 25 | 5.5 |
| B2 | 34-65 | | 10YR4/6 | - | SMC | - | M3LE | - | T5 | 50 | 7 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

**Vegetation:** C. cunninghamiana, E. populnea

**Notes:**

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 22/06/2018 | | **Site:** | DP8 | |
| **Location:** | Atkinson | | **Coordinates:** | E 0730656 | N 7378873 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Hill slope | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Upper slope | | **S C Fragments:** | - | |
| **Site Disturbance:** | 4 | | **Substrate:** | Sandstone or mudstone | |
| **Erosion:** | Stable | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 141 | **Permeability:** | 2 | |
| | Slope (%): | 6 | **Drainage:** | 3 | |
| | Relief: | | **Run-off:** | 3 | |

**[Geoffrey]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Aj | 0-32 | S | 7.5YR5/6 (D)<br>7.5YR4/3 (W) | - | SL | 12SMS | G | - | D1 | 15 | 5.5 |
| B | 32-60 | | 7.5YR4/6 | M31FO | MC | - | W3LE | - | D6 | 50 | 6.5 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

**Vegetation:** Cleared

**Notes:**

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 22/06/2018 | | **Site:** | **DP9** | |
| **Location:** | Atkinson | | **Coordinates:** | **E 0731431** | **N 7381263** |
| **Landform Pattern:** | Rise | | **Micro Relief:** | **-** | |
| **Landform Element:** | Hill slope | | **Rock Outcrops:** | **- (outcrop up slope DO20)** | |
| **Morphological Type:** | Lower slope | | **S C Fragments:** | **-** | |
| **Site Disturbance:** | 2 | | **Substrate:** | **Quartzite sandstone** | |
| **Erosion:** | Stable | | **Surface Condition:** | **S** | |
| **Landform** | Elevation: | 117 | **Permeability:** | **3** | |
| | Slope (%): | 5 | **Drainage:** | **3** | |
| | Relief: | | **Run-off:** | **3** | |

**[Geoffrey – shallow phase]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-11 | D | 7.5YR3/2 | - | SL | - | V | - | D1 | 5 | 5.5 |
| A2 | 11-19 | C | 10YR3/3 | - | SL | - | W2AB | - | D2 | 15 | 5.5 |
| B2 | 19-45 | C | 10YR5/2 | M3DOC | SLC | - | W2LE | - | D3 | 30 | 5.5 |
| B3 | 45-55 | | 10YR5/3 | M3DOC | SLC | 32SM | V | - | D4 | 50 | 5.5 |
| | | | | | | | | | | | |

**Vegetation: A. rhodoxylon and E. crebra**

**Notes: Soil increases down slope. Quartzite and redder soils up hill. Looks like shallow phase Geoffrey?**

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 22/06/2018 | | **Site:** | DP10 | |
| **Location:** | Atkinson | | **Coordinates:** | E 0732219 | N 7382129 |
| **Landform Pattern:** | Plain | | **Micro Relief:** | - | |
| **Landform Element:** | Plain | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Flat | | **S C Fragments:** | 14UMVS | |
| **Site Disturbance:** | 2 | | **Substrate:** | Quartzite? Q. alluvium? | |
| **Erosion:** | S | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 117 | **Permeability:** | 2 | |
| | Slope (%): | 1 | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 1 | |

**[Charlevue]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1e | 0-16 | S | 7.5YR6/2 (D)<br>7.5YR4/3 (W) | - | SCL | - | M2LE | - | D2 | 10 | 5.5 |
| B21 | 16-28 | C | 7.5YR3/4 | - | MC | - | M2LE | - | D4 | 20 | 6 |
| B22 | 28-60 | | 10YR4/6 | - | MHC | - | W3LE | - | T5 | 40 | 6.5 |
| | | | | | | | | | | 50 | 7 |
| | | | | | | | | | | | |

**Vegetation:** E. populnea, F. dissosperma, C. spinarum

**Notes:** Texture contrast soil. Clay variant, may not be Geoffrey.

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 22/06/2018 | | **Site:** | DP11 | |
| **Location:** | Atkinson | | **Coordinates:** | E 0733663 | N 7382923 |
| **Landform Pattern:** | Plain | | **Micro Relief:** | - | |
| **Landform Element:** | Plain | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Flat | | **S C Fragments:** | - | |
| **Site Disturbance:** | 2 | | **Substrate:** | Q. alluvium | |
| **Erosion:** | Stable | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 108 | **Permeability:** | 2 | |
| | Slope (%): | 1 | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 2 | |

**[Charlevue]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1e | 0-12 | C | 7.5YR3/3 (W)<br>7.5YR5/3 (D) | - | LC | - | W3LE | - | D5 | 5 | 5.5 |
| A2e | 12-34 | A | 7.5YR4/4 (W)<br>7.5YR6/4 (D) | - | LC | - | V | - | D5 | 30 | 5.5 |
| B2 | 34-70 | | 5YR4/4 | - | | - | M3LE | - | D5 | 50 | 6.5 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

**Vegetation:** E. populnea, C. spinarum

**Notes:**

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 22/06/2018 | | **Site:** | DP12 | |
| **Location:** | Atkinson | | **Coordinates:** | E 0733811 | N 7383903 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Hill crest | | **Rock Outcrops:** | - | |
| **Morphological Type:** | crest | | **S C Fragments:** | - | |
| **Site Disturbance:** | 2 | | **Substrate:** | Sandstone or mudstone | |
| **Erosion:** | Stable | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 137 | **Permeability:** | 2 | |
| | Slope (%): | 3 | **Drainage:** | 3 | |
| | Relief: | | **Run-off:** | 3 | |

**[Geoffrey]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-8 | C | 10YR4/3 | - | SL | - | M3PL | - | D2 | 5 | 5 |
| A2e | 8-58 | A | 10YR6/3 (D)<br>10YR4/3 (W) | - | SL | - | G | - | D1 | 30 | 6 |
| A3e | 58-63 | A | 10YR7/2 (D)<br>10YR5/3 (W) | - | SL | - | V | - | D2 | 60 | 6.5 |
| B2 | 63-70 | | 10YR5/4 | M41FOD | MC | 12UMS | M3LE | - | D5 | 66 | 6.5 |
| | | | | | | | | | | | |

**Vegetation:** E. crebra, C. clarksoniana

**Notes:** This unit will have low moisture holding capacity, unless water trapped by clay layer.

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 22/06/18 | | **Site:** | DP13 | |
| **Location:** | Atkinson | | **Coordinates:** | E 0731176 | N 7382463 |
| **Landform Pattern:** | Plain | | **Micro Relief:** | - | |
| **Landform Element:** | Plain | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Flat | | **S C Fragments:** | - | |
| **Site Disturbance:** | 2 | | **Substrate:** | Sandstone or mudstone | |
| **Erosion:** | Stable | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 155 | **Permeability:** | 1 | |
| | Slope (%): | 2 | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 2 | |

**[Geoffrey]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-12 | C | 10YR6/3 | - | SCL | - | W3PL | - | D2 | 5 | 6 |
| A2e | 12-38 | C | 10YR7/4 (D)<br>10YR5/4 (W) | - | SL | - | V | - | D1 | 20 | 5.8 |
| A3e | 38-51 | A | 10YR8/2 (D)<br>10YR6/4 (W) | - | SL | - | G | - | D1 | 45 | 5.5 |
| B2 | 51-68 | | 10YR5/4 | M42DRD | MC | - | M3LE | - | T5 | 60 | 6.5 |
| | | | | | | | | | | | |

**Vegetation:** C. clarksoniana, E. crebra, A. rhodoxylon

**Notes:** Same unit as DP12

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 22/06/2018 | | **Site:** | DP14 | |
| **Location:** | Matt | | **Coordinates:** | E 0729800 | N 7382699 |
| **Landform Pattern:** | Alluvial Plain | | **Micro Relief:** | - | |
| **Landform Element:** | Plain | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Flat | | **S C Fragments:** | - | |
| **Site Disturbance:** | 2 | | **Substrate:** | Q. alluvium | |
| **Erosion:** | Stable | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 141 | **Permeability:** | 3 | |
| | Slope (%): | 2 | **Drainage:** | 4 | |
| | Relief: | | **Run-off:** | 3 | |

**[Barry]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 0-15 | D | 7.5YR4/3 | - | LMC | - | M3PL | - | D4 | 5 | 6.5 |
| B21 | 15-31 | D | 7.5YR3/3 | - | LMC | - | M3SB | - | D4 | 20 | 6.5 |
| B22 | 31-52 | D | 7.5YR4/4 | - | CL | - | M3PO | - | D5 | 40 | 6.5 |
| B23 | 52-85 | C | 7.5YR4/4 | - | LC | - | M3PL | - | D5 | 70 | 6.5 |
| B24 | 85-105 | | 7.5YR3/3 | - | LMC | - | M3PO | - | D4 | 95 | 6.5 |

**Vegetation:** E. populnea, L. hookeri, E. tereticornis

**Notes:** Alluvial unit

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 23/06/2018 | | **Site:** | DP15 | |
| **Location:** | Atkinson | | **Coordinates:** | E 0729898 | N 7377652 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Hill crest | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Crest | | **S C Fragments:** | - | |
| **Site Disturbance:** | 2 | | **Substrate:** | Sandstone or mudstone | |
| **Erosion:** | Stable | | **Surface Condition:** | S | |
| **Landform** | Elevation: | 140 | **Permeability:** | 2 | |
| | Slope (%): | 4 | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 3 | |

**[Geoffrey]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1e | 0-10 | D | 10YR6/3 (D)<br>10YR4/3 (W) | - | FSL | - | V | - | D2 | 5 | 6 |
| A2e | 10-40 | C | 10YR6/4 (D)<br>10YR5/4 (W) | - | FSL | 11UM-S | V | - | D2 | 20 | 5.5 |
| A3e | 40-50 | A | 10YR7/3 (D)<br>10YR5/4 (W) | - | FSL | 32UM-S | G | - | D1 | 45 | 6 |
| B2 | 50-55 | | 10YR5/6 | M42DRD | MC | - | M2SB | - | D5 | 55 | 6.5 |

**Vegetation:** E. crebra, E. tesselaris, C. clarksoniana, A. excelsa

**Notes:** Looks same as DP13 (bleached A horizon), Lots of erosion approximately 100m south. Texture contrast soils are prone to erosion and sensitive to stripping.

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 23/06/2018 | | **Site:** | DP16.1 | |
| **Location:** | Matt | | **Coordinates:** | E 0729618 | N 7381631 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Hill crest | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Crest | | **S C Fragments:** | 41UM-S | |
| **Site Disturbance:** | 2 | | **Substrate:** | Iron-rich sedimentary | |
| **Erosion:** | Stable | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 145 | **Permeability:** | 3 | |
| | Slope (%): | 6 | **Drainage:** | 5 | |
| | Relief: | | **Run-off:** | 4 | |

**[James]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-10 | D | 5YR3/4 | - | SCL | 11UM-S | W3PL | - | D4 | 5 | 6 |
| B21 | 10-28 | D | 2.5YR3/6 | - | CL | 31UM-S | G | - | D3 | 20 | 6 |
| B22 | 28-58 | | 2.5YR3/6 | - | CL | 51SM-S | M3PO | - | D4 | 45 | 6 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

**Vegetation:** A. rhodoxylon, C. clarksoniana

**Notes:** Very red soil on hill. Started as topography increased. Uniform textures throughout.

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 23/06/2018 | | **Site:** | DP16.2 | |
| **Location:** | Matt | | **Coordinates:** | E 0729199 | N 7381193 |
| **Landform Pattern:** | Alluvial plain | | **Micro Relief:** | - | |
| **Landform Element:** | Plain | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Flat | | **S C Fragments:** | Small 1-5mm rounded fm nodules in places | |
| **Site Disturbance:** | 4 | | **Substrate:** | Iron-rich sedimentary | |
| **Erosion:** | S (eroded stream ~100m away) | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 132 | **Permeability:** | 3 | |
| | Slope (%): | 2 | **Drainage:** | 3 | |
| | Relief: | | **Run-off:** | 3 | |

**[Kosh]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 0-9 | D | 7.5YR4/3 | - | CL | - | M2SB | - | D2 | 5 | 6.5 |
| B21 | 9-42 | D | 5YR3/2 | - | MC | 14AM | M3LE | - | D5 | 30 | 8 |
| B22 | 42-76 | | 5YR4/4 | - | MC | - | M3LE | - | D4 | 60 | 8 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

**Vegetation:** Cleared, C. spinarum, V. nilotica, E. populnea

**Notes:** This alluvial plain appears to have formed from reddish hills in the surrounding area (vegetated). Clayey, but different from black vertosol in DP4.

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 23/06/2018 | | **Site:** | DP17 | |
| **Location:** | Matt | | **Coordinates:** | E 0729348 | N 7381855 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Hill slope | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Mid slope | | **S C Fragments:** | 21RM-S | |
| **Site Disturbance:** | 2 | | **Substrate:** | Q. alluvium/colluvium | |
| **Erosion:** | Stable | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 139 | **Permeability:** | 3 | |
| | Slope (%): | 4 | **Drainage:** | 4 | |
| | Relief: | | **Run-off:** | 3 | |

**[James]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-9 | D | 5YR3/4 | - | CL | - | M2PL | - | D2 | 5 | 6 |
| B21 | 9-28 | D | 5YR3/4 | - | LMC | - | W2AB | - | D3 | 20 | 6 |
| B22 | 28-48 | D | 2.5YR3/6 | - | LC | - | M2SB | - | D3 | 40 | 6 |
| B23 | 48-85 | | 2.5YR3/6 | - | LMC | - | M3LE | - | D4 | 60 | 6.5 |
| | | | | | | | | | | 70 | 6.5 |

**Vegetation:** A. rhodoxylon, E. crebra

**Notes:** Mid-slope on non-alluvial side of red hill

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 23/06/2018 | | **Site:** | **DP18** | |
| **Location:** | Matt | | **Coordinates:** | **E 0728774** | **N 7381822** |
| **Landform Pattern:** | Rise | | **Micro Relief:** | **-** | |
| **Landform Element:** | Hill slope | | **Rock Outcrops:** | **-** | |
| **Morphological Type:** | Lower slope | | **S C Fragments:** | **-** | |
| **Site Disturbance:** | 2 | | **Substrate:** | **Sandstone or mudstone** | |
| **Erosion:** | A3 | | **Surface Condition:** | **H** | |
| **Landform** | Elevation: | 136 | **Permeability:** | **1** | |
| | Slope (%): | 2 | **Drainage:** | **3** | |
| | Relief: | | **Run-off:** | **3** | |

**[Geoffrey - Creek Cutting]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ae | 0-45 | C | 10YR4/3 | - | LC | - | V | - | D5 | 20 | 5.5 |
| B | 45→ | | 10YR6/6 | M41DYD | HC | - | S3AB | 2NN1 | D5 | 70 | 7 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

**Vegetation:** E. crebra

**Notes:** Creek cutting site (no samples taken)

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 23/06/2018 | | **Site:** | DP19 | |
| **Location:** | Matt | | **Coordinates:** | E 0728412 | N 7382010 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Foot slope | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Lower slope | | **S C Fragments:** | - | |
| **Site Disturbance:** | 4 | | **Substrate:** | Q. alluvium/colluvium | |
| **Erosion:** | Stable | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 145 | **Permeability:** | 2 | |
| | Slope (%): | 2 | **Drainage:** | 3 | |
| | Relief: | | **Run-off:** | 3 | |

**[Geoffrey]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-10 | C | 5YR4/2 | - | SCL | 22UM-S | W2PO | - | D3 | 5 | 6.5 |
| A2e | 10-22 | D | 5YR7/1 (D)<br>5YR4/2 (W) | - | SCL | 22UM-S | V | - | D3 | 15 | 6.5 |
| A3e | 22-48 | D | 5YR8/1 (D)<br>5YR6/2 (W) | - | LSC | 22RM-S | G | 2NN2 | D1 | 30 | 6.5 |
| B1 | 48-65 | C | 5YR6/2 | M3FOD | SLMC | 12AM-S | W2SB | 3NN2 | D4 | 55 | 6.5 |
| B2 | 65-85 | | 5YR6/2 | M3FOD | MC | - | W2LE | | D4 | 75 | 6 |

**Vegetation:** E. crebra, E. tesselaris, E. populnea, C. brewsteri

**Notes:** Beige flats/rises (Geoffrey)

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 23/06/.2018 | | **Site:** | DP20 | |
| **Location:** | Matt | | **Coordinates:** | E 0730151 | N 7382804 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Drainage depression | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Depression | | **S C Fragments:** | 32UM-S | |
| **Site Disturbance:** | 2 | | **Substrate:** | Sandstone or mudstone | |
| **Erosion:** | A3 | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 153 | **Permeability:** | 1 | |
| | Slope (%): | | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 4 | |

**[Geoffrey - Creek Cutting]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1e | 0-20 | C | 10YR4/3 | - | SL | - | V | - | D4 | 10 | 5 |
| B2 | 20→ | | 10YR6/6 | M41DYD | MHC | - | M3LE | 2NN1 | D5 | 50 | 6.5 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

**Vegetation:** A. rhodoxylon, E. crebra

**Notes:** Creek cutting, same as DP18/19 (Geoffrey)

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 23/06/2018 | | **Site:** | DP21 | |
| **Location:** | Matt | | **Coordinates:** | E 0731807 | N 7384730 |
| **Landform Pattern:** | Plain | | **Micro Relief:** | - | |
| **Landform Element:** | Plain | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Flat | | **S C Fragments:** | - | |
| **Site Disturbance:** | 3 | | **Substrate:** | Q. alluvium/colluvium | |
| **Erosion:** | Stable | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 143 | **Permeability:** | 2 | |
| | Slope (%): | 2 | **Drainage:** | 3 | |
| | Relief: | | **Run-off:** | 2 | |

**[Kosh]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-8 | C | 7.5YR4/3 | - | SL | - | W2LE | - | D2 | 5 | 6 |
| B1 | 8-28 | C | 5YR4/3 | - | LMC | - | W3LE | - | D4 | 20 | 6 |
| B2 | 28-70 | | 5YR4/4 | - | MC | - | V | - | D5 | 50 | 6.5 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

**Vegetation:** V. nilotica, C. spinarum, E. tesselaris, E. tereticornis (shrubs)

**Notes:** Different unit – more blocky structure in top soils than powdery unit (Geoffrey).

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 23/06/2018 | | **Site:** | DP22 | |
| **Location:** | Matt | | **Coordinates:** | E | N |
| **Landform Pattern:** | Plain | | **Micro Relief:** | - | |
| **Landform Element:** | Plain | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Flat | | **S C Fragments:** | - | |
| **Site Disturbance:** | 4 | | **Substrate:** | Q. alluvium | |
| **Erosion:** | Stable | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 149 | **Permeability:** | 2 | |
| | Slope (%): | 1 | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 2 | |

**[Kosh]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-10 | C | 5YR4/3 | - | LMC | - | M2AB | - | D4 | 5 | 6 |
| A2e | 10-22 | A | 5YR6/2 (D)<br>5YR4/2 (W) | - | LC | - | V | - | D4 | 15 | 6 |
| B2 | 22-85 | | 7.5YR3/4 | - | MHC | - | M4LE | - | T5 | 40 | 6 |
| | | | | | | | | | | 70 | 7.5 |
| | | | | | | | | | | | |

**Vegetation:** Cleared with V. nilotica, C. lasiantha

**Notes:** Different unit to other texture contrast soils. Clay is dark brown not grey, and bleached horizons are very shallow. B2 is soapy.

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 24/06/2018 | | **Site:** | DP23 | |
| **Location:** | Matt | | **Coordinates:** | E 0730391 | N 7384342 |
| **Landform Pattern:** | Plain | | **Micro Relief:** | - | |
| **Landform Element:** | Plain | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Flat | | **S C Fragments:** | - | |
| **Site Disturbance:** | 4 | | **Substrate:** | Q. alluvium | |
| **Erosion:** | Stable | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 113 | **Permeability:** | 2 | |
| | Slope (%): | 1 | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 2 | |

**[Kosh]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-10 | C | 5YR3/3 | - | MC | - | W2SB | - | D5 | 5 | 6 |
| B21 | 10-24 | D | 5YR3/2 | - | MHC | - | M3AB | - | D4 | 15 | 6 |
| B22 | 24-44 | D | 5YR3/3 | - | MHC | - | M2LE | - | T4 | 30 | 6 |
| B23 | 44-73 | | 7.5YR3/4 | - | MHC | - | M3LE | - | T4 | 50 | 6.5 |
| | | | | | | | | | | 70 | 7.5 |

**Vegetation:** Cleared with V. nilotica

**Notes:** Same as DP22. Soapy B23.

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 24/06/18 | | **Site:** | DP24 | |
| **Location:** | Matt | | **Coordinates:** | E 0729605 | N 7383991 |
| **Landform Pattern:** | Plain or alluvial plain | | **Micro Relief:** | - | |
| **Landform Element:** | Plain | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Flat | | **S C Fragments:** | - | |
| **Site Disturbance:** | 4 | | **Substrate:** | Q. alluvium | |
| **Erosion:** | Stable | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 117 | **Permeability:** | 3 | |
| | Slope (%): | 1 | **Drainage:** | 4 | |
| | Relief: | | **Run-off:** | 2 | |

[BOUNDARY]

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-10 | C | 10YR3/4 | - | L | - | G | - | D2 | 5 | 6.5 |
| A2e | 10-23 | A | 10YR6/3 (D)<br>10YR4/3 (W) | - | SL | - | M3PL | - | D2 | 15 | 6.5 |
| B1 | 23-54 | D | 7.5YR4/6 | - | SL | - | V | - | D1 | 35 | 6.5 |
| B2 | 54-85 | | 7.5YR5/6 | - | SCL | - | W2SB | 2MN2 | D4 | 60 | 6.5 |
| | | | | | | | | | | 80 | 6.5 |

**Vegetation:** Cleared. Small E. populnea and C. brewsteri

**Notes:** Alluvial unit. Closer to river. Sandier soil than DP22/23 – no clay horizon. Potential boundary unit?

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 24/06/2018 | | **Site:** | DP25 | |
| **Location:** | Matt | | **Coordinates:** | E 0727595 | N 7383271 |
| **Landform Pattern:** | Plain | | **Micro Relief:** | - | |
| **Landform Element:** | Plain | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Flat | | **S C Fragments:** | - | |
| **Site Disturbance:** | 4 | | **Substrate:** | Q. alluvium | |
| **Erosion:** | Stable | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 115 | **Permeability:** | 2 | |
| | Slope (%): | 1 | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 2 | |

**[Kosh]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1j | 0-9 | C | 5YR6/3 (D)<br>7.5YR3/4 (W) | - | SCL | - | V | - | D2 | 5 | 6 |
| A2e | 9-23 | D | 7.5YR7/4 (D)<br>7.5YR4/4 (W) | - | SLC | - | V | - | D3 | 15 | 6 |
| B1 | 23-33 | C | 7.5YR4/4 | - | MC | - | M4LE | - | D5 | 30 | 6 |
| B2 | 33-65 | | 5YR3/4 | - | MHC | - | W3LE | - | D5 | 40 | 7 |
| | | | | | | | | | | 60 | 8 |

**Vegetation:** Cleared with V. nilotica, C. lasiantha. More alluvial units seem to have E. populnea (DP24)

**Notes:** Same as DP22 and DP23 – likely sodic. Soapy B2.

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 24/06/2018 | | **Site:** | DP26 | |
| **Location:** | Matt | | **Coordinates:** | E 0726714 | N 7383558 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Hill slope | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Upper slope | | **S C Fragments:** | - | |
| **Site Disturbance:** | 2 | | **Substrate:** | Coarse grained sed – iron-rich | |
| **Erosion:** | Stable | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 124 | **Permeability:** | 2 | |
| | Slope (%): | 6 | **Drainage:** | 4 | |
| | Relief: | | **Run-off:** | 4 | |

**[Anderson]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-10 | D | 10YR3/2 | - | SL | - | V | - | D2 | 5 | 4.5 |
| A2e | 10-32 | C | 10YR6/3 (D)<br>5YR4/4 (W) | - | SL | 33SM | V | - | D2 | 15 | 5.0 |
| B21 | 32-50 | D | 10YR5/3 | M3FR1 | MC | - | M2PO | - | D5 | 35 | 5.5 |
| B22 | 50-75 | | 10YR6/2 | M4DR2 | MC | - | S2AB | - | D4 | 60 | 5.5 |
| | | | | | | | | | | 70 | 5.5 |

**Vegetation:** E. crebra, A. rhodoxylon

**Notes:** Almost at crest of hill. Not many hills on this property.

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 24/06/2018 | | **Site:** | DP27 | |
| **Location:** | Matt | | **Coordinates:** | E 0725835 | N 7384918 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Hill slope | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Lower slope | | **S C Fragments:** | - | |
| **Site Disturbance:** | 2 | | **Substrate:** | Q. alluvium | |
| **Erosion:** | Stable | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 130 | **Permeability:** | 2 | |
| | Slope (%): | 3 | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 3 | |

**[Kosh]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-9 | D | 7.5YR4/3 | - | CL | - | W1SB | - | D4 | 5 | 6 |
| B1 | 9-25 | S | 7.5YR4/3 | - | MC | - | W2SB | - | D4 | 15 | 6 |
| B21j | 25-38 | C | 10YR7/4 (D)<br>7.5YR4/4 (W) | - | MHC | - | W2LE | - | D3 | 30 | 6 |
| B22 | 38-60 | | 10YR4/6 | - | MHC | - | M2LE | - | T5 | 45 | 6.5 |
| | | | | | | | | | | 60 | 7.5 |

**Vegetation:** E. crebra, E. populnea, C. brewsteri

**Notes:** Another one like DP22/23 (Kosh). Soapy B22 suggests sodic subsoil.

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 24/06/2018 | | **Site:** | DP28 | |
| **Location:** | Matt | | **Coordinates:** | E 0726342 | N 7383254 |
| **Landform Pattern:** | Plain | | **Micro Relief:** | - | |
| **Landform Element:** | Plain | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Flat | | **S C Fragments:** | - | |
| **Site Disturbance:** | 4 | | **Substrate:** | Q. alluvium | |
| **Erosion:** | Stable | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 122 | **Permeability:** | 2 | |
| | Slope (%): | 2 | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 2 | |

[BOUNDARY]

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-8 | D | 7.5YR4/3 | - | SL | - | W2AB | - | D2 | 5 | 7.5 |
| A2j | 8-28 | D | 7.5YR6/4 (D)<br>7.5YR4/4 (W) | - | SL | - | V | - | D2 | 20 | 6.5 |
| A3j | 28-44 | A | 5YR6/4 (D)<br>5YR4/6 (W) | - | SL | - | V | - | D3 | 35 | 6 |
| B2 | 44-75 | | 5YR4/4 | - | MC | - | M2LE | - | T5 | 50 | 5.5 |
| | | | | | | | | | | 65 | 6 |

**Vegetation:** Cleared, A. salicina, E. populnea shrubs

**Notes:** Appears to be different unit. Deep surface soils. Red clay subsoil. Neutral surface with acidic subsurface. Could be Kosh/Anderson?

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 24/06/2018 | | **Site:** | DP29 | |
| **Location:** | Matt | | **Coordinates:** | E 0727377 | N 7382782 |
| **Landform Pattern:** | Alluvial plain | | **Micro Relief:** | - | |
| **Landform Element:** | Levee | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Depression/flat | | **S C Fragments:** | - | |
| **Site Disturbance:** | 2 | | **Substrate:** | Q. alluvium | |
| **Erosion:** | Stable | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 124 | **Permeability:** | 3 | |
| | Slope (%): | 3 | **Drainage:** | 4 | |
| | Relief: | | **Run-off:** | 4 | |

**[Barry]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-15 | D | 7.5YR3/3 | - | MC | - | M3PO | - | D2 | 8 | 6 |
| B21 | 15-33 | D | 7.5YR4/4 | - | MHC | - | M3PO | - | D3 | 25 | 6 |
| B22 | 33-80 | | 7.5YR3/2 | - | MC | - | M4PO | - | D3 | 40 | 6 |
| | | | | | | | | | | 60 | 6 |
| | | | | | | | | | | 80 | 6 |

**Vegetation:** E. tesselaris, E. populnea, L. hookeri, C. spinarum, C. brewsteri

**Notes:** Alluvial unit

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 24/06/18 | | **Site:** | DP30 | |
| **Location:** | Matt | | **Coordinates:** | E 0728190 | N 7383971 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Hill slope | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Mid slope | | **S C Fragments:** | - | |
| **Site Disturbance:** | 2-4 (on fence) | | **Substrate:** | Sandstone or mudstone | |
| **Erosion:** | Stable | | **Surface Condition:** | L | |
| **Landform** | Elevation: | 141 | **Permeability:** | 1 | |
| | Slope (%): | 4 | **Drainage:** | 1 | |
| | Relief: | | **Run-off:** | 3 | |

**[Geoffrey]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-8 | D | 7.5YR4/2 | - | SL | - | V | - | D2 | 5 | 6 |
| A2j | 8-30 | D | 7.5YR6/3 (D)<br>7.5YR4/3 (W) | - | S | - | G | - | D1 | 20 | 6 |
| A3e | 30-72 | A | 7.5YR7/2 (D)<br>10YR6/3 (W) | - | S | - | G | - | D1 | 50 | 6 |
| B2 | 72-95 | | 10YR6/4 | M4DR/OS | MC | - | M2AB | - | T5 | 80 | 6 |
| | | | | | | | | | | 90 | 6 |

**Vegetation:** A. excelsa, M. leucadendra, P. pubecens, C. clarksoniana

**Notes:** Same as DP18/19 (Geoffrey) from Atkinson. Pale bleached sands over grey clay with orange mottles.

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 24/06/2018 | | **Site:** | DP31 | |
| **Location:** | Matt | | **Coordinates:** | E 0729088 | N 3783173 |
| **Landform Pattern:** | Plain | | **Micro Relief:** | - | |
| **Landform Element:** | Plain | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Flat | | **S C Fragments:** | - | |
| **Site Disturbance:** | 4 | | **Substrate:** | Q. alluvium | |
| **Erosion:** | Stable | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 147 | **Permeability:** | 2 | |
| | Slope (%): | 1 | **Drainage:** | 4 | |
| | Relief: | | **Run-off:** | 1 | |

**[Kosh]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-8 | D | 7.5YR4/4 | - | CL | - | V | - | D2 | 5 | 6.5 |
| A2e | 8-25 | C | 7.5YR6/4 (D)<br>7.5YR4/4 (W) | - | CL | - | V | - | D2 | 20 | 7 |
| B1j | 25-38 | D | 5YR4/6 (D)<br>5YR4/4 (W) | - | MC | - | W3AB | - | D4 | 30 | 6.5 |
| B2 | 38-80 | | 5YR4/6 | - | MC | - | M2LE | - | D5 | 45 | 6 |
| | | | | | | | | | | 80 | 6.5 |

**Vegetation:** Cleared, C. brewsteri, E. populnea, A. harpophylla, A. salicina

**Notes:** No alkaline subsoil here. Too close to creek?

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 24/06/2018 | | **Site:** | DP32 | |
| **Location:** | Matt | | **Coordinates:** | E 0729720 | N 7385206 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Hill slope | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Simple slope | | **S C Fragments:** | - | |
| **Site Disturbance:** | 2 | | **Substrate:** | Sandstone | |
| **Erosion:** | Stable | | **Surface Condition:** | S | |
| **Landform** | Elevation: | | **Permeability:** | 1 | |
| | Slope (%): | | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 3 | |

**[Geoffrey]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-10 | C | 5YR4/2 | - | LS | - | G | - | D1 | 5 | 5.5 |
| A2e | 10-60 | C | 5YR7/2 (D)<br>5YR 5/2 (W) | - | S | - | G | - | D1 | 35 | 6 |
| A3j | 60-70 | A | 5YR8/2 (D)<br>5YR7/3 (W) | - | LS | - | G | - | D1 | 65 | 6.5 |
| B2 | 70-90 | | 5YR7/2 | M42DOC | MC | - | M3LE | - | D5 | 80 | 7.5 |
| | | | | | | | | | | | |

**Vegetation:** M. leucadendra, C. clarksoniana, C. cunninghamiana, E. tereticornis

**Notes:** Geoffrey

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 25/06/2018 | | **Site:** | DP33 | |
| **Location:** | Matt | | **Coordinates:** | E 0727686 | N 7385306 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Hill crest | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Crest | | **S C Fragments:** | - | |
| **Site Disturbance:** | 4 | | **Substrate:** | Sandstone | |
| **Erosion:** | Stable | | **Surface Condition:** | F | |
| **Landform** | Elevation: | 131 | **Permeability:** | 1 | |
| | Slope (%): | 2 | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 3 | |

**[Geoffrey]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-10 | C | 5YR3/3 | - | LS | - | V | - | D2 | 5 | 6 |
| A2 | 10-70 | D | 5YR4/6 | - | S | - | G | - | D1 | 40 | 6 |
| A3j | 70-83 | A | 7.5YR6/6 (D)<br>7.5YR5/6 (W) | - | S | - | G | - | D2 | 75 | 6 |
| B2 | 83-100 | | 7.5YR5/3 | M42PRS | MHC | - | M5LE | - | T5 | 90 | 5.5 |
| | | | | | | | | | | | |

**Vegetation:** Cleared. A. harpophylla saplings, nearby veg C. clarksoniana, C. cunninghamiana, M. leucadendra

**Notes:** Sand appears less obviously bleached at crest vs. mid-lower slopes. Water available for less time. Mottling very prominent, though only red – no orange. Less variable water table.

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 25/06/2018 | | **Site:** | DP34 | |
| **Location:** | Matt | | **Coordinates:** | E 0728311 | N 7385163 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Foot slope | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Lower slope | | **S C Fragments:** | - | |
| **Site Disturbance:** | 4 | | **Substrate:** | Q. alluvium | |
| **Erosion:** | Stable | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 117 | **Permeability:** | 2 | |
| | Slope (%): | 2 | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 3 | |

**[Kosh]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-12 | D | 10YR3/3 | - | SCL | - | W3SB | - | D2 | 5 | 6 |
| A2e | 12-24 | C | 10YR7/3 (D)<br>10YR6/3 (W) | - | SCL | - | V | - | D3 | 17 | 6 |
| B2 | 24-80 | | 10YR5/6 | - | MHC | - | M2LE | - | T5 | 30 | 6 |
| | | | | | | | | | | 50 | 7.5 |
| | | | | | | | | | | 70 | 8 |

**Vegetation:** Cleared with V. nilotica, C. spinarum

**Notes:** Kosh

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 25/06/2018 | | **Site:** | DP35 | |
| **Location:** | Matt | | **Coordinates:** | E 0730393 | N 7384004 |
| **Landform Pattern:** | Plain | | **Micro Relief:** | - | |
| **Landform Element:** | Plain | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Flat | | **S C Fragments:** | - | |
| **Site Disturbance:** | 2 | | **Substrate:** | Q. alluvium | |
| **Erosion:** | Stable | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 97 | **Permeability:** | 2 | |
| | Slope (%): | 3 | **Drainage:** | 4 | |
| | Relief: | | **Run-off:** | 3 | |

**[Kosh]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-8 | D | 7.5YR4/3 | - | LC | - | V | - | D4 | 5 | 6 |
| A2j | 8-32 | C | 7.5YR5/4 (D)<br>7.5YR3/4 (W) | - | MC | - | W3AB | - | D3 | 20 | 6 |
| B2 | 32-85 | | 7.5YR3/4 | - | MHC | - | M3LE | - | T4 | 40 | 6 |
| | | | | | | | | | | 60 | 6.5 |
| | | | | | | | | | | 80 | 7.5 |

**Vegetation:** E. teritecornis, A. hemiglauca, A. salicina, L. hookeri

**Notes:** Kosh

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 25/06/2018 | | **Site:** | DP36 | |
| **Location:** | Matt | | **Coordinates:** | E 0730325 | N 7383633 |
| **Landform Pattern:** | Alluvial plain | | **Micro Relief:** | - | |
| **Landform Element:** | Levee | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Flat | | **S C Fragments:** | - | |
| **Site Disturbance:** | 2 | | **Substrate:** | Q. alluvium | |
| **Erosion:** | AN | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 99 | **Permeability:** | 4 | |
| | Slope (%): | 2 | **Drainage:** | 4 | |
| | Relief: | | **Run-off:** | 3 | |

**[Barry]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-18 | D | 5YR3/4 | - | CL | - | W3PL | - | D4 | 10 | 6.5 |
| A3 | 18-70 | D | 5YR4/4 | - | SCL | - | V | - | D3 | 40 | 6.5 |
| B2 | 70-95 | | 5YR3/3 | - | SLMC | - | W1LE | - | D4 | 80 | 6.5 |
| | | | | | | | | | | 95 | 6.5 |
| | | | | | | | | | | | |

**Vegetation:** E. tesselaris, E. populnea, E. tereticornis

**Notes:** DP35 is not ALP but PLA, not LEV but PLA.

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 25/06/2018 | | **Site:** | DP37 | |
| **Location:** | Beath | | **Coordinates:** | E | N |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Hill Crest | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Crest | | **S C Fragments:** | 2MN2-S | |
| **Site Disturbance:** | 3 | | **Substrate:** | Coarse iron sandstone | |
| **Erosion:** | Stable | | **Surface Condition:** | H | |
| **Landform** | Elevation: | | **Permeability:** | 3 | |
| | Slope (%): | | **Drainage:** | 3 | |
| | Relief: | | **Run-off:** | 3 | |

**[Anderson]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-20 | D | 5YR4/4 | - | CL | - | V | - | D3 | 10 | 4.5 |
| A2 | 20-40 | D | 5YR4/4 | - | LMC | 12RM | W2PL | - | D3 | 30 | 4.5 |
| B2 | 40-82 | D | 5YR4/6 | - | LMC | 32AM | W1LE | 1MN1 | D5 | 60 | 5.5 |
| B3 | 82-97 | | 5YR4/6 | - | LC | 11UM | V | - | D4 | 90 | 5.8 |
| | | | | | | | | | | | |

**Vegetation:** E. australe, C. clarksoniana, E. crebra, A. rhodoxylon

**Notes:** Red soil

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 25/06/2018 | | **Site:** | DP38 | |
| **Location:** | Beath | | **Coordinates:** | E 0724862 | N 7386456 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Hill slope | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Mid-slope | | **S C Fragments:** | - | |
| **Site Disturbance:** | 3 | | **Substrate:** | Sandstone | |
| **Erosion:** | Stable | | **Surface Condition:** | S | |
| **Landform** | Elevation: | 150 | **Permeability:** | 2 | |
| | Slope (%): | | **Drainage:** | 3 | |
| | Relief: | | **Run-off:** | 3 | |

**[Geoffrey]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-15 | C | 10YR3/3 | - | SLC | - | V | - | D2 | 5 | 5.5 |
| A2j | 15-55 | D | 10YR6/3 (D)<br>10YR5/3 (W) | - | SLC | - | G | - | D1 | 30 | 4.5 |
| B1j | 55-72 | D | 10YR7/4 (D)<br>10YR5/4 (W) | - | SLC | - | V | - | D2 | 60 | 4.5 |
| B2 | 72-90 | | 10YR6/4 | M31FO/YD | SLC | - | W2SB | - | D4 | 90 | 5 |
| | | | | | | | | | | | |

**Vegetation:** M. leucadendra, Acacia sp.

**Notes:** This sand is much deeper than other Geoffrey units.

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 25/06/2018 | | **Site:** | DP39 | |
| **Location:** | Bradbury | | **Coordinates:** | E 0729901 | N 7386161 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Hill slope | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Mid-slope | | **S C Fragments:** | - | |
| **Site Disturbance:** | 2 | | **Substrate:** | Sandstone | |
| **Erosion:** | Stable | | **Surface Condition:** | S | |
| **Landform** | Elevation: | 141 | **Permeability:** | 1 | |
| | Slope (%): | 3 | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 2 | |

**[Geoffrey]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1j | 0-8 | C | 10YR6/3 (D)<br>10YR4/4 (W) | - | LS | - | G | - | D2 | 5 | 4.8 |
| A2e | 8-36 | A | 10YR7/4 (D)<br>10YR4/6 (W) | - | LS | - | G | - | D2 | 20 | 4.8 |
| B2 | 36-72 | | 10YR6/4 | M42DOD | MHC | - | M5LE | - | D6 | 40 | 6 |
| | | | | | | | | | | 55 | 6 |
| | | | | | | | | | | 70 | 7 |

**Vegetation:** C. clarksoniana, A. excelsa, P. pubecens, E. crebra

**Notes:**

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 25/06/2018 | | **Site:** | DP40 | |
| **Location:** | Bradbury | | **Coordinates:** | E 0729623 | N 7386575 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Hill crest | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Crest | | **S C Fragments:** | - | |
| **Site Disturbance:** | - | | **Substrate:** | Fine sandstone | |
| **Erosion:** | Stable | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 142 | **Permeability:** | 2 | |
| | Slope (%): | 3 | **Drainage:** | 4 | |
| | Relief: | | **Run-off:** | 2 | |

**[Ellesmere]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-10 | D | 7.5YR3/4 | - | FSL | - | M3PL | - | D2 | 5 | 5 |
| A2 | 10-20 | D | 7.5YR3/4 | - | SCL | - | G | - | D2 | 15 | 4.5 |
| B1 | 20-40 | D | 7.5YR4/4 | - | LC | - | G | - | D2 | 30 | 4.5 |
| B2 | 40-65 | C | 5YR4/6 | | MC | - | M2PO | - | D4 | 50 | 5.5 |
| B3 | 65-87 | | 7.5YR6/3 | | MC | - | M2PO | - | T5 | 70 | 5.5 |

**Vegetation:** A. sherleyi

**Notes:** Similar looking to Geoffrey but with different veg and less sandy. Also highly acidic.

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 26/06/2018 | | **Site:** | DP41 | |
| **Location:** | Alan | | **Coordinates:** | E 0727396 | N 7386922 |
| **Landform Pattern:** | Plain | | **Micro Relief:** | - | |
| **Landform Element:** | Plain | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Flat | | **S C Fragments:** | - | |
| **Site Disturbance:** | 4 | | **Substrate:** | Sandstone | |
| **Erosion:** | Stable | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 97 | **Permeability:** | 2 | |
| | Slope (%): | 1 | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 2 | |

**[Kosh – pale varient]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-10 | D | 5YR4/3 | - | L | - | W2SB | - | D3 | 5 | 6 |
| A2j | 10-30 | S | 7.5YR7/4 | - | L | - | V | - | D4 | 20 | 5.5 |
| B21j | 30-42 | C | 7.5YR7/4 | - | SMC | - | M2LE | - | D5 | 35 | 6 |
| B22 | 42-82 | | | - | MC | - | M3LE | - | D5 | 50 | 7 |
| | | | | | | | | | | 80 | 9 |

**Vegetation:** Cleared with C. spinarum and V. nilotica

**Notes:** Kosh. Not sandy enough for Geoffrey, in correct location for Kosh and has alkaline subsoil.

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 26/06/2018 | | **Site:** | DP42 | |
| **Location:** | Alan | | **Coordinates:** | E 0728049 | N 7387508 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Hill slope | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Upper slope | | **S C Fragments:** | - | |
| **Site Disturbance:** | 4 | | **Substrate:** | Sandstone | |
| **Erosion:** | Stable | | **Surface Condition:** | S | |
| **Landform** | Elevation: | 98 | **Permeability:** | 2 | |
| | Slope (%): | 5 | **Drainage:** | 4 | |
| | Relief: | | **Run-off:** | 3 | |

**[Geoffrey]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-13 | D | 10YR4/3 | - | LS | - | V | - | D1 | 8 | 5 |
| A2e | 13-44 | D | 10YR7/4 (D)<br>10YR5/4 (W) | - | S | - | G | - | D1 | 30 | 5 |
| A3e | 44-66 | C | 10YR7/4 (D)<br>10YR5/4 (W) | - | LS | - | V | - | D2 | 55 | 5 |
| B1j | 66-97 | A | 10YR6/4 (D)<br>10YR5/6 (W) | M22FR/OD | CS | - | W2SB | - | D2 | 75 | 6 |
| B2 | 97-110 | | 10YR6/6 | M42DR/OC | SLMC | - | M2LE | - | D4 | 90 | 6 |

**Vegetation:** Cleared with E. australe and C. clarksoniana shrubs

**Notes:** Geoffrey.

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 26/06/2018 | | **Site:** | DP43 | |
| **Location:** | Alan | | **Coordinates:** | E 0727017 | N 7387656 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Hill crest | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Crest | | **S C Fragments:** | - | |
| **Site Disturbance:** | 2 | | **Substrate:** | Sandstone | |
| **Erosion:** | Active sheet | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 138 | **Permeability:** | 3 | |
| | Slope (%): | 3 | **Drainage:** | 3 | |
| | Relief: | | **Run-off:** | 2 | |

**[Nigel]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 0-20 | D | 10YR3/3 | - | S | - | V | - | D1 | 5 | 4.8 |
| A2 | 20-63 | D | 2.5YR3/6 | - | S | - | G | - | D1 | 30 | 5.5 |
| B1 | 63-68 | C | 2.5YR4/6 | - | LS | - | G | - | D2 | 50 | 5.5 |
| C | 68→ | | | | C (laterite pebbles) | | | | | 60 | 5.5 |
| | | | | | | | | | | | |

**Vegetation:** A. sherleyi and cleared

**Notes:** Same as laterite unit from Joan Bradbury's property (Nigel)

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 26/06/2018 | | **Site:** | DP44 | |
| **Location:** | Alan | | **Coordinates:** | E 0726526 | N 7387223 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Plain | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Flat | | **S C Fragments:** | - | |
| **Site Disturbance:** | 4 | | **Substrate:** | Sandstone or mudstone | |
| **Erosion:** | Stable | | **Surface Condition:** | S | |
| **Landform** | Elevation: | 146 | **Permeability:** | 1 | |
| | Slope (%): | 1 | **Drainage:** | 4 | |
| | Relief: | | **Run-off:** | 2 | |

**[Geoffrey]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-12 | D | 7.5YR3/4 | - | LS | - | V | - | D2 | 8 | 6 |
| A2e | 12-35 | C | 10YR6/4 (D)<br>10YR4/6 (W) | - | S | - | G | - | D2 | 20 | 6 |
| A3j | 35-67 | C | 10YR7/4 (D)<br>10YR5/8 (W) | - | LS | - | W1LE | - | D2 | 50 | 6 |
| B2 | 67-75 | | 10YR5/6 | Faint orange | SLMC | - | V | - | D5 | 70 | 6 |
| | | | | | | | | | | | |

**Vegetation:** Open clearing, pastures, near E. tesselaris, E. crebra, C. clarksoniana

**Notes:** Did not reach clay layer but still Geoffrey.

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 26/06/2018 | | **Site:** | DP45 | |
| **Location:** | Alan | | **Coordinates:** | E 0727775 | N 7385854 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Hill slope | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Upper slope | | **S C Fragments:** | - | |
| **Site Disturbance:** | 3 | | **Substrate:** | Sandstone or mudstone | |
| **Erosion:** | Stable | | **Surface Condition:** | S | |
| **Landform** | Elevation: | 128 | **Permeability:** | 1 | |
| | Slope (%): | 3 | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 2 | |

**[Geoffrey]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-12 | D | 7.5YR3/3 | - | SL | - | V | - | D1 | 8 | 4.8 |
| A2j | 12-55 | D | 7.5YR7/3 (D)<br>7.5YR464 (W) | - | SL | - | G | - | D1 | 30 | 5 |
| A3e | 55-61 | A | 10YR7/4 (D)<br>10YR6/3 (W) | - | S | - | G | - | D1 | 55 | 6 |
| B2 | 61-73 | | 10YR6/2 | 42PRC | MC | - | M3LE | - | D5 | 70 | 6 |
| | | | | | | | | | | | |

**Vegetation:** E. crebra, C. clarksoniana, Acacia spp.

**Notes:** Did not sample this site.

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 26/06/2018 | | **Site:** | DP46 | |
| **Location:** | Alan | | **Coordinates:** | E 0727034 | N 7386292 |
| **Landform Pattern:** | Drainage depression | | **Micro Relief:** | - | |
| **Landform Element:** | Levee | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Depression | | **S C Fragments:** | - | |
| **Site Disturbance:** | 3 | | **Substrate:** | Q. alluvium | |
| **Erosion:** | AW | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 115 | **Permeability:** | 1 | |
| | Slope (%): | 1 | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 3 | |

**[Geoffrey]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-15 | A | 10YR4/4 | - | LC | - | V | - | D5 | 10 | 5.8 |
| A2 | 15-50 | C | 10YR4/6 (W)<br>10YR7/4 (D) | - | MC | - | S3PO | - | D5 | 40 | 6 |
| B2 | 50-70 | | 7.5YR5/6 | | MC | - | S3AB | 2MN2 | D5 | 60 | 6.5 |
| | | | | | | | | | | 100 | 7 |
| | | | | | | | | | | | |

**Vegetation:** E. teritecornis, Acacia spp.

**Notes:** Second alluvial unit. Looks like alluvial variant of Geoffrey. Topsoil not as sandy or deep.

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 27/06/2018 | | **Site:** | DP47 | |
| **Location:** | Kevin | | **Coordinates:** | E 0732691 | N 7384997 |
| **Landform Pattern:** | Plain | | **Micro Relief:** | - | |
| **Landform Element:** | Plain | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Flat | | **S C Fragments:** | - | |
| **Site Disturbance:** | 4 | | **Substrate:** | Q. alluvium | |
| **Erosion:** | Stable | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 90 | **Permeability:** | 2 | |
| | Slope (%): | 2 | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 2 | |

**[Kosh]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-10 | C | 10YR3/3 | - | CL | - | W3PL | - | D2 | 5 | 6.5 |
| A2e | 10-21 | D | 10YR6/3 (D)<br>7.5YR4/3 (W) | - | CL | - | V | - | D4 | 15 | 7 |
| B21j | 21-33 | C | 7.5YR6/4 (D)<br>7.5YR4/4 (W) | - | MHC | - | W2AB | - | D5 | 25 | 7 |
| B22 | 33-70 | | 7.5YR3/3 | - | MHC | - | M3SB | - | D5 | 40 | 7 |
| | | | | | | | | | | 70 | 8.5 |

**Vegetation:** Cleared with C. lasiantha, V. nilotica, C. spinarum

**Notes:** Likely Kosh

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 27/06/2018 | | **Site:** | DP48 | |
| **Location:** | Kevin | | **Coordinates:** | E 0732221 | N 7386415 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Hill slope | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Upper slope | | **S C Fragments:** | - | |
| **Site Disturbance:** | 4 | | **Substrate:** | Iron-rich sandstone | |
| **Erosion:** | Stable | | **Surface Condition:** | S | |
| **Landform** | Elevation: | 95 | **Permeability:** | 4 | |
| | Slope (%): | 3 | **Drainage:** | 5 | |
| | Relief: | | **Run-off:** | 2 | |

**[Normanby]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-7 | C | 2.5YR4/4 | - | LS | - | G | - | D1 | 5 | 6.5 |
| A2 | 7-23 | D | 2.5YR3/3 | - | LS | - | V | - | T2 | 15 | 6.5 |
| B1 | 23-75 | D | 10R4/6 | - | LS | - | V | - | T3 | 35 | 6.5 |
| B2 | 75-90 | | 10R4/6 | - | SLMC | - | W1LE | - | T3 | 80 | 7 |
| | | | | | | | | | | | |

**Vegetation:** E. crebra, A. oleifolius, cleared

**Notes:** Red earth occupies upper slope in this area

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 27/06/2018 | | **Site:** | DP49 | |
| **Location:** | Bradbury | | **Coordinates:** | E 0730993 | N 7387688 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Hill slope | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Simple slope | | **S C Fragments:** | - | |
| **Site Disturbance:** | 3 | | **Substrate:** | Sandstone | |
| **Erosion:** | Stable | | **Surface Condition:** | F | |
| **Landform** | Elevation: | 107 | **Permeability:** | 1 | |
| | Slope (%): | 4 | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 3 | |

**[Geoffrey]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-10 | C | 7.5YR4/3 | - | LS | - | V | - | D2 | 5 | 5.5 |
| A2e | 10-36 | D | 10YR4/3 (W)<br>10YR6/3 (D) | - | LS | - | V | - | D1 | 25 | 6 |
| A3e | 36-54 | A | 10YR8/2 (D)<br>10YR6/4 (W) | - | LS | - | G | - | D1 | 45 | 6 |
| B2 | 54-80 | | 10YR6/3 | 32DY | MHC | - | M3LE | - | T4 | 60 | 7 |
| | | | | | | | | | | 80 | 7 |

**Vegetation:** C. cunninghamiana, E. teritecornis

**Notes:** Geoffrey

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 26/06/2018 | | **Site:** | DP50 | |
| **Location:** | Bradbury | | **Coordinates:** | E 0731220 | N 7385733 |
| **Landform Pattern:** | Plain | | **Micro Relief:** | - | |
| **Landform Element:** | Plain | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Flat | | **S C Fragments:** | - | |
| **Site Disturbance:** | 4 | | **Substrate:** | Iron-rich sandstone | |
| **Erosion:** | Stable | | **Surface Condition:** | S | |
| **Landform** | Elevation: | 119 | **Permeability:** | 3 | |
| | Slope (%): | 2 | **Drainage:** | 4 | |
| | Relief: | | **Run-off:** | 2 | |

**[Normanby]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-8 | D | 5YR4/3 | - | SL | - | V/G | - | D1 | 5 | 6 |
| A2 | 8-23 | D | 2.5YR4/3 | - | SL | - | G | - | D2 | 15 | 6 |
| B21 | 23-54 | D | 2.5YR4/6 | - | SL | - | G | - | D2 | 35 | 6 |
| B22 | 54-73 | | 2.5YR3/6 | - | SL | - | W1LE | - | D2 | 60 | 6 |
| | | | | | | | | | | | |

**Vegetation:** Cleared with E. crebra

**Notes:**

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 27/06/2017 | | **Site:** | DP51 | |
| **Location:** | Bradbury | | **Coordinates:** | E 0729334 | N 7387801 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Hill slope | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Simple slope | | **S C Fragments:** | - | |
| **Site Disturbance:** | 2 | | **Substrate:** | Iron rich sandstone | |
| **Erosion:** | Stable | | **Surface Condition:** | S | |
| **Landform** | Elevation: | 150 | **Permeability:** | 3 | |
| | Slope (%): | 3 | **Drainage:** | 4 | |
| | Relief: | | **Run-off:** | 2 | |

**[Nigel]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-11 | C | 10YR4/4 | - | LS | - | V | - | D1 | 5 | 5 |
| A2j | 11-30 | D | 5YR3/3 (W)<br>7.5YR5/6 (D) | - | LS | - | G | - | D2 | 20 | 5 |
| A3j | 30-45 | D | 10YR5/8 | - | SCL | - | G | - | D2 | 35 | 5.5 |
| B2 | 45-76 | C | 10YR5/6 | - | SLC | - | V | - | D3 | 60 | 5.5 |
| C | 76-86 | | | | | | | | | 80 | 6 |

**Vegetation:** M. leucadendra, C. clarksoniana, E. tesselaris, Acacia sp.

**Notes:**

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 27/06/2018 | | **Site:** | DP52 | |
| **Location:** | Bradbury | | **Coordinates:** | E 0729292 | N 7388122 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Hill slope | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Crest | | **S C Fragments:** | - | |
| **Site Disturbance:** | 1 | | **Substrate:** | Laterite | |
| **Erosion:** | Stable | | **Surface Condition:** | S | |
| **Landform** | Elevation: | 148 | **Permeability:** | 3 | |
| | Slope (%): | 5 | **Drainage:** | 3 | |
| | Relief: | | **Run-off:** | 3 | |

**[Nigel]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-22 | D | 7.5YR3/4 | - | LS | - | V | - | D2 | 10 | 5.5 |
| A2j | 22-40 | C | 5YR4/6 (W)<br>7.5YR5/8 (D) | - | CS | - | V | - | D1 | 30 | 5 |
| B2 | 40-60 | D | 7.5YR4/4 | - | CS | - | W2PO | - | D1 | 50 | 5.5 |
| B3 | 60-75 | | 10YR4/6 | - | CS | - | V | 1MN2 | D2 | 70 | 6 |
| | | | | | | | | | | | |

**Vegetation:** A. rhodoxylon, E. crebra

**Notes:** Unit is rosewood laterite

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 27/06/2018 | | **Site:** | DP53 | |
| **Location:** | Bradbury | | **Coordinates:** | E 0728508 | N 7388239 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Hill slope | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Upper slope | | **S C Fragments:** | - | |
| **Site Disturbance:** | 2 | | **Substrate:** | Sandstone or mudstone | |
| **Erosion:** | Stable | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 120 | **Permeability:** | 1 | |
| | Slope (%): | 4 | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 4 | |

**[Geoffrey]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-10 | D | 7.5YR3/3 | - | FSL | - | V | - | D1 | 5 | 6 |
| A2j | 10-24 | D | 10YR3/3 (D)<br>10YR6/2 (W) | - | CS | - | G | - | D1 | 18 | 6 |
| A3e | 24-42 | A | 10YR7/2 (D)<br>7.5YR5/3 (W) | - | LS | - | G | - | D1 | 35 | 5.5 |
| B2 | 42-58 | | 10YR5/2 | | MC | - | M3LE | - | D5 | 50 | 6 |
| | | | | | | | | | | | |

**Vegetation:** E. populnea, C. spinarum

**Notes:**

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 28/06/2018 | | **Site:** | DP54 | |
| **Location:** | Bradbury | | **Coordinates:** | E 0731040 | N 7386289 |
| **Landform Pattern:** | Plain | | **Micro Relief:** | - | |
| **Landform Element:** | Plain | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Flat | | **S C Fragments:** | - | |
| **Site Disturbance:** | 4 | | **Substrate:** | Sandstone or mudstone | |
| **Erosion:** | Stable | | **Surface Condition:** | L | |
| **Landform** | Elevation: | 112 | **Permeability:** | 1 | |
| | Slope (%): | 1 | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 2 | |

**[Geoffrey]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-9 | C | 10YR4/4 | - | LS | - | V | - | D1 | 5 | 6 |
| A2e | 9-29 | C | 7.5YR7/3 (D)<br>7.5YR5/3 (W) | - | LS | - | G | - | D2 | 20 | 6 |
| A3e | 29-38 | A | 10YR7/3 (D)<br>7.5YR6/4 (W) | - | LS | - | G | - | D2 | 35 | 6 |
| B2 | 38-45 | | 7.5YR5/3 | M42FOD | MHC | - | M2LE | - | D5 | 45 | 6.5 |
| | | | | | | | | | | | |

**Vegetation:** Cleared

**Notes:**

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 28/06/2018 | | **Site:** | DP55 | |
| **Location:** | Atkinson | | **Coordinates:** | E 0733270 | N 7383687 |
| **Landform Pattern:** | Ruse | | **Micro Relief:** | M and T (biotic) | |
| **Landform Element:** | Hill slope | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Upper slope | | **S C Fragments:** | - | |
| **Site Disturbance:** | 4 | | **Substrate:** | Mudstone or sandstone | |
| **Erosion:** | Stable | | **Surface Condition:** | H | |
| **Landform** | Elevation: | 105 | **Permeability:** | 1 | |
| | Slope (%): | 3 | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 2 | |

**[Geoffrey]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-10 | C | 10YR4/3 | - | LS | - | V | - | D2 | 5 | 6 |
| A2j | 10-20 | C | 10YR6/3 (D)<br>10YR4/6 (W) | - | LS | - | V | - | D3 | 15 | 6 |
| A31j | 20-46 | S | 10YR6/4 (D)<br>10YR6/4 (W) | - | LS | - | G | - | D2 | 35 | 6 |
| A32j | 46-52 | A | 10YR8/3 (D)<br>7.5YR6/4 (W) | - | LS | - | G | - | D1 | 48 | 6 |
| B2 | 52-62 | | 10YR5/6 | - | MHC | - | M2LE | - | T5 | 60 | 6.5 |

**Vegetation:** Cleared with gum shrubs (C. clarksoniana)

**Notes:** Lots of uneven ground

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 28/06/2018 | | **Site:** | DP56 | |
| **Location:** | Atkinson | | **Coordinates:** | E 0731652 | N 7383912 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Hill crest | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Crest | | **S C Fragments:** | - | |
| **Site Disturbance:** | 4 | | **Substrate:** | Sandstone or mudstone | |
| **Erosion:** | Stable | | **Surface Condition:** | S | |
| **Landform** | Elevation: | 103 | **Permeability:** | 1 | |
| | Slope (%): | 2 | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 3 | |

**[Geoffrey]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-10 | C | 10YR4/3 | - | LS | - | V | - | D1 | 5 | 6 |
| A2 | 10-19 | C | 10YR5/3 | - | LS | - | M2PL | - | D2 | 15 | 6 |
| A31e | 19-47 | D | 10YR8/4 (D)<br>7.5YR6/4 (W) | - | LS | - | V | - | D1 | 35 | 6 |
| A32e | 47-53 | A | 10YR8/4 (D)<br>7.5YR5/4 (W) | - | LS | - | V | - | D2 | 45 | 6 |
| B2 | 53-76 | | 10YR6/6 | M31FRD | MHC | - | M3LE | - | T5 | 55 | 7 |

**Vegetation:** Cleared.

**Notes:**

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 28/06/2018 | | **Site:** | DP57 | |
| **Location:** | Matt | | **Coordinates:** | E 0726879 | N 7381963 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Hill slope | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Mid slope | | **S C Fragments:** | - | |
| **Site Disturbance:** | 4 | | **Substrate:** | Sandstone or mudstone | |
| **Erosion:** | Stable | | **Surface Condition:** | F | |
| **Landform** | Elevation: | 112 | **Permeability:** | 1 | |
| | Slope (%): | 3 | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 3 | |

**[Geoffrey]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-9 | C | 7.5YR4/3 | - | SCL | - | V | - | D2 | 5 | 6 |
| A2 | 9-23 | D | 7.5YR6/4 | - | SCL | - | V | - | D3 | 30 | 6 |
| A31 | 23-70 | C | 7.5YR6/6 | - | SLC | - | V | - | D3 | 55 | 6 |
| A32e | 70-80 | A | 7.5YR5/6 | - | SLC | - | G | - | D2 | 75 | 6 |
| B2 | 80-100 | | 7.5YR5/6 | M42PRC | MC | - | M2LE | - | T5 | 100 | 6.5 |

**Vegetation:** Cleared with C. brewsteri

**Notes:** Higher in landscape = less bleaching and redder soil. (Geoffrey)

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 28/06/2018 | | **Site:** | DP58 | |
| **Location:** | Matt | | **Coordinates:** | E 0728775 | N 7384245 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Hill slope | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Mid slope | | **S C Fragments:** | - | |
| **Site Disturbance:** | 4 | | **Substrate:** | Sandstone or mudstone | |
| **Erosion:** | Stable | | **Surface Condition:** | S | |
| **Landform** | Elevation: | 131 | **Permeability:** | 1 | |
| | Slope (%): | 5 | **Drainage:** | 2 | |
| | Relief: | | **Run-off:** | 3 | |

**[Geoffrey]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-15 | C | 7.5YR4/4 | - | LS | - | V | - | D1 | 10 | 6 |
| A2e | 15-55 | C | 7.5YR7/3 (D)<br>7.5YR6/3 (W) | - | LS | - | V | - | D1 | 35 | 6 |
| A3e | 55-62 | A | 7.5YR7/3 (D)<br>7.5YR5/4 (W) | - | LS | - | V | - | D1 | 58 | 6.5 |
| B2 | 62-66 | | 7.5YR6/3 | - | MC | - | W2LE | - | D5 | 64 | 7 |
| | | | | | | | | | | | |

**Vegetation:** Cleared, M. leucadendra, C. cunninghamiana, C. clarksoniana

**Notes:**

Project Name: Dingo Soils

**[Site Description]**

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | 28/06/2018 | | **Site:** | DP59 | |
| **Location:** | Matt | | **Coordinates:** | E 0726749 | N 738337 |
| **Landform Pattern:** | Rise | | **Micro Relief:** | - | |
| **Landform Element:** | Hill slope | | **Rock Outcrops:** | - | |
| **Morphological Type:** | Lower slope | | **S C Fragments:** | - | |
| **Site Disturbance:** | 4 | | **Substrate:** | Fine sandstone | |
| **Erosion:** | Stable | | **Surface Condition:** | F | |
| **Landform** | Elevation: | 144 | **Permeability:** | 2 | |
| | Slope (%): | 4 | **Drainage:** | 3 | |
| | Relief: | | **Run-off:** | 3 | |

**[Kosh]**

**[Soil Description]**

| Horizon | Depth (cm) | Boundary | Colour | Mottles | Texture | Coarse Fragments | Structure | Segregations | Consistency | Field pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0-5 | C | 7.5YR2.5/3 | - | CL | - | W1LE | - | D2 | 5 | 6.5 |
| B21 | 5-24 | C | 7.5YR3/2 | - | CL | - | W2PO | - | D3 | 15 | 7 |
| B22j | 24-40 | C | 10YR4/3 (D)<br>10YR3/3 (W) | - | LC | - | W2AB | - | D3 | 30 | 7.5 |
| B23 | 40-68 | | 10YR3/4 | - | MC | - | M3LE | - | D5 | 45 | 8 |
| | | | | | | | | | | 60 | 8.5 |

**Vegetation:** Cleared with C. lasiantha, C. spinarum

**Notes:** B23 soapy. (Kosh)

# Appendix C Soil Observation Data

| Site Name | Date | Latitude | Longitude | Elevation | Soil Unit | Vegetation Notes |
|---|---|---|---|---|---|---|
| DO1 | 20/06/2018 | -23.69 | 149.24 | 136.51 | Namoi | E. crebra, E. tereticornis |
| DO2 | 21/06/2018 | -23.69 | 149.24 | 136.01 | Geoffrey | E. crebra, Acacia spp, C. clarksoniana |
| DO3 | 21/06/2018 | -23.69 | 149.25 | 136.75 | Geoffrey | E. populnea |
| DO4 | 21/06/2018 | -23.67 | 149.25 | 129.08 | *boundary* | W: A. rhodoxylon E: E. crebra, E. populnea |
| DO5 | 21/06/2018 | -23.67 | 149.26 | 130.10 | Wallace | Cleared |
| DO6 | 21/06/2018 | -23.67 | 149.26 | 125.32 | Charlevue | E. crebra, E. populnea |
| DO7 | 21/06/2018 | -23.67 | 149.26 | 127.57 | *boundary* | Cleared |
| DO8 | 21/06/2018 | -23.67 | 149.26 | 139.19 | *boundary* | N: Cleared S: E. crebra, E. populnea, E. tereticornis |
| DO9 | 21/06/2018 | -23.68 | 149.25 | 143.03 | Geoffrey | E. crebra, silver wattle, E. exerta |
| DO10 | 21/06/2018 | -23.68 | 149.24 | 172.43 | *boundary* | E: E. crebra, A. rhodoxylon |
| DO11 | 21/06/2018 | -23.68 | 149.24 | 168.21 | Geoffrey | Cleared |
| DO12 | 21/06/2018 | -23.68 | 149.25 | 163.36 | Geoffrey | Cleared |
| DO13 | 21/06/2018 | -23.68 | 149.25 | 157.39 | *boundary* | Cleared |
| DO14 | 21/06/2018 | -23.68 | 149.26 | 126.09 | Geoffrey | E. crebra. Silver wattle |
| DO15 | 21/06/2018 | -23.67 | 149.26 | 120.15 | *boundary* | |
| DO16 | 21/06/2018 | -23.67 | 149.26 | 120.78 | *boundary* | Cleared |
| DO17 | 21/06/2018 | -23.67 | 149.26 | | *boundary* | A. rhodoxylon, E. populnea |
| DO18 | 21/06/2018 | -23.67 | 149.26 | 123.08 | Wallace | E. populnea, F. dissosperma |
| DO19 | 21/06/2018 | -23.67 | 149.26 | 122.75 | *boundary* | Silver leaf iron bark |
| DO20 | 21/06/2018 | -23.66 | 149.27 | 132.22 | Unsure | A. rhodoxylon, E. crebra |
| DO21 | 21/06/2018 | -23.66 | 149.27 | 126.74 | *boundary* | A. rhodoxylon, E. crebra |
| DO22 | 21/06/2018 | -23.66 | 149.27 | 118.17 | Geoffrey | A. rhodoxylon, E. crebra |
| DO23 | 22/06/2018 | -23.66 | 149.27 | 116.85 | *boundary* | A. rhodoxylon, E. populnea |
| DO24 | 22/06/2018 | -23.66 | 149.27 | 123.34 | Charlevue | E. populnea, A. rhodoxylon, F. dissosperma |
| DO25 | 22/06/2018 | -23.65 | 149.28 | 115.16 | Charlevue | E. populnea, A. rhodoxylon, F. dissosperma |
| DO26 | 22/06/2018 | -23.66 | 149.28 | 110.70 | *boundary* | E: E. crebra, E. tereticornis W: E. populnea, F. dissosperma |
| DO27 | 22/06/2018 | -23.65 | 149.29 | 107.36 | Charlevue | E. populnea, C. spinarum |
| DO28 | 22/06/2018 | -23.65 | 149.29 | 121.09 | *boundary* | N: E. crebra S: E. populnea |
| DO29 | 22/06/2018 | -23.64 | 149.29 | 151.43 | Geoffrey | E. crebra |
| DO30 | 22/06/2018 | -23.63 | 149.29 | 148.82 | Geoffrey | W: E. populnea, C. cunninghamiana E: E. crebra |
| DO31 | 22/06/2018 | -23.69 | 149.25 | 141.68 | *boundary* | N: C. cunninghamiana, silver wattle S: C. clarksoniana, E. crebra, E. tesselaris |
| DO32 | 22/06/2018 | -23.69 | 149.25 | 137.70 | *boundary* | W: E. populnea, F. dissosperma E: C. cunninghamiana, silver wattle |
| DO33 | 22/06/2018 | -23.68 | 149.26 | 123.72 | Geoffrey | E. crebra, E. tesselaris. C. cunninghamiana |
| DO34 | 22/06/2018 | -23.66 | 149.25 | 142.72 | Kosh | E. crebra, C. clarksoniana, A. rhodoxylon |
| DO35 | 22/06/2018 | -23.66 | 149.25 | 134.31 | Kosh | Cleared with C. spinarum, C. lasiantha, V. nilotica |
| DO36 | 22/06/2018 | -23.66 | 149.25 | 133.08 | *boundary* | NW: Cleared with C. spinarum SE: A. rhodoxylon, E. crebra |

| Site Name | Date | Latitude | Longitude | Elevation | Soil Unit | Vegetation Notes |
|---|---|---|---|---|---|---|
| DO37 | 22/06/2018 | -23.66 | 149.25 | 130.55 | Kosh | Cleared, C. spinarum, C. lasiantha |
| DO38 | 22/06/2018 | -23.66 | 149.23 | 119.76 | Kosh | Cleared, V. nilotica |
| DO39 | 22/06/2018 | -23.67 | 149.24 | 131.19 | James | C. clarksoniana, E. crebra Charlevue, A. rhodoxylon |
| DO40 | 23/06/2018 | -23.66 | 149.25 | 136.54 | James | E. crebra, A. rhodoxylon |
| DO41 | 23/06/2018 | -23.66 | 149.25 | 130.72 | *boundary* | N: A. rhodoxylon S: E. crebra, A. rhodoxylon, E. populnea |
| DO42 | 23/06/2018 | -23.66 | 149.25 | 131.46 | James | C. clarksoniana, E. crebra, A. rhodoxylon |
| DO43 | 23/06/2018 | -23.66 | 149.24 | 137.23 | *boundary* | W: E. crebra, C. clarksoniana, A. rhodoxylon E: E. crebra, C. clarksoniana |
| DO44 | 23/06/2018 | -23.66 | 149.24 | 133.07 | *boundary* | NE: E. crebra, SW: Cleared |
| DO45 | 23/06/2018 | -23.65 | 149.24 | 134.12 | Barry | L. hookeri, E. tereticornis, C. cunninghamiana |
| DO46 | 23/06/2018 | -23.65 | 149.26 | 160.48 | Geoffrey | E. crebra, A. rhodoxylon, C. brewsteri |
| DO47 | 23/06/2018 | -23.65 | 149.26 | 156.06 | Unsure | F. dissosperma, E. populnea |
| DO48 | 23/06/2018 | -23.65 | 149.25 | 146.98 | *boundary* | SW: E. crebra, A. rhodoxylon NE: L. hookeri, C. clarksoniana, E. tereticornis |
| DO49 | 23/06/2018 | -23.66 | 149.25 | | *boundary* | SW: E. crebra N: A. rhodoxylon |
| DO50 | 23/06/2018 | -23.66 | 149.25 | 157.90 | *boundary* | S: E. crebra N: A. rhodoxylon |
| DO51 | 23/06/2018 | -23.66 | 149.26 | 157.27 | Geoffrey | A. rhodoxylon |
| DO52 | 23/06/2018 | -23.65 | 149.27 | 159.55 | Geoffrey | E. populnea, E. crebra, A. rhodoxylon |
| DO53 | 23/06/2018 | -23.64 | 149.27 | 154.17 | Geoffrey | |
| DO54 | 24/06/2018 | -23.63 | 149.21 | 146.89 | Unsure | A. salicina, E. crebra, A. rhodoxylon |
| DO55 | 24/06/2018 | -23.64 | 149.22 | | Anderson | E. crebra, A. rhodoxylon, E. australe |
| DO56 | 24/06/2018 | -23.64 | 149.22 | 125.28 | *boundary* | SE: Cleared NW: Cleared with E. crebra, A. rhodoxylon |
| DO57 | 24/06/2018 | -23.65 | 149.23 | 135.23 | *boundary* | S: E. populnea, L. hookeri, C. clarksoniana N: DP22 (Kosh) |
| DO58 | 24/06/2018 | -23.64 | 149.23 | 153.93 | Geoffrey | M. leucadendra, C. cunninghamiana, silver wattle |
| DO59 | 24/06/2018 | -23.64 | 149.23 | 155.62 | Geoffrey | Cleared, silver acacia shrubs |
| DO60 | 24/06/2018 | -23.63 | 149.26 | 101.34 | *boundary* | W: C. cunninghamiana, M leucadendra, C. clarksoniana E: Cleared |
| DO61 | 24/06/2018 | -23.63 | 149.25 | 107.73 | Geoffrey | Cleared with M. leucadendra |
| DO62 | 24/06/2018 | -23.63 | 149.25 | 117.22 | Geoffrey | Cleared with M. leucadendra, C. cunninghamiana |
| DO63 | 24/06/2018 | -23.63 | 149.24 | 121.62 | Geoffrey | Cleared |
| DO64 | 24/06/2018 | -23.63 | 149.23 | 120.99 | Geoffrey | C. cunninghamiana, M. leucadendra, C. clarksoniana |
| DO65 | 24/06/2018 | -23.63 | 149.23 | 119.36 | Geoffrey | Cleared, E. populnea shrubs |
| DO66 | 24/06/2018 | -23.63 | 149.24 | 112.17 | *boundary* | Cleared |
| DO67 | 24/06/2018 | -23.63 | 149.24 | 115.92 | Kosh | |
| DO68 | 24/06/2018 | -23.63 | 149.24 | 114.36 | *boundary* | S: Geoffrey N: Kosh |
| DO69 | 24/06/2018 | -23.63 | 149.24 | 115.14 | *boundary* | S: V. nilotica N: gum shrubs |
| DO70 | 24/06/2018 | -23.63 | 149.24 | 114.56 | Geoffrey | M. leucadendra, C. clarksoniana |
| DO71 | 24/06/2018 | -23.63 | 149.25 | 101.65 | Geoffrey | C. clarksoniana |

| Site Name | Date | Latitude | Longitude | Elevation | Soil Unit | Vegetation Notes |
|---|---|---|---|---|---|---|
| DO72 | 24/06/2018 | -23.64 | 149.25 | 99.67 | *boundary* | N: C. clarksoniana, E. populnea S: V. nilotica, C. lasiantha |
| DO73 | 24/06/2018 | -23.65 | 149.24 | 103.09 | Kosh | V. nilotica, A. salicina |
| DO74 | 24/06/2018 | -23.64 | 149.23 | 103.96 | *boundary* | N: M. leucadendra, silver wattle S: V. nilotica |
| DO75 | 25/06/2018 | -23.62 | 149.20 | 161.90 | Anderson | E. austral, C. clarksoniana, E. crebra |
| DO76 | 25/06/2018 | -23.62 | 149.21 | | *boundary* | NE: A. excelsa, M. leucadendra SW: E. australe |
| DO77 | 25/06/2018 | -23.62 | 149.21 | 150.49 | Geoffrey | |
| DO78 | 25/06/2018 | -23.62 | 149.21 | 142.42 | Geoffrey | M. leucadendra, C. clarksoniana, silver wattle |
| DO79 | 25/06/2018 | -23.62 | 149.20 | 142.41 | Barry | E. populnea, A. excelsa |
| DO80 | 25/06/2018 | -23.62 | 149.20 | | Geoffrey | M. leucadendra |
| DO81 | 25/06/2018 | -23.62 | 149.26 | 130.63 | Geoffrey | M. leucadendra, C. cunninghamiana, E. australe, E. tesselaris, E. populnea, C. clarksoniana |
| DO82 | 25/06/2018 | -23.61 | 149.25 | 145.47 | Geoffrey | A. excelsa, E. crebra, C. clarksoniana, E. australe |
| DO83 | 25/06/2018 | -23.60 | 149.25 | | Nigel | A. rhodoxylon |
| DO84 | 25/06/2018 | -23.60 | 149.25 | 141.34 | *boundary* | NW: E. populnea, A. excelsa, C. clarksoniana, E. australe SE: A. rhodoxylon |
| DO85 | 25/06/2018 | -23.62 | 149.25 | 137.74 | *boundary* | SE: C. clarksoniana, E. crebra, E. australe, A. excelsa NW: A. sherleyi |
| DO86 | 25/06/2018 | -23.62 | 149.22 | 97.63 | Geoffrey | E. tesselaris, E. tereticornis |
| DO87 | 25/06/2018 | -23.62 | 149.23 | 97.59 | *boundary* | |
| DO88 | 26/06/2018 | -23.61 | 149.23 | 95.61 | Geoffrey | P. pubecens, A. excelsa, E. crebra, E. tesselaris |
| DO89 | 26/06/2018 | -23.60 | 149.24 | 103.38 | Geoffrey | A. excelsa, C. clarksoniana, P. pubecens |
| DO90 | 26/06/2018 | -23.60 | 149.24 | | Geoffrey | A. excelsa, C. clarksoniana, P. pubecens |
| DO91 | 26/06/2018 | -23.60 | 149.24 | 97.07 | Geoffrey | E. populnea, A. harpophylla, E. tereticornis |
| DO92 | 26/06/2018 | -23.60 | 149.23 | 99.37 | Geoffrey | E. populnea, C. lasiantha, C. brewsteri, C. clarksoniana |
| DO93 | 26/06/2018 | -23.60 | 149.23 | 112.69 | Geoffrey | Cleared with C. clarksoniana |
| DO94 | 26/06/2018 | -23.60 | 149.23 | 112.07 | Geoffrey | E. crebra, C. clarksoniana, A. excelsa, C. cunninghamiana, M. leucadendra |
| DO95 | 26/06/2018 | -23.61 | 149.23 | 125.99 | *boundary* | W: Lancewood Ellesmere E: E. crebra, C. clarksoniana, A. excelsa, C. cunninghamiana, M/ leucadendra |
| DO100 | 26/06/2018 | -23.60 | 149.22 | 133.16 | *boundary* | NE: Cleared SW: A. sherleyi |
| DO101 | 26/06/2018 | -23.60 | 149.22 | 135.95 | Nigel | Lancewood |
| DO102 | 26/06/2018 | -23.60 | 149.22 | | *boundary* | SW: A. excelsa, C. clarksoniana, M. leucadendra, E. crebra NE: A. sherleyi |
| DO103 | 26/06/2018 | -23.60 | 149.22 | 136.65 | Geoffrey | |
| DO104 | 26/06/2018 | -23.60 | 149.22 | 139.50 | *boundary* | Cleared |
| DO105 | 26/06/2018 | -23.61 | 149.22 | 144.54 | *boundary* | |
| DO106 | 26/06/2018 | -23.61 | 149.22 | 144.11 | *boundary* | |
| DO107 | 26/06/2018 | -23.61 | 149.22 | 138.97 | Nigel | |
| DO108 | 26/06/2018 | -23.62 | 149.22 | 132.74 | *boundary* | |

| Site Name | Date | Latitude | Longitude | Elevation | Soil Unit | Vegetation Notes |
|---|---|---|---|---|---|---|
| DO109 | 26/06/2018 | -23.62 | 149.22 | 122.39 | Geoffrey | |
| DO110 | 26/06/2018 | -23.61 | 149.21 | 133.53 | *boundary* | |
| DO111 | 26/06/2018 | -23.62 | 149.23 | 118.64 | Geoffrey | |
| DO112 | 26/06/2018 | -23.62 | 149.23 | 126.91 | Geoffrey | |
| DO113 | 26/06/2018 | -23.62 | 149.24 | 131.25 | Geoffrey | |
| DO114 | 26/06/2018 | -23.62 | 149.24 | 133.52 | Geoffrey | A. excelsa, E. australe, C. clarksoniana, C. cunninghamiana, M. leucadendra |
| DO115 | 26/06/2018 | -23.62 | 149.22 | 114.31 | Geoffrey | Cleared with E. populnea and C. spinarum |
| DO116 | 26/06/2018 | -23.62 | 149.22 | | Geoffrey | E. teritecornis |
| DO117 | 26/06/2018 | -23.62 | 149.22 | 110.71 | *boundary* | W: Cleared E: E. populnea, E. tereticornis, E. tesselaris |
| DO118 | 26/06/2018 | -23.61 | 149.23 | 109.29 | *boundary* | NW: Cleared with gum shrubs SE: Cleared with C. spinarum and C. lasiantha |
| DO119 | 26/06/2018 | -23.61 | 149.22 | 127.46 | *boundary* | S: Cleared N: A. rhodoxylon, A. sherleyi, E. crebra |
| DO200 | 26/06/2018 | -23.61 | 149.23 | 113.78 | Geoffrey | |
| DO201 | 26/06/2018 | -23.62 | 149.22 | 114.21 | Kosh | C. spinarum, E. populnea (shrubs) |
| DO202 | 27/06/2018 | -23.63 | 149.28 | 88.31 | *boundary* | E: M. leucadendra, E. crebra W: Cleared with C. spinarum, C. lasiantha and V. nilotica |
| DO203 | 27/06/2018 | -23.63 | 149.28 | 88.35 | Barry | E: M. leucadendra, E. crebra, A. hemiglauca W: Cleared with C. spinarum, C. lasiantha and V. nilotica |
| DO204 | 27/06/2018 | -23.62 | 149.28 | | Kosh | L. hookeri, E. tereticornis, A. hemiglauca |
| DO205 | 27/06/2018 | -23.62 | 149.28 | 89.52 | *boundary* | Cleared with C. lasiantha |
| DO206 | 27/06/2018 | -23.62 | 149.28 | 90.15 | *boundary* | E: Cleared with C. lasiantha W: E populnea S: L. hookeri |
| DO207 | 27/06/2018 | -23.62 | 149.28 | 87.91 | *boundary* | NW: C. brewsteri, A. salicina SE: V. nilotica |
| DO208 | 27/06/2018 | -23.62 | 149.28 | 88.71 | Normanby | V. nilotica, C. lasiantha |
| DO209 | 27/06/2018 | -23.62 | 149.28 | 96.42 | Unsure | |
| DO210 | 27/06/2018 | -23.62 | 149.27 | 98.61 | *boundary* | W: E. populnea, A. hemiglauca, E. crebra E: Cleared |
| DO211 | 27/06/2018 | -23.62 | 149.27 | 100.35 | *boundary* | |
| DO212 | 27/06/2018 | -23.62 | 149.27 | 99.42 | *boundary* | |
| DO213 | 27/06/2018 | -23.61 | 149.27 | 104.48 | Geoffrey | M. leucadendra, E. tereticornis, A. excelsa, C. cunninghamiana |
| DO214 | 27/06/2018 | -23.60 | 149.26 | 118.34 | *boundary* | S: M. leucadendra, C. cunninghamiana N: A. rhodoxylon |
| DO215 | 27/06/2018 | -23.60 | 149.26 | 118.67 | *boundary* | |
| DO216 | 27/06/2018 | -23.63 | 149.27 | 112.48 | Geoffrey | N: A. excelsa, P. pubecens, C. clarksoniana, E. crebra S: A. rhodoxylon |
| DO217 | 27/06/2018 | -23.62 | 149.26 | 113.31 | Geoffrey | |
| DO218 | 27/06/2018 | -23.62 | 149.27 | 114.90 | Geoffrey | E. crebra. C. clarksoniana |
| DO219 | 27/06/2018 | -23.62 | 149.27 | 113.93 | *boundary* | SE: C. clarksoniana NW: E. crebra |

| Site Name | Date | Latitude | Longitude | Elevation | Soil Unit | Vegetation Notes |
|---|---|---|---|---|---|---|
| DO220 | 27/06/2018 | -23.62 | 149.27 | 119.20 | *boundary* | |
| DO221 | 27/06/2018 | -23.62 | 149.27 | 115.32 | Geoffrey | |
| DO222 | 27/06/2018 | -23.62 | 149.27 | 118.86 | *boundary* | |
| DO223 | 27/06/2018 | -23.62 | 149.26 | 118.08 | *boundary* | W: M. leucadendra, E. tereticornis E: Cleared with E. crebra |
| DO224 | 27/06/2018 | -23.61 | 149.25 | 134.53 | *boundary* | N: M. leucadendra, E. tereticornis, A. excelsa, C. cunninghamiana S: A. sherleyi |
| DO225 | 27/06/2018 | -23.61 | 149.25 | 147.83 | *boundary* | S: M. leucadendra, E. tereticornis, A. excelsa, C. cunninghamiana N: A. rhodoxylon |
| DO226 | 27/06/2018 | -23.61 | 149.26 | 115.50 | Geoffrey | E. tereticornis |
| DO227 | 27/06/2018 | -23.63 | 149.26 | 97.94 | Geoffrey | A. rhodoxylon, E. populnea, A. hemiglauca |
| DO228 | 27/06/2018 | -23.63 | 149.27 | 97.28 | Geoffrey | |
| DO229 | 27/06/2018 | -23.63 | 149.29 | 107.20 | Geoffrey | |
| DO230 | 27/06/2018 | -23.64 | 149.29 | 96.27 | Geoffrey | |
| DO231 | 27/06/2018 | -23.66 | 149.23 | 104.96 | Kosh | V. nilotica, C. lasiantha, C. spinarum |
| DO232 | 28/06/2018 | -23.66 | 149.23 | 107.90 | Geoffrey | |
| DO233 | 28/06/2018 | -23.67 | 149.26 | 109.30 | *boundary* | |
| DO234 | 28/06/2018 | -23.67 | 149.25 | 117.29 | Unsure | A. rhodoxylon |
| DO235 | 28/06/2018 | -23.67 | 149.26 | 113.80 | *boundary* | |
| DO236 | 28/06/2018 | -23.66 | 149.26 | 136.84 | *boundary* | N: C. clarksoniana, C. cunninghamiana, M. leucadendra S: A. rhodoxylon |
| DO237 | 28/06/2018 | -23.64 | 149.24 | 128.20 | *boundary* | N: Low lying grasses S: longer grasses on rise |
| DO238 | 28/06/2018 | -23.64 | 149.22 | 147.20 | Geoffrey | C. brewsteri, E. populnea |
| DO239 | 28/06/2018 | -23.64 | 149.22 | 147.21 | Geoffrey | E. populnea, silver wattle, C. clarksoniana |
| DO240 | 28/06/2018 | -23.64 | 149.22 | 142.71 | Geoffrey | C. brewsteri, silver wattle |
| DO241 | 28/06/2018 | -23.64 | 149.23 | 148.84 | Geoffrey | C. brewsteri, silver wattle |
| DO243 | 28/06/2018 | -23.65 | 149.26 | 150.16 | *boundary* | A. rhodoxylon |
| DO244 | 28/06/2018 | -23.66 | 149.26 | 143.69 | Charlevue | A. rhodoxylon |
| DO245 | 28/06/2018 | -23.64 | 149.23 | 138.43 | Geoffrey | C. brewsteri, silver wattle |
| DO246 | 28/06/2018 | -23.69 | 149.26 | 140.80 | Geoffrey | Cleared |
| DO247 | 28/06/2018 | -23.69 | 149.26 | 142.68 | Geoffrey | Cleared |
| DO248 | 28/06/2018 | -23.67 | 149.26 | 132.57 | Wallace | Cleared |
| DO249 | 28/06/2018 | -23.64 | 149.29 | 124.77 | Geoffrey | Cleared |
| DO250 | 28/06/2018 | -23.64 | 149.27 | 119.88 | Kosh | Cleared with V. nilotica, C. lasiantha, C. spinarum |
| DO251 | 28/06/2018 | -23.62 | 149.28 | 113.38 | Geoffrey | Cleared |
| DO252 | 28/06/2018 | -23.64 | 149.28 | 126.57 | Geoffrey | Cleared |
| DO253 | 28/06/2018 | -23.67 | 149.24 | 136.26 | James | E. crebra, A. rhodoxylon |
| DO254 | 28/06/2018 | -23.66 | 149.23 | 133.32 | Geoffrey | Cleared |
| DO255 | 28/06/2018 | -23.66 | 149.24 | 128.72 | Kosh | Cleared with V. nilotica, C. lasiantha, C. spinarum |
| DO256 | 28/06/2018 | -23.67 | 149.24 | 136.77 | Geoffrey | Cleared |
| DO257 | 28/06/2018 | -23.65 | 149.26 | 134.96 | Geoffrey | |
| DO258 | 28/06/2018 | -23.68 | 149.26 | 134.77 | Geoffrey | |
| DO260 | 28/06/2018 | -23.61 | 149.26 | 128.32 | Geoffrey | |

| Site Name | Date | Latitude | Longitude | Elevation | Soil Unit | Vegetation Notes |
|---|---|---|---|---|---|---|
| DO261 | 28/06/2018 | -23.61 | 149.23 | 126.20 | Geoffrey | |
| DO262 | 28/06/2018 | -23.62 | 149.21 | 143.30 | Geoffrey | |
| DO263 | 28/06/2018 | -23.62 | 149.21 | 140.69 | Geoffrey | |
| DO264 | 28/06/2018 | -23.64 | 149.27 | 107.58 | *boundary* | SE: Cleared NW: Cleared with V. nilotica and C. lasiantha |
| DO265 | 28/06/2018 | -23.64 | 149.28 | | Geoffrey | Cleared with E. populnea |
| Heavy clay intergrade | 28/06/2018 | -23.67 | 149.25 | 113.92 | *boundary* | |