



PROJECT CHINA STONE

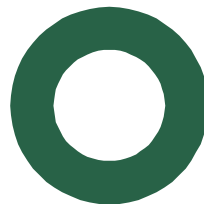
Soils and Land Suitability Report



Soil and Land Suitability Assessment

PROJECT CHINA STONE

Prepared for Hansen Bailey
on behalf of MacMines Austasia Pty Ltd
November 2014



GTenvironmental

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1 INTRODUCTION

GT Environmental Pty Ltd (GTE) was commissioned by Hansen Bailey on behalf of MacMines Austasia (the proponent) to complete a soil and land suitability assessment as part of the Environmental Impact Statement (EIS) for Project China Stone (the project).

1.1 Project Description

The project involves the construction and operation of a large-scale coal mine on a greenfield site in Central Queensland. The project site (the area that will ultimately form the mining leases for the project) is remote, being located approximately 270 km south of Townsville and 300 km west of Mackay at the northern end of the Galilee Basin (Figure 1). The closest townships are Charters Towers, approximately 285 km by road to the north, and Clermont, approximately 260 km by road to the south-east. The project site comprises approximately 20,000 ha of well vegetated land, with low-lying scrub in the south and east and a densely vegetated ridgeline, known as 'Darkies Range', running north to south through the western portion of the site.

The mine will produce up to approximately 55 million tonnes per annum (Mtpa) of Run of Mine (ROM) thermal coal. Coal will be mined using both open cut and underground mining methods (Figure 2). Open cut mining operations will involve multiple draglines and truck and shovel pre-stripping. Underground mining will involve up to three operating longwalls. Coal will be washed and processed on site and product coal will be transported from site by rail. It is anticipated that mine construction will commence in 2016 and the mine life will be in the order of 50 years.

The majority of the mine infrastructure will be located in the eastern portion of the project site (Figure 2). Infrastructure will include coal handling and preparation plants (CHPPs), stockpiles, conveyors, rail loop and train loading facilities, workshops, dams, tailings storage facility (TSF) and a power station. A workforce accommodation village and private airstrip will also be located in the eastern part of the project site.

The scope of this soil and land suitability assessment is restricted to assessing activities that are proposed to be undertaken within the project site and no off-lease activities are considered in this assessment.

1.2 Assessment Scope

This report presents the findings of a soil and land suitability assessment for the project site. This soil and land suitability assessment comprises of:

- a detailed description of the regulatory framework relevant to the project (Section 2.1);

- a description of the project setting (Section 2.2);
- a detailed desktop review of published information and remote sensing data relating to regional and local soils (Section 3.1);
- a detailed description of Soil Mapping Units (SMUs) present at the project site (Section 4.1). Soil descriptions are based upon the findings of the field investigation detailed in Section 3.2;
- an assessment of the available soil resources and suitability of existing soil types for reuse in rehabilitation activities (Section 4.2); and
- an assessment of land suitability for cropping and grazing activities and existing agricultural land classes (Section 5.1 and 5.2).

For the purposes of this soil and land suitability assessment, the 'study area' comprises the project site as shown on Figure 2.

2 PROJECT SETTING

2.1 Regulatory Framework

The overarching regulatory framework for assessing soils and agricultural land in Queensland is provided by the Guidelines for Agricultural Land Evaluation in Queensland (ALE Guidelines), Queensland Department of Primary Industries (QDPI) 1990) and associated Regional Land Suitability Frameworks for Queensland, 2013 (ALE Frameworks 2013). The Queensland Government is currently revising these guidelines to incorporate recent developments in the field of soil and agricultural land assessment. A draft of the Guidelines for Agricultural Land Evaluation in Queensland: Second Edition (Draft ALE Guidelines) was released by the Queensland Government in 2013 (Draft ALE Guidelines 2013).

The Draft ALE Guidelines provide an updated method of describing soils and classifying agricultural land. These guidelines draw from a range of guidance and standards that have been developed at national and state level since the original ALE Guidelines were published in 1990. The Draft ALE Guidelines and numerous land resource surveys and land evaluations projects which have been undertaken across Queensland since 1990 have been used to establish the suitability framework for selected regions. The associated ALE Frameworks provide the detail for assessing which crops are suitable for individual mapped areas of land or soil.

Key national guidance documents and standards are drawn from the Australian Soil and Land Survey Handbook series produced by the Commonwealth Scientific and Industrial Research Organisation (CSIRO). These references are particularly applicable to the investigation and description of soils in Queensland and, in the absence of recent Queensland guidance, GTE has applied these where they represent current best practice. Specifically, GTE has been guided by the following guidance documents and standards in investigating and describing soils:

- The soil survey was scoped and conducted in accordance with the Guidelines for Surveying Soils and Land Resources (McKenzie et al. 2008).
- Soil characteristics and soil profiles were described in accordance with the Australian Soil and Land Survey Handbook (National Committee on Soil and Terrain 2009).
- Soils have been grouped according to their parent material and position in the landscape and classified in accordance with the Australian Soil Classification (Isbell 2002). For completeness, soils have also been correlated to soils identified within key regional soil assessments, including Lands of the Nogoa-Belyando Area, Queensland (Galloway et al. 1967).

The classification of agricultural land in Queensland has been developed since the ALE Guidelines were published. Over this period, the typical approach has involved the classification of land use suitability against a range of limitations, and application of a hierarchy of Agricultural Land Classification (ALC). Application of this approach to mining projects is described in the Land Suitability Assessment Techniques (LSAT) provided within the Technical Guidelines for Environmental Management of Exploration and Mining in Queensland (Department of Mines and Energy (DME). 1995 (DME Guidelines 1995)). This approach has been refined as part of the Draft ALE Guidelines. GTE has undertaken the assessment of ALC in accordance with these requirements and verbal guidance from the Queensland Department of Natural Resources and Mining (DNRM).

The ALC approach also forms the basis of the assessment of agricultural land within priority agricultural areas (PAAs) defined under the State Planning Policy 2014 (SPP). PAAs are considered an area of regional interest under the *Regional Planning Interests Act 2014* (RPI Act). Associated *Regional Planning Interests Regulation 2014* (RPI Regulation) and RPI Act Guidelines provide additional information identifying regional areas of interest and guidance in applying for a Regional Interests Development Application (RIDA), if required.

Strategic Cropping Area (SCA) also falls under the RPI Act. This replaces the *Strategic Cropping Land Act 2011* (SCL Act) which was repealed and is now designated as an area of regional interest as SCA. A search of Queensland Government mapping shows that no PAAs or SCAs are present in the vicinity of the project site, therefore, no further investigation is required. It is noted that the SPP supersedes the State Planning Policy 1/92: Development and Conservation of Good Quality Agricultural Land.

2.2 Local Setting

2.2.1 Land Use

The project site is currently used for cattle grazing and coal exploration activities and there is limited built infrastructure on the project site.

The project site is traversed by a number of unsealed access tracks associated with grazing activities and exploration drilling programs. Infrastructure on the site is limited to minor farm infrastructure including various stock fences, farm dams and farm water bores, as well as minor infrastructure associated with coal exploration programs.

For the purposes of this soil and land suitability assessment, the existing soils at the project site have been assessed as undisturbed. This provides a conservative assessment of soil disturbance associated with the project.

2.2.2 Natural Features

The project site comprises an area of approximately 20,000 ha. The project site consists of low-lying, generally flat to undulating woodlands in the southern and eastern parts of the site. A well vegetated ridgeline known as Darkies Range runs in a roughly north to south alignment through the western portion of the site. The project site is located in the headwaters of the Tomahawk Creek and North Creek catchments. There are numerous ephemeral drainage lines traversing the site. The project site drains in a generally west to east direction from Darkies Range to the Belyando River via Tomahawk Creek and North Creek.

2.2.3 Vegetation

The vegetation within the project site includes low-lying scrub in the south and east and a densely vegetated ridgeline running north to south through the western portion of the site

3 SOIL ASSESSMENT BACKGROUND AND METHODOLOGY

3.1 Desktop Review

A significant body of soils and land resources information relevant to the project site is available, including: regional soil mapping, exploration surveys undertaken within the project site, aerial photography and soil assessments undertaken for the adjacent Carmichael Coal Mine and Rail Project (CCM&RP). This information was used to inform the preliminary soils mapping for the project site and in turn, assisted in the development of the field investigation.

3.1.1 Regional Soils Reports and Available Documentation

The CSIRO and Queensland Government have undertaken regional scale mapping over extensive areas of central Queensland, including the project site. The following references have been reviewed and summarised below:

- *Lands of the Nogoa-Belyando Area, Queensland* (Galloway et al. 1967 for the CSIRO)

This report mapped land systems, which are landscape patterns comprising generally uniform geology but with variable landforms, soils and vegetation. Within each land system are individual 'units' that describe the range of individual soil types (refer Table 1). In addition, the relative proportion of each unit in the land system is provided.

Soils in the locality are described as forming from prolonged erosion in softer rock resulting in the formation of a level to gently undulating landscape while leaving the harder rocks standing as scarps and hill masses.

Table 1: CSIRO Soil Types and Description

CSIRO Soil Type Units	Description
Davy	Uniform coarse textured alluvial soils
Wyseby	Texture-contrast soils, thin loamy surface soils,
Dunrobin	Loamy red earths
Struan	Loamy and sandy yellow earths
Annandale	Sandy red earths
Struan	loamy yellow earths
Gregory	Shallow red and yellow earths
Shotover	Mainly shallow rocky soils
Highmont	Deep uniform coarse textured soils
Petrona	Minor uniform coarse-textured soils

This report has been used to provide a preliminary indication of expected soil types based upon land systems mapping. Expected soil types have been refined through additional desk study and site investigation. The expected soil types derived from Galloway's land systems have proved to be generally correct at a broad scale.

- *Understanding and Managing Soils of the Central Highlands* (Bourne and Tuck 1993)

This report provides a collation of land resource data, local experience and knowledge of the Central Highlands area, including the Belyando shire.

The report details land resource areas (LRAs) and agricultural management units (AMUs) for the Central Highlands area. LRAs are based upon the landform and associated vegetation and soils such as plains and undulating downs. AMUs are groups of soils with similar agricultural and soil management requirements within the LRAs. The AMUs are a relevant guide in the assessment of the project's SMUs and land suitability.

- *Land Resource Survey and Evaluation of the Kilcummin Area, Queensland* (Shields and Williams, 1991)

This report provides a practical application of the Land Resources Branch land suitability assessment techniques (DME Guidelines 1995). This assessment method has been used to supplement the land suitability assessment guidance provided in the DME Guidelines (1995).

Relevant regional soil types were identified within these reports and used as a guide for the project sites SMUs.

3.1.2 Local Soils Reports

Soils of the CCM&RP were mapped by GHD (GHD 2012). The soil study area for the CCM&RP covers an area of approximately 26,000 hectares and adjoins the south-eastern corner of the project site. The following reference has been reviewed and summarised below:

- *Carmichael Coal Mine and Rail Project* (GHD 2012)
 - mapped at an intensity of 1:100,000
 - This report described the CCM&RP site as consisting of the following soils and associated vegetation:
 - brown gravelly shallow loam to clay loam soils with Eucalypts
 - gravelly shallow to moderately deep loam to clay loam soils with Eucalypts

- deep texture contrast soils with a thick sandy to loamy surface over sandy clay / clay subsoil with Eucalypts
- bleached moderately deep gravelly sand to loam with Eucalypts
- texture contrast soils with a thick sandy to loamy surface over mottled sandy clay subsoil with Brigalow / Gidgee
- red, brown and grey cracking clay with strong gilgai or melon holes with Brigalow
- yellow or brown texture contrast soils with a moderately thick loamy surface over mottled clay subsoil with Brigalow / Gidgee

A total of 19 SMUs were identified for the CCM&RP site based on geology, landform, native vegetation and soil profile features. The soils identified were used as a guide when identifying soil types for the project.

3.1.3 Erosion Assessment

Erosion assessment is based upon the Bourne and Tuck (1993) which assessed the susceptibility of major Central Highlands soil types for sheet, rill, gully and wind erosion.

All soil types described for the project can be aligned to comparable soil types which are described in Bourne and Tuck (1993). The SMU summaries (Section 4.1) present the range of erosion sensitivities based on the susceptibility for erosion levels for sheet, fill, gully and wind erosion as well as views of George Bourne (deduced from Bourne and Tuck 1993).

3.1.4 Aerial Photography

Aerial photography was reviewed as part of the desktop evaluations. Initial map units and boundaries were demarcated using Google Earth™ imagery (Google Earth 2014) and 2012 site aerial photos.

3.1.5 Preliminary Soil Mapping

After the detailed review of regional and local reports and aerial photography, and prior to field work, a preliminary soil map was created. This preliminary mapping provided an initial understanding of the different types of soil and landscapes likely to occur across the project site and provided a basis for planning field investigations.

3.2 Field Investigation Methodology

Field investigations were undertaken to confirm the information on soil types and agricultural suitability outlined in the desktop review of available soil studies, and to refine the preliminary soil mapping. This section describes the rationale and methodology used for the field investigations at the project site and the activities undertaken to classify and analyse the main soil types located within the project site.

A detailed field investigation was undertaken in two stages from 6 to 13 November 2012 and 3 to 4 April 2013. The field investigation used 'free survey' techniques (McKenzie et al. 2008) to collect site-specific observational and sampling data.

3.2.1 Investigation Sites, Scale and Density

Observation Sites

Surface observation sites were utilised to provide basic information for indicative soil type, slope, surface condition, landscape characteristics and assist in refining of soil boundaries in accordance with McKenzie et al. (2008). Some observation sites were recorded outside the actual study area to confirm land use or soil type for more accurate soil boundary depiction through to the actual study area boundary. A total of 281 soil observation sites were recorded during the field investigation.

The information collected from individual observation sites varies but generally includes:

- indicated soil type deduced from position in the landscape, soil surface and vegetation type;
- landform type, position and slope gradient;
- major vegetation type and cover density;
- soil surface characteristics; and
- land characteristics including disturbance, microrelief, evidence of cultivation, significant erosional features, presence of coarse fragments and estimated % rock cover and outcropping bedrock.

Surface observation sites are included within Attachment A.

Detailed Soil Profile Descriptions

Detailed soil profile description information was collected at 82 investigation sites during the field investigation.

Hand augering methods were used to allow for suitably detailed assessment of the soil profile and sampling at representative depths. At each investigation site, the soil stratigraphy was exposed and photographs were taken. Detailed soil profile descriptions confirmed the preliminary mapping and surface observations.

Excavation depth varied depending upon the stratigraphy encountered. Excavations generally terminated within one to two metres of the ground surface or where hard impenetrable or non-excavatable horizons were encountered. Soil profiles were logged in the field by a soil scientist.

The specific location of each detailed profile description site was initially based upon preliminary soil mapping and was refined in the field based upon accessibility and representation of the soil unit being described. The locations of the detailed soil profile description sites are presented in Figure 3.

The information typically collected from each detailed soil profile descriptions included:

- location (GDA94) and type of soil observation (e.g. naturally exposed surface or hand auger);
- major vegetation types and land use;
- landform type, position of the site and slope gradient;
- surface condition (e.g. presence of cracks, surface crust, rocks stones and cobbles, erosion status, microrelief);
- types and vertical extent of soil horizons;
- colour (as per Munsell Soil Colour Charts) and mottling of each horizon;
- observations for each horizon of field texture, pH, presence and abundance of segregations, coarse fragments, structure and pedality, consistency, pH and moisture content;
- presence of organic matter, roots and prevalence of biological activity; and
- photographs of the soil profile and surrounding landscape.

Investigation Scale and Density

A soil mapping scale of 1:100,000 or better was applied to the project site. To satisfy this mapping scale across the project site, a semi-detailed investigation of 0.25 to 1 site per 100 hectares is recommended by the

McKenzie et al. (2008). This is equivalent to 1 investigation site per 100 to 400 ha, or 0.0025 to 0.01 investigation sites per hectare. Of this number, approximately 20% should be detailed soil profile descriptions.

The field investigations for this project comprised a total of 363 investigation sites over the 20,087.9 ha project site. Topsoil will be stripped from the open cut mine and mine infrastructure areas. The total area to be stripped of topsoil is approximately 10,300 ha. A significant proportion of the remainder of the project site (approximately 9,800 ha) will be subject to mine subsidence. Within this area, soil disturbance will be limited to small areas of rehabilitation of surface subsidence effects and minor surface infrastructure above the longwalls.

A more detailed mapping scale and higher investigation density were applied over the 10,300 ha open cut mine and mine infrastructure area to ensure a more detailed understanding of the soils requiring stripping for re-use in mine rehabilitation and closure. Soils within this area were mapped at 1:50,000 scale or better and using a medium density investigation that comprised 55 detailed soil profile descriptions and 215 surface observations. This is equivalent to approximately 1 investigation site per 40 ha comprising 20% detailed soil profile descriptions.

Within the remainder of the project site the investigation comprised 27 detailed soil profile descriptions and 66 surface observations. This is equivalent to approximately 1 investigation site per 100 ha comprising 29% detailed soil profile descriptions. This investigation density satisfies the requirements for a soil mapping scale of 1:100,000.

Table 2 provides a summary of the investigations undertaken. This strategy provides a targeted and robust approach to investigating the full extent of the project site.

Results of soil observations and detailed soil profile descriptions are presented in full within Attachment A.

Table 2: Investigation Density

Study Area (ha)	Mapping Scale	Detailed Investigation Sites	Investigation Density
20,087.90	1:100,000 in non-disturbance areas 1:50,000 in disturbance areas	1 per 362 ha for non-disturbance areas 1 per 187 ha for disturbance areas	1 per 105 ha for non-disturbance areas 1 per 38 ha for disturbance areas

3.2.2 Soil Sampling and Laboratory Analysis

Soil samples were collected from each SMU present at the project site. Samples were taken from detailed soil profile description sites that were found to be representative of each soil unit. A total of 37 soil samples

were selected during field investigations from 12 detailed soil profile description sites.

Soil sampling of sites was conducted as per McKenzie et al. (2008) with samples taken from the surface (0.0-0.1m) and every horizon change within the soil profile. Samples were not collected across horizon or sub-horizon boundaries.

Soil samples were submitted for laboratory analysis. Laboratory analysis was undertaken to assist in overall soil characterisation, determination of agricultural suitability of the soils and to establish the physical and chemical limitations of soils for use in rehabilitation activities. Laboratory testing was also used to identify soils that may require specific management measures.

Samples were analysed at Agricultural Chemistry Pty Ltd, Brisbane. This laboratory is accredited by Australasian Soil and Plant Analysis Certification (ASPAC).

Most samples submitted for testing were analysed for salinity, dispersion and pH attributes with surface soils tested for a further suite of parameters to determine fertility. Selected samples were also tested for additional parameters such as cations and particle size distribution to refine the characterisation of the source horizon. In addition, calculations were undertaken to determine the exchangeable sodium percentage and calcium to magnesium ratio where data was available. Overall, the samples were analysed for the following parameters:

- pH (1:5);
- electrical conductivity (EC [1:5]);
- chloride;
- bicarbonate extractable P;
- available nitrogen and phosphate;
- cation exchange capacity, exchangeable cations and exchangeable sodium percentage;
- organic matter content;
- particle size assessment;
- Emerson aggregate test and R1 dispersion;
- selected metals (Al, B, Cu, Zn, Mn and Fe); and
- sulfur (total as S).

During the course of fieldwork, a number of 'field' 1:5 soil/water pH and EC tests were conducted using a portable Aqua-CP/A instrument for selected sites. This information, which was well correlated to the laboratory results, was used to confirm the effective rooting depths.

The laboratory analytical results were used in conjunction with the field assessment results to determine the suitability of the soil for agricultural use as well as the maximum depth of soil resources available for stripping and reuse during rehabilitation. The laboratory results are summarised in Section 3 and detailed in Attachment B (Laboratory Certificates).

The rationale for the selection of individual analyses is presented in Table 3.

Table 3: Analytical Program

Test	No. Tests	Application	Justification
Field pH and EC using portable Aqua-CP/A instrument	158	Indication of possible limitations from salinity and pH.	Used for 'on the spot' estimates of possible salinity or pH problems and to confirm the effective rooting depth.
pH	37	Nutrient availability, nutrient fixation, toxicities (Al, Mn), liming, sodicity and correlation with other physical, chemical and biological properties.	Measurement of pH is a useful indicator of various soil properties (e.g. values >8.5 usually indicate high exchangeable sodium levels and the presence of carbonates and nutrient availability limitations)
Electrical Conductivity	37	Appraisal of salinity hazard in soil substrates or groundwater and total soluble salts.	The measure of electrical conductivity is used as a means of appraising soil salinity. The electrical conductance increases with soluble salt content and thus allows simple interpretation of salinity.
Chloride Content	37	The concentration of chloride is usually an indicator of the severity of potential salinity.	The chloride anion is usually present in soil associated with sodium. It is highly mobile making it a valuable indicator of salt and water movement. It provides additional confirmation of salinity risk.
Bicarbonate Extractable Phosphorus	12	Measurement of the total Phosphorus in the soil.	While both acid extractable P (acid extr. P) and bicarbonate extractable P (Bicarb. extr. P) are routinely measured, only Bicarb. extr. P has been used to assess P fertility. This is due to the reliable and consistent data across a wide range of pH values that is achieved using Bicarb. extr. P.
Available Nitrogen	12	Presence of nitrogen in an available form for plant uptake.	Testing provides an indication of the general fertility of soils and thus their suitability as a topdressing agent.
Cation Exchange Capacity (CEC), Exchangeable Ca, Mg, Na, K, (Cations), Ca/MG ratio and Exchangeable Sodium Percentage (ESP)	12	Fertile soils have moderate to high CEC. Infertile soils have low CEC. Nutrient status, calculation of ESP, assessment of other physical and chemical properties, dispersivity, shrink – swell, water movement and aeration.	The amounts and relative proportions of the exchangeable cations in soil have important effects on both physical and chemical properties. High levels of exchangeable sodium cause dispersion and increased swelling, reducing water movement and affecting near surface aeration whereas exchangeable calcium flocculates colloids and will reduce swelling tendencies. Excessively high or low concentrations of one or the other of the cations may impact buffering

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Test	No. Tests	Application	Justification
			capacity and as a result, soil nutrient availability.
Organic Matter	12	Soil organic matter comprises an accumulation of partially disintegrated and decomposed plant and animal residues and other organic compounds synthesized by the soil microbes as the decay occurs. Soil organic matter forms a substantial reserve of potentially mineralizable nitrogen, sulfur and other nutrients.	Testing for soil organic matter provides an indication of the general fertility of soils and thus suitability as a topdressing agent. It also provides information on stored potential nutrients which may not yet be accessible to plants but may become available in the future.
Particle Size Assessment (<2 mm)	37	Nutrient retention, exchange properties, erodibility, droughtiness, workability, permeability, sealing, drainage, interpretation of most other physical and chemical properties and soil qualities.	Particle size assessment data provides an assessment of the composition of a soil (based upon the dominant grain size within a soil). This assists with confirmation of field observations as well as providing better grounds for identification of soil types and plant available water capacity.
Aggregate Stability (Emerson Aggregate Test and R1 Dispersion Test)	37	Susceptibility to surface sealing under rainfall or irrigation, effect of raindrop impact and slaking, permeability, infiltration, aeration, seedling emergence and correlation with other properties. Measurement of the amount of silt and clay that disperses during testing	An Emerson Aggregate Class number is determined using the results of this test. The method for this test is provided in Australian Standard (AS) 1289.3. 8.1 - 1997. Soils are divided into seven classes on the basis of their coherence in water, with a further class distinguished by the presence of calcium-rich minerals. This test provides an indication of dispersivity and slaking behavior of soil and its preponderance to becoming erosive under natural conditions. Therefore it is a useful test in assessing options for ongoing management for excavated and stockpiled materials. The measure of R1 dispersion is useful when used in conjunction with ESP and the Ca/Mg ratio for predicting soil physical behaviour.
Selected Metals (Mn, Al, B, Cu, Fe, Mn and Zn)	12	Detection of heavy metals.	The analysis of aluminum, copper, zinc, manganese and iron will assess potential natural concentrations of these select heavy metals in the soil as well as any phytotoxicity issues that may exist.
Sulfur (sulfate – S)	12	Measurement of total sulfur in soil.	Total levels of sulfur help identify where organic matter or gypsum are present in a profile.

4 SOIL ASSESSMENT

4.1 Soil Mapping Units

Eleven SMUs have been identified across the project site. The SMUs have been grouped according to basic soil morphology, position in the landscape and parent material and are summarised in Table 4. Individual soil types have been classified in accordance with the Australian Soil Classification (Isbell 2002). In some instances, mapped SMUs may include other associated minor soil types.

Table 4: Soil Mapping Units

SMU	Description	Land System	CSIRO Soil Type	Australian Soil Classification	Area (ha)*
Recent Drainage Lines and Overland Flowpaths					
A1	Active drainage lines, lower fluvial sandy loams	Degulla	Davy (deep loam)	Kandosol	483.9
A2	Palustrine area with silty clays	Degulla	Wyseby	Vertosol	108.5
Foot slopes and lowlands of relic alluvial plains					
A1sv	Relic drainage lines, hard setting and scalded surface sandy loams	Degulla	Davy	Sodosol	106.1
E1	Low lying red deep >150cm red sandy earth	Tichbourne	Dunrobin	Kandosol	895.1
E2	Low lying greyish / yellow deep > 150 cm yellow sandy earth	Lennox	Struan	Kandosol	3071.2
E3	Mid to upland red sandy loam, firmer surface with silty loam	Renlew	Annandale	Kandosol	3684.9
E4	Mid to upland sandy loam with 60% yellow and 40 % red interfingering loamy earths	Renlew	Annandale 40% Struan 60%	Kandosol	5661.5
E5	Mid to upland duplex, loamy sands above hard silty clay loams, Yellowish grey, minor conspicuous bleach	Tichbourne	Wyseby	Sodosol	124.8
Lateritic Uplands					
U1	Silty rocky channels and loamy foot slope areas associated with rocky uplands	Carborough	Davy Gregory	Tenosol	422.6
U2(a)	Upland skeletal, rugged scarps, ridges and valleys. Extensive outcropping hard laterite and gravelly skeletal soils	Carborough	Shotover	Rudosol	4746.0
U2(b)	Lower sloping plateaus and drainage basins with shallow to moderately deep loams	Carborough	Highmont Petrona	Kandosol	783.3
Total Project Site					20,087.90

*Areas based on ground truthed mapping

Figure 3 illustrates the spatial distribution of all mapped soil units within the project site. Representative detailed soil profile descriptions for each SMU are provided in the following sections.

4.1.1 Soil Mapping Unit A1

Overview

SMU A1 is characterised by active drainage lines and deep loamy lower fluvial sands. This SMU is associated with the floodplains and active drainage lines of the main drainage features at the project site. Landforms are flat to very gently undulating plains with soils that are typically uniform deep and consist of loamy sandy. Soils present are considered Kandosols under the ASC system.

Soil Characteristics and Chemistry

For this SMU, a total of 11 soil samples were collected at two sites. Eleven samples were analysed in the field and seven samples for two sites underwent laboratory analysis. The representative laboratory and field data are presented below.

The soil chemistry data indicate that this SMU is characterised as follows:

- slightly acidic to neutral reaction trends indicating great conditions for nutrients and chemical availability for plant growth;
- very low chloride throughout profile indicating low salinity;
- electrical conductivity is very low throughout the profile indicating low salinity;
- low to very low CEC ratings throughout the soil profile indicating low soil fertility levels due to limitations in adsorbing and holding nutrient cations leading to a reduced supply of nutrients available to plants;
- particle size assessment confirms a coarse sandy dominated profile;
- R1 dispersion is the amount of silt and clay that dispersed compared with the total amount present is moderate to very high ratios with Ca:Mg ratios are high to very high indicating soils have very low to low dispersive qualities. ESP levels increasing with depth indicates potential for limited water infiltration for plant growth;
- sodicity increases slightly with depth in the soil profile indicating soils below 0.60m may have dispersive attributes which impacts on soil structure and water infiltration; and
- moderate levels of available phosphorus, manganese and copper indicating moderate levels of established nutrients for plant growth.

Land Suitability

Land suitability assessment is determined using the available detailed soil profile descriptions, soil chemistry and landform properties. The limitations and definitions are detailed in Section 5.

The SMU is not suitable for agricultural use with the following major limitations for rainfed cropping:

- plant available water capacity is less than 75mm at 36-50mm;
- the landform contains abundant deep gullies preventing any practical cultivation; and
- regular flooding (inundation occurs whenever stream flow increases).

The SMU is not suitable for grazing use with the following major limitations for beef cattle grazing:

- plant available water capacity is less than 50mm at 36-50mm; and
- landform contains deep gullies, which makes cultivation for sowing pastures impractical.

Available Soil Resources

These soils are suitable for reuse with a maximum topsoil stripping depth of 0.6m recommended.

Representative Site

A total of seven detailed soil profile descriptions were undertaken across this SMU. Detailed soil profile description Site 6 is presented below as a representative site for this SMU with additional laboratory data for Site 36.

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Land Summary

SMU	A1	Representative site number	Site 6
Representative site photograph			
Site type	Detailed. 50 mm hand auger	Main vegetation	Eucalyptus open woodlands
Location	mE419091 mN7581100	Disturbance	No effective disturbance other than grazing by hoofed animals
Landform element and pattern	Gentle Undulating Plain Lower slope <1.0%	Micro relief	Absent
		Permeability	High
Slope	< 1.0%	Drainage	Rapidly drained
Surface coarse fragments	No surface coarse fragments observed	Surface condition	Surface is dry at time of investigation, loamy sand
ASC Order (s) present in SMU	Kandosol	Land use	Low intensity grazing
CSIRO soil type	Davy (Deep loam) Conseulo (stratified)	Substrate	Unconsolidated sediments
		Erosion potential (Bourne and Tuck 1993)	Low to medium, high for sheet
Land suitability summary	Effective rooting depth : 0.90-1.10m Estimated plant available water capacity: 36-50mm Rainfed Cropping: Class 5 Beef Cattle Grazing: Class 5 Agricultural Land Class: D		
Soil resources	The stratified drainage lines are dominated by deep loamy sand, SMU A1 which may be taken quite deep (0.60m) with an increase in sodicity at depth. However, the soil is not preferred as a plant growth medium on rehabilitation as it is likely to set hard and seal. Its main value for rehabilitation is as part of the capping layer between the mine waste material and the topsoil. <u>Recommended Topsoil Strip Depth: 0.6m</u>		

Soil Profile Morphology

Site 6	Horizon name and Depth (m)	Colour Mottles Bleach	Moisture Field pH Drainage	Texture Structure Consistency	Coarse fragments, segregations
	Horizon: A11 Horizon depth: 0-0.20 Boundary: Abrupt	Colour: Brownish grey, 7.5YR5/1 No mottles	Moisture: Dry, Field pH: 0.10 m- pH 6.5 Drainage: Rapid drained	Texture: Loamy sand, Structure: single grain, Consistency: loose	No surface rock No segregations
	Horizon: A12 Horizon depth: 0.20-0.60 Boundary: Abrupt	Colour: Greyish yellow brown 10YR6/2 No mottles	Moisture: Dry, Field pH: 0.3 m – pH 6.5 0.6 m – pH 6.5 Drainage: Rapid drained	Texture: Loamy sand, Structure: single grain, Consistency: loose	No surface rock No segregations
	Horizon: A13 Horizon depth: 0.60-0.80 Boundary: Abrupt	Colour: Dull yellow orange 10YR7/2 No mottles	Moisture: Dry, Drainage: Rapid drained	Texture: Loamy sand, Structure: single grain, Consistency: loose	No surface rock No segregations
	Horizon: A14 Horizon depth: 0.80-0.90	Colour: Light grey 7.5YR8/2 No mottles	Moisture: Dry, Drainage: Rapid drained	Texture: Loamy sand, Structure: single grain, Consistency: loose	No surface rock No segregations

Soil Chemistry Results for Site 6

Analysis (Unit)	Site, Horizon, Sample Depth (cm)			
	0-10	30-40	60-70	80-90
Lab pH (1:5 water)	6.3	5.9	6.9	7.2
EC (dS/cm)	0.04	0.03	0.02	0.02
Soil Chloride (mg/kg)	23	25	25	27
P Olsen (mg/kg)	14	-	-	-
Exch. Ca (meq/100g)	5.29	2.26	1.44	1.36
Exch. Mg (meq/100g)	1.3	0.73	0.89	0.91
Exch. K (meq/100g)	0.46	0.08	0.05	0.09
Exch. Na (meq/100g)	<0.1	0.09	0.26	0.23
CEC (meq/100g)	7.5	3.5	3.0	3.0
Ca/Mg (ratio)	4.1	3.1	1.6	1.5
ESP (%Na/CEC)	1	3	9	8
Total N (%)	<0.01	-	-	-
Nitrate N (%)	8	-	-	-
Organic Matter (%)	1.9	-	-	-
PSA-CS (%)	42	50	52	48
PSA-FS (%)	30	29	26	35
PSA-Silt (%)	16	11	8	6
PSA-Clay (%)	14	11	15	11
Disp Ratio (R1)	0.69	0.99	0.86	0.89
ADMC (%)	1.0	0.5	0.8	0.5
Emerson (Number)	5	5	5	5
Sulfate-S (mg/kg)	3	-	-	-
Mn (mg/kg)	30.4	-	-	-
Boron (mg/kg)	0.3	-	-	-
Copper (mg/kg)	0.6	-	-	-
Iron (mg/kg)	25	-	-	-
Zinc (mg/kg)	<0.1	-	-	-
Al (meq/100g)	0.35	0.32	0.33	0.37
Al/CEC (%)	5	9	11	13

"-" indicates no laboratory analysis undertaken for the selected sample

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Soil Chemistry Results for Site 36

Analysis (Unit)	Site, Horizon, Sample Depth (cm)		
	0-10	50-60	90-100
Lab pH (1:5 water)	6.2	6.2	6.7
EC (dS/cm)	0.06	0.03	0.02
Soil Chloride (mg/kg)	32	26	24
P Olsen (mg/kg)	15	-	-
Exch. Ca (meq/100g)	5.01	4.77	1.16
Exch. Mg (meq/100g)	1.6	2.23	0.76
Exch. K (meq/100g)	0.36	0.45	0.11
Exch. Na (meq/100g)	<0.1	0.12	<0.1
CEC (meq/100g)	7.4	8.0	2.5
Ca/Mg (ratio)	3.1	2.1	1.5
ESP (%Na/CEC)	1	2	3
Total N (%)	0.04	-	-
Nitrate N (%)	<1	-	-
Organic Matter (%)	2.2	-	-
PSA-CS (%)	27	19	46
PSA-FS (%)	45	35	35
PSA-Silt (%)	15	19	7
PSA-Clay (%)	14	26	15
Disp Ratio (R1)	0.74	0.76	0.81
ADMC (%)	1.0	1.1	0.4
Emerson (Number)	5	5	5
Sulfate-S (mg/kg)	4	-	-
Mn (mg/kg)	15.3	-	-
Boron (mg/kg)	0.3	-	-
Copper (mg/kg)	0.4	-	-
Iron (mg/kg)	60	-	-
Zinc (mg/kg)	0.5	-	-
Al (meq/100g)	0.36	0.44	0.43
Al/CEC (%)	5	6	17

"-" indicates no laboratory analysis undertaken for the selected sample

4.1.2 Soil Mapping Unit A1sv

Overview

SMU A1sv (Scalded variant) is characterised by relic drainage lines and hard setting and scalded surface silty loams. This SMU is associated with red and yellow earths where overland flow occurs. This unit comprises hard setting sandy loams above sodic sandy clay loams. Soils present are considered Sodosols under the ASC system.

This SMU contains areas of sparse vegetation and signs of localised erosion associated with surface water drainage.

Soil Characteristics and Chemistry

For this SMU, a total of ten soil samples were collected at five sites. Five samples were analysed in the field and three samples for one site underwent laboratory analysis. The representative laboratory and field data are presented below.

The soil chemistry data indicates that this SMU is characterised as follows:

- strongly acid to acid reaction trends are present indicating potential for nutrient toxicity and deficiencies which do not favour plant growth;
- very low chloride and electrical conductivity within the topsoil to extreme levels within the subsoils indicating a significant increase in salinity within subsoils;
- low CEC rating throughout the soil profile indicating low soil fertility levels due to limitations in adsorbing and holding nutrient cations leading to a reduced supply of nutrients available to plants;
- particle size assessments confirm a coarse to fine sandy dominated profile;
- Ca:Mg ratios are moderate to low indicating the soil has low dispersive qualities within the top soil horizon;
- strongly sodic levels within the subsoils indicated by ESP levels of 60 %Na/CEC at 0.30m;
- topsoil and subsequent subsoils Ca:Mg ratio indicates high Ca ratings to low Mg ratings in the soil profile indicating low dispersive conditions and minor soil structure issues increasing with depth; and
- moderate to low available phosphorus and nutrient levels within the topsoil indicates less than favourable existing nutrient conditions .

Land Suitability

Land suitability assessment is determined using the available detailed soil profile descriptions, soil chemistry and landform properties. The limitations and definitions are detailed in Section 5.

The SMU is not suitable for agricultural use with the following major limitations for rainfed cropping:

- plant available water capacity is less than 75mm at 25-30mm; and
- rootzone contains EC >1.2 and Cl >1500ppm.

The SMU is not suitable for grazing use with the following major limitations for beef cattle grazing:

- landform contains deep gullies make cultivation for sowing pastures impractical; and
- rootzone contains EC >1.2 and Cl >1500ppm.

Other issues influencing the land suitability for agricultural are a rockiness value of three for this SMU.

Available Soil Resources

These soils are suitable for reuse with a maximum topsoil stripping depth of 0.1m recommended.

Representative Site

A total of four detailed soil profile descriptions were conducted across the SMU. Detailed soil profile description Site 302 is presented below as a representative site for this SMU.

Land Summary

SMU	A1sv	Representative site number	Site 302
Representative site photograph			
Site type	Detailed, 50 mm hand auger	Main vegetation	Eucalyptus woodlands
Location	mE417240 mN7587547	Disturbance	Partial clearing due to natural elements
Landform element and pattern	Gentle Undulating Plain, Mid-slope	Micro relief	Nil
		Permeability	High
Slope	2.5%	Drainage	Rapidly drained
Surface coarse fragments	Dry, hard setting, mixed gravels 10-20mm <30%	Surface condition	Silty Loam, hard setting
ASC Order (s) present in SMU	Sodosol	Land use	Grazing native pastures
CSIRO soil type	Davy		Substrate
Erosion potential (Bourne and Tuck 1993)	Moderate		
Land suitability summary	Effective rooting depth : 0.30m (high chlorides from 0.3m) Estimated plant available water capacity: 25-30mm Rainfed Cropping: Class 5 Beef Cattle Grazing: Class 5 Agricultural Land Class: D		
Soil resources	The topsoils present are suitable for reuse in rehabilitation activities. Acidic topsoils and sodic and saline subsoil characteristics are the main potential limitations to topsoil stripping depth. <u>Recommended Topsoil Strip Depth: 0.1m</u>		
Land condition	Small areas have being identified with washed out topsoils and identified by bleach white appearance.		

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Soil Profile Morphology

Site 302	Horizon name and Depth (m)	Colour Mottles Bleach	Moisture Field pH Drainage	Texture Structure Consistency	Coarse fragments, segregations Roots
	Horizon: A1 Horizon depth: 0.0-0.25 Boundary: Abrupt	Colour: 10YR7/2 No mottles	Moisture: Dry, Field pH: 0.10m- pH 5.13, Drainage: Rapid	Texture: Sandy loam, Structure: single grain, Consistency: loose.	Coarse Fragments: Dry, hard setting, mixed gravels 10-20mm <30%
	Horizon: B21 Horizon depth: 0.25-0.70 Boundary: Sharp	Colour: 10YR7/2 Mottles: 10% mottle 10YR6/6	Moisture: Dry, Field pH: 0.30-0.40m – pH 5.45 0.60-0.70m – pH 5.84 Drainage: Rapid	Texture: Sandy clay loam, Structure: single grain, Consistency: loose	Nil surface rock Nil segregations
	Horizon: B22 Horizon depth: 0.70+	Colour: 10YR7/2 Mottles: 10% mottle 10YR6/6	Moisture: Dry, Drainage: Rapid	Texture: Sandy clay loam, Structure: single grain, Consistency: loose	Nil surface rock Nil segregations

Soil Chemistry Results for Site 302

Analysis (Unit)	Site, Horizon, Sample Depth (m)		
	0.0-0.10	0.30-0.40	0.60-0.70
Lab pH (1:5 water)	5.0	5.8	5.6
EC (dS/cm)	0.01	1.34	3.02
Soil Chloride (mg/kg)	<1	2268	2698
P Olsen (mg/kg)	15	7	6
Exch. Ca (meq/100g)	0.34	0.88	0.08
Exch. Mg (meq/100g)	0.31	1.26	2.7
Exch. K (meq/100g)	0.03	0.21	0.05
Exch. Na (meq/100g)	<0.1	3.9	4.5
CEC (meq/100g)	1.0	6.5	7.6
Ca/Mg (ratio)	1.1	0.7	<0.1
ESP (%Na/CEC)	3	60	60
Total N (%)	0.012	0.012	0.012
Nitrate N (%)	<1	24	69
Organic Matter (%)	0.7	0.7	0.7
PSA-CS (%)	32	32	21
PSA-FS (%)	44	40	28
PSA-Silt (%)	9	5	7
PSA-Clay (%)	17	24	45
ADMC (%)	0.4	0.4	0.7
Emerson (Number)	2	5	1
Sulfate-S (mg/kg)	4	27	119
Mn (mg/kg)	0.3	2.8	<0.2
Boron (mg/kg)	0.12	0.7	1.7
Copper (mg/kg)	0.2	0.3	0.2
Iron (mg/kg)	18	20	12
Zinc (mg/kg)	<0.1	0.2	<0.1
Al (meq/100g)	0.33	0.26	0.26
Al/CEC (%)	32	4	3

4.1.3 Soil Mapping Unit A2

Overview

SMU A2 is characterised by Palustrine areas with silty clays. This unit occurs generally along higher lying flat plains. The soil surface is silty clay loam to light clay often cracking with a minor crust. Subsoils are clayey, moderately well-structured increasing in sodicity with depth.

Soil Characteristics and Chemistry

For this SMU, a total of three soil samples were collected at one site. Three samples were analysed in the field and three samples for one site underwent laboratory analysis. The representative laboratory and field data are presented below.

The soil chemistry data indicate that this SMU is characterised as follows:

- acidic to neutral reaction trends indicating favourable conditions for nutrient and chemical availability for plant growth;
- chloride increases slightly from very low to low ratings indicating low salinity;
- electrical conductivity varies from low within the top 0.4m and increases to moderate throughout the deeper sub-soils indicating, as per chloride, levels of low salinity;
- moderate CEC levels throughout indicate marginal soil fertility levels due to limitations in adsorbing and holding nutrient cations available for plant growths;
- particle size assessment confirms field textures of a uniform clay profile, slightly lighter in the surface horizon;
- R1 dispersion indicates the amount of silt and clay that dispersed, when compared with the total amount present, was low with Ca:Mg ratios at moderate levels indicating soils have low dispersive qualities with favourable soil structure and water infiltration for plant growth within topsoil horizon;
- sodic ratings increase from non-sodic to strongly sodic with depth indicating soils below 0.30m indicates dispersive attributes not favourable for plant growth or water infiltration; and
- moderate available phosphorus levels and very low to moderate nutrient levels indicate favourable existing conditions for plant growth.

Land Suitability

Land suitability assessment is determined using the available detailed soil profile descriptions, soil chemistry and landform properties. The limitations and definitions are detailed in Section 5.

The SMU is not suitable for agricultural use, with the major limitation for rainfed cropping being that plant available water capacity is less than 75mm at 35-55mm.

The SMU is suitable for limited grazing use of native pastures with the major limitation for beef cattle grazing being that plant available water capacity is, as a majority, less than 50mm at 35-55mm.

Available Soil Resources

These soils are suitable for reuse with a maximum topsoil stripping depth of 0.3m recommended.

Representative Site

One detailed soil profile description was undertaken across this SMU. Detailed soil profile description Site 79 is presented below as a representative site for this SMU.

Land Summary

SMU	A2	Representative site number	79
Representative site photograph			
Site type	Detailed, 50mm hand auger	Main vegetation	Grasslands and open woodland
Location	mE407515 mN7602242	Disturbance	No effective disturbance other than grazing by hoofed animals
Landform element and pattern	Gentle Undulating Plain, Flat plain	Micro relief	Irregular/crabhole gilgai present observed within the area <2.0m wide and <20cm deep
		Permeability	Slow
Slope	<0.5%	Drainage	Moderately well drained
Surface coarse fragments	No coarse fragments	Surface condition	Silty clay loam
ASC Order (s) present in SMU	Vertosol	Land use	Grazing native pastures
CSIRO soil type	Wyseby	Substrate	Unconsolidated sediments
Erosion potential (Bourne and Tuck 1993)	Medium		
Land suitability summary	Effective rooting depth : 0.30– 0.6m Estimated plant available water capacity: 24-55mm Rainfed Cropping: Class 5 Beef Cattle Grazing: Class 4 Agricultural Land Class: C3		
Soil resources	The major limiting factor for cropping indicated from the chemistry results is increasing salinity levels below 0.3m depth and acidic pH. Also, sodicity increases significantly below 0.3m depth which may impede water infiltration and plant growth. <u>Recommended Topsoil Strip Depth:</u> 0.3m		
Land condition	Palustrine area present within the project site with cracking clays		

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Soil profile morphology

Site 79	Horizon name and Depth (m)	Colour Mottles Bleach	Moisture Field pH Drainage	Texture Structure Consistency	Coarse fragments, segregations
	Horizon: A11 Horizon depth: 0.0-0.10 Boundary: Abrupt	Colour: 10YR5/2 Greyish yellow brown No mottles	Moisture: Dry, Field pH: 0.10m- pH 5.87, Drainage: Imperfect.	Texture: Silty clay loam, Structure: weak structure, Consistency: firm	Coarse Fragments: Dry, firm, no coarse fragments Effective rooting depth: 0.10m
	Horizon: A12 Horizon depth: 0.10-0.30 Boundary: Abrupt	Colour: 10YR5/2 Greyish yellow brown No mottles	Moisture: Dry, Drainage: Rapid	Texture: Silty clay loam, Structure: weak structure, Consistency: soft	Nil surface rock Nil segregations
	Horizon: B21 Horizon depth: 0.30-1.20	Colour: 10YR4/1 Brownish grey No mottles	Field PH: 0.30-0.40m – pH 6.80 0.90-1.00m – pH 5.05	Texture: Light clay, rough polyhedral peds, Structure: moderate	Nil surface rock Nil segregations

Soil Chemistry Results for Site 79

Analysis (Unit)	Site, Horizon, Sample Depth (m)		
	0.0-0.1	0.3-0.4	0.90-1.00
Lab pH (1:5 water)	6.1	6.9	5.1
EC (dS/cm)	0.08	0.06	0.49
Soil Chloride (mg/kg)	39	219	360
P Olsen (mg/kg)	12	-	-
Exch. Ca (meq/100g)	6.3	7.2	5.92
Exch. Mg (meq/100g)	6.87	6.97	6.64
Exch. K (meq/100g)	0.61	0.48	0.44
Exch. Na (meq/100g)	0.65	1.42	2.68
CEC (meq/100g)	14.9	16.6	16.3
Ca/Mg (ratio)	0.9	1.0	0.9
ESP (%Na/CEC)	4	9	17
Total N (%)	0.01	-	-
Nitrate N (%)	2	-	-
Organic Matter (%)	2.3	-	-
PSA-CS (%)	10	9	8
PSA-FS (%)	20	17	15
PSA-Silt (%)	13	14	15
PSA-Clay (%)	55	58	62
Disp Ratio (R1)	0.57	0.57	0.53
ADMC (%)	4.3	4.3	4.6
Emerson (Number)	5	5	2
Sulfate-S (mg/kg)	4	-	-
Mn (mg/kg)	30.8	-	-
Boron (mg/kg)	0.6	-	-
Copper (mg/kg)	0.7	-	-
Iron (mg/kg)	74	-	-
Zinc (mg/kg)	0.2	-	-
Al (meq/100g)	0.5	0.52	0.61
Al/CEC (%)	3	3	4

" - " indicates no laboratory analysis undertaken for the selected sample

4.1.4 Soil Mapping Unit E1

Overview

SMU E1 is characterised by deep red earths. This unit occurs extensively along the southern portion of the project site. The SMU is dominated by areas of red earths. These areas are characterised by Galloway et al., (1967) as comprising deep uniform red earths on gently undulating, relic alluvial plains and flat plains similar to the E2 SMU (Section 4.1.5) which exhibits deep yellow earths.

Soil Characteristics and Chemistry

For this SMU, a total of seven soil samples were collected at two sites. Four samples were analysed in the field and three samples for one site underwent laboratory analysis. The representative laboratory and field data are presented below.

The soil chemistry data indicate that this SMU is characterised as follows:

- acidic reaction trends throughout profile indicating favourable conditions for nutrient and chemical availability for plant growth;
- chloride and electrical conductivity ratings are very low indicating very low salinity;
- CEC ratings are very low indicating low soil fertility levels due to limitations in adsorbing and holding nutrient cations leading to a reduced supply of nutrients available to plants;
- particle size assessment confirms field textures of uniform loamy sand;
- R1 dispersion is the amount of silt and clay that dispersed compared with the total amount present was moderate, ESP levels were non-sodic with Ca:Mg ratios high to very high indicating soils having low to insignificant dispersive qualities and soil structure issues for plant growth; and
- very low available phosphorus levels and low to moderate nutrients indicating low existing nutrient levels within topsoil.

Land Suitability

Land suitability assessment is determined using the available detailed soil profile descriptions, soil chemistry and landform properties. The limitations and definitions are detailed in Section 5.

The SMU is not suitable for agricultural use with the major limitation for rainfed cropping being that plant available water capacity is generally

less than 75mm at 32-56mm for the effective rooting depth of 0.8 to 1.4m depth.

The SMU is suitable for limited grazing use of native pastures with the major limitation for beef cattle grazing being that plant available water capacity is within 50-75mm at 32-56mm for the effective rooting depth of 0.8 to 1.4m depth.

Available Soil Resources

These soils are suitable for reuse, with a maximum topsoil stripping depth of 1.0m recommended.

Representative Site

A total of three detailed soil profile descriptions were undertaken across this SMU. Detailed soil profile description Site 2 is presented below as a representative site for this SMU.

Land Summary Site

SMU	E1	Representative site number	Site 2
Representative site photograph			
Site type :	Detailed, 50mm hand auger		
Location	mE416473 mN7580665	Disturbance	No effective disturbance other than grazing by hoofed animals
Landform pattern	Flat Plain	Micro relief	Nil
		Permeability	Highly
Slope	0.5%	Drainage	Rapidly drained
Surface coarse fragments	Nil	Surface condition	Sandy, Firm
ASC Order (s) present in SMU	Kandosol	Land use	Grazing pastures
CSIRO soil type	Dunrobin	Substrate	-
		Erosion potential (Bourne and Tuck 1993)	Low / medium
Land suitability summary	Effective rooting depth : 0.80-1.40m Estimated plant available water capacity: 32-56mm Rainfed Cropping: Class 5 Beef Cattle Grazing: Class 4 Agricultural Land Class: C3		
Soil resources	Soil origin contributes to these soils exhibiting generally coarser textured (i.e. sandier) surface layers overlying either deep loamy sand. Stripping depth basically varies with the depth of the sandy upper horizon. Anecdotal evidence of the area suggests loamy sand horizons extend several metres below during the exploration phase of the project <u>Recommended Topsoil Strip Depth: 1.0m</u>		
Land condition	Deep loamy sands on gently undulating low lying plains		

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Soil Profile Morphology

Site 2	Horizon Depth (m)	Colour Mottles Bleach	Moisture Field pH Drainage	Texture Structure Consistency	Coarse fragments, segregations
	Horizon: A11 Horizon depth: 0.0-0.04 Boundary: Sharp	Colour: 7.5YR5/4 Dull brown No mottles	Moisture: Dry, Field pH: 0.02 m- pH 6.5, Drainage: Rapid	Texture: Loamy sand, sticky large grains Structure: Single grain	Nil surface rock Nil segregations
	Horizon: A12 Horizon depth: 0.04-2.00	Colour: 2.5YR5/8 Bright brown No mottles	Moisture: Dry, Field pH: 0.50 m- pH 7.0, 0.90 m- pH 7.0, 1.90 m- pH 7.0, Drainage: Rapid	Texture: Loamy sand, sticky large grains Structure: Single grain	Nil surface rock Nil segregations

Soil Chemistry Results for Site 2

Analysis (Unit)	Site, Horizon, Sample Depth (m)		
	0.0-0.1	0.3-0.4	0.60-0.70
Lab pH (1:5 water)	6.2	6.3	6.4
EC (dS/cm)	0.02	0.02	0.01
Soil Chloride (mg/kg)	28	29	22
P Olsen (mg/kg)	5	-	-
Exch. Ca (meq/100g)	2.39	1.59	1.6
Exch. Mg (meq/100g)	0.76	0.87	1.33
Exch. K (meq/100g)	0.17	0.13	0.1
Exch. Na (meq/100g)	<0.1	<0.1	<0.1
CEC (meq/100g)	3.7	3.0	.4
Ca/Mg (ratio)	3.1	1.8	1.2
ESP (%Na/CEC)	1	1	1
Total N (%)	<0.01	-	-
Nitrate N (%)	<1	-	-
Organic Matter (%)	1.4	-	-
PSA-CS (%)	49	46	40
PSA-FS (%)	36	31	29
PSA-Silt (%)	6	6	4
PSA-Clay (%)	9	18	27
Disp Ratio (R1)	0.60	0.73	0.58
ADMC (%)	0.4	0.4	0.7
Emerson (Number)	5	5	3
Sulfate-S (mg/kg)	2	-	-
Mn (mg/kg)	23.8	-	-
Boron (mg/kg)	0.2	-	-
Copper (mg/kg)	0.3	-	-
Iron (mg/kg)	13	-	-
Zinc (mg/kg)	0.2	-	-
Al (meq/100g)	0.34	0.39	0.38
Al/CEC (%)	9	13	11

"-" indicates no laboratory analysis undertaken for the selected sample

4.1.5 Soil Mapping Unit E2

Overview

SMU E2 is characterised by greyish yellow to yellow earths (>150cm depth) and gradational grey yellow deep, sandy earths. This unit occurs extensively along the southern portion of the project site along with the SMU E1. The SMU includes significant areas of greyish and yellow earths. Galloway et al. (1967) characterised these areas as consisting of deep uniform yellow and red earths on gently undulating, relic alluvial plains and flat plains (similar to the E1 SMU). SMU E2 is also defined by having a softer surface than SMU E1 (which has a firm surface).

Soil Characteristics and Chemistry

For this SMU, a total of 16 soil samples were collected at five sites. Forty one samples were analysed in the field and four samples for one site underwent laboratory analysis. The representative laboratory and field data are presented below.

The soil chemistry data indicates that this SMU is characterised as follows:

- acidic reaction trends throughout profile indicating favourable conditions for nutrient and chemical availability for plant growth;
- chloride and electrical conductivity ratings are very low indicating very low salinity;
- CEC ratings are very low indicating low soil fertility levels due to limitations in adsorbing and holding nutrient cations leading to a reduced supply of nutrients available to plants;
- particle size assessment confirms field textures of uniform loamy sand;
- R1 dispersion indicates the amount of silt and clay that dispersed compared with the total amount present was high to very high,
- ESP levels were non-sodic with Ca:Mg ratios high to moderate indicating soils having very low dispersive qualities within the soil structure issue increasing slightly at depth; and
- low available phosphorus levels and moderate levels of manganese and copper nutrients indicating low existing nutrient levels within the topsoil.

Land Suitability

Land suitability assessment is determined using the available detailed soil profile description, soil chemistry and landform properties. The limitations and definitions are detailed in Section 5.

The SMU is not suitable for agricultural use with the major limitation for rainfed cropping being that plant available water capacity is less than 75mm at 36-56mm up to 1.4m depth.

The SMU is suitable for limited grazing use of native pastures with the major limitation for beef cattle grazing being that plant available water capacity is, within 50-75mm at 32-56mm for the effective rooting depth of 0.9 to 1.4m.

Available Soil Resources

These soils are suitable for reuse with a maximum topsoil stripping depth of 1.0m recommended.

Representative Site

A total of fifteen detailed soil profile descriptions were undertaken across this SMU. Detailed soil profile description Site 18 is presented below as a representative site for this SMU.

Land Summary

SMU	E2	Representative site number	Site 18
Representative site photograph			
Site type	Detailed, 50 mm hand auger		
Location	mE417020 mN7582693	Disturbance	No effective disturbance other than grazing by hoofed animals
Landform pattern	Gently undulating plain	Micro relief	Nil microrelief present
		Permeability	Highly
Slope	0.0%	Drainage	Rapidly drained to well drained
Surface coarse fragments	No coarse fragments	Surface condition	Soft to firm, dry
ASC Order (s) present in SMU	Kandosol	Land use	Grazing native pastures
CSIRO soil type	Struan	Substrate	-
Erosion potential (Bourne and Tuck 1993)	Low / medium		
Land suitability summary	Effective rooting depth : 0.90-1.40m Estimated plant available water capacity: 36-56mm Rainfed Cropping: Class 5 Beef Cattle Grazing: Class 4 Agricultural Land Class: C3		
Soil resources	As per E1, the soil origin contributes to these soils exhibiting generally coarser textured (i.e. sandier) surface layers overlying either deep loamy sands or hard and possibly sodic silty loam subsoils. <u>Recommended Topsoil Strip Depth: 1.0m</u>		
Land condition	Deep loamy sands on gently undulating low lying plains		

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Soil profile morphology

Site 18	Horizon Depth (m)	Colour Mottles Bleach	Moisture Field pH Drainage	Texture Structure Consistency	Coarse fragments, segregations
	Horizon: A11 Horizon depth: 0.0-0.05 Boundary: sharp	Colour: 10YR5/3 Dull yellowish brown No mottles	Moisture: Dry, Field pH: 0.05 m- pH 6.5, Drainage: Rapid	Texture: Loamy sand, Structure: single grain, Consistency: loose	Nil surface rock Nil segregations
	Horizon: A12 Horizon depth: 0.05-0.25 Boundary: sharp	Colour: 10YR5/4 Dull yellowish brown No mottles	Moisture: Dry, Field pH: 0.10 m- pH 6.5, Drainage: Rapid	Texture: Loamy sand, Structure: single grain, Consistency: loose	Nil surface rock Nil segregations
	Horizon: A13 Horizon depth: 0.25-0.90 Boundary: Abrupt	Colour: 10YR5/6 Yellowish brown No mottles	Moisture: Dry, Field pH: 0.30 m- pH 6.5, 0.60 m- pH 7.5, Drainage: Rapid	Texture: Loamy sand, Structure: single grain, Consistency: loose	Nil surface rock Nil segregations
	Horizon: B21 Horizon depth: 0.90-1.20	Colour: 10YR6/6 Bright yellowish brown No mottles	Moisture: Dry, Field pH: 1.00 m- pH 7.5, Drainage: Well	Texture: Clayey sand, Structure: single grain, massive, Consistency: loose	Nil surface rock Nil segregations

Soil Chemistry Results for Site 18

Analysis (Unit)	Site, Horizon, Sample Depth (cm)			
	0-5	10-20	50-60	100-110
Lab pH (1:5 water)	6.4	6.2	6.1	6.2
EC (dS/cm)	0.03	0.02	0.01	0.01
Soil Chloride (mg/kg)	22	21	20	21
P Olsen (mg/kg)	8	-	-	-
Exch. Ca (meq/100g)	2.08	1.69	0.65	0.73
Exch. Mg (meq/100g)	0.61	0.43	0.49	1.18
Exch. K (meq/100g)	0.2	0.14	0.03	0.03
Exch. Na (meq/100g)	<0.1	<0.1	<0.1	<0.1
CEC (meq/100g)	3.3	2.6	1.7	2.5
Ca/Mg (ratio)	3.4	3.9	1.3	0.6
ESP (%Na/CEC)	1	1	2	3
Total N (%)	<0.01	-	-	-
Nitrate N (%)	<1	-	-	-
Organic Matter (%)	1.1	-	-	-
PSA-CS (%)	55	47	43	43
PSA-FS (%)	35	40	42	35
PSA-Silt (%)	3	5	3	4
PSA-Clay (%)	6	9	13	18
Disp Ratio (R1)	0.99	0.90	0.99	0.95
ADMC (%)	0.3	0.3	0.3	0.6
Emerson (Number)	5	5	5	5
Sulfate-S (mg/kg)	2	-	-	-
Mn (mg/kg)	30.9	-	-	-
Boron (mg/kg)	0.2	-	-	-
Copper (mg/kg)	0.3	-	-	-
Iron (mg/kg)	18	-	-	-
Zinc (mg/kg)	0.1	-	-	-
Al (meq/100g)	0.38	0.36	0.45	0.47
Al/CEC (%)	12	14	27	19

"-" indicates no laboratory analysis undertaken for the selected sample

4.1.6 Soil Mapping Unit E3

Overview

SMU E3 is characterised by red sandy loams, with firmer surface silty loams. SMU E3 exhibits similar characteristics to the deep sandy low lying soils of SMU E1. However SMU E3 soils comprise less coarse textured (i.e. siltier) sub-soils. This unit occurs within the mid to upper lands of the project site. The SMU includes significant areas red earths characterised by Galloway et al. (1967) consisting of deep uniform yellow and red earths on gently undulating, relic alluvial plains and flat plains similar to the E1 and E2 SMU which contains deep red and yellow earths.

Soil Characteristics and Chemistry

For this SMU, a total of three soil samples were collected at one site. Twelve samples were analysed in the field and three samples at one site underwent laboratory analysis. The representative laboratory and field data are presented below.

The soil chemistry data indicate that this SMU is characterised as follows:

- acidic reaction trends throughout profile indicating favourable conditions for nutrient and chemical availability for plant growth;
- chloride ratings and electrical conductivity are very low indicating very low salinity;
- CEC ratings are very low indicating very low soil fertility levels due to limitations in adsorbing and holding nutrient cations leading to a reduced supply of nutrients available to plants;
- particle size assessment confirms field textures of silty loam;
- R1 dispersion indicates the amount of silt and clay that dispersed compared with the total amount present was high to very high, ESP levels were non-sodic with Ca:Mg ratios high to moderate indicating soils having very low to low dispersive qualities within the soil structure; and
- low available phosphorus levels and moderate levels of manganese and copper nutrients indicating low existing nutrient levels within the topsoil.

Land Suitability

Land suitability assessment is determined using the available detailed soil profile descriptions, soil chemistry and landform properties. The limitations and definitions are detailed in Section 5.

The SMU is not suitable for agricultural use with the major limitation for rainfed cropping being that plant available water capacity is generally less than 75mm at 56mm up to 1.1m depth.

The SMU is suitable for limited grazing use of native pastures with the major limitation for beef cattle grazing being that plant available water capacity is between 50-75mm at 56mm up to 1.1m depth.

Available Soil Resources

These soils are suitable for reuse with a maximum topsoil stripping depth of 1.0m recommended.

Representative Site

A total of nine detailed soil profile descriptions were undertaken across this SMU. Detailed soil profile description Site 38 is presented below as a representative site for this SMU.

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Land Summary

Representative site numbers	E3	Representative site number	Site 38
Representative site photograph			
Site type	Detailed, 50mm hand auger		
Location	mE415235 mN7584875	Disturbance	No effective disturbance other than grazing by hoofed animals
Landform pattern	Gently undulating plains	Micro relief	Nil microrelief.
		Permeability	Highly
Slope	3.0%	Drainage	Rapidly drained
Surface coarse fragments	No surface rocks	Surface condition	Hard setting
ASC Order (s) present in SMU	Kandosol	Land use	Grazing pastures
CSIRO soil type	Annandale	Substrate	
Erosion potential (Bourne and Tuck 1993)	Low / medium		
Land suitability summary	Effective rooting depth; 0.70-1.10m Estimated plant available water capacity: 36-54mm Rainfed Cropping: Class 5 Beef Cattle Grazing: Class 4 Agricultural Land Class: C3		
Soil resources	SMU E3 exhibit similar characteristics to the deep sandy low lying soils E1 and E2 however the plant available water capacity of SMU E3 is lower <u>Recommended Topsoil Stripping Depth: 1.0m</u>		
Land condition	Deep Silty Loam on gently undulating in mid to high lying plains		

Soil profile morphology

Site 38	Horizon Depth (m)	Colour Mottles Bleach	Moisture Field pH Drainage	Texture Structure Consistency	Coarse fragments, segregations Roots
	Horizon: A11 Horizon depth: 0.0-0.30 Boundary: sharp	Colour: 7.5YR5/6 Bright brown No mottles	Moisture: Dry, Field pH: n/a Drainage: Rapid	Texture: Sandy loam, Structure: single grain, Consistency: loose	Nil surface rock Nil segregations
	Horizon: B21 Horizon depth: 0.30-0.70+	Colour: 2.5YR4/8 Reddish brown No mottles	Moisture: Dry, Field pH: n/a Drainage: Rapid	Texture: Silty Loam, Structure: single grain Consistency: loose	Nil surface rock Nil segregations

Soil Chemistry Results for Site 38

Analysis (Unit)	Site, Horizon, Sample Depth (m)		
	0.0-0.1	0.30-0.40	0.60-0.70
Lab pH (1:5 water)	6.1	5.9	6
EC (dS/cm)	0.02	0.03	0.02
Soil Chloride (mg/kg)	22	35	16
P Olsen (mg/kg)	7	-	-
Exch. Ca (meq/100g)	1.59	1.22	1.58
Exch. Mg (meq/100g)	0.62	0.94	1.35
Exch. K (meq/100g)	0.19	0.24	0.24
Exch. Na (meq/100g)	<0.1	<0.1	<0.1
CEC (meq/100g)	2.8	3.0	3.8
Ca/Mg (ratio)	2.6	1.3	1.2
ESP (%Na/CEC)	1	1	1
Total N (%)	<0.01	-	-
Nitrate N (%)	<1	-	-
Organic Matter (%)	0.9	-	-
PSA-CS (%)	26	27	21
PSA-FS (%)	54	38	28
PSA-Silt (%)	18	9	7
PSA-Clay (%)	4	27	45
Disp Ratio (R1)	0.87	0.60	0.35
ADMC (%)	0.5	0.7	1.1
Emerson (Number)	5	5	5
Sulfate-S (mg/kg)	2	-	-
Mn (mg/kg)	5.5	-	-
Boron (mg/kg)	-0.1	-	-
Copper (mg/kg)	0.4	-	-
Iron (mg/kg)	15	-	-
Zinc (mg/kg)	0.3	-	-
Al (meq/100g)	0.39	0.55	0.55
Al/CEC (%)	14	19	15

"-" indicates no laboratory analysis undertaken for the selected sample

4.1.7 Soil Mapping Unit E4

Overview

SMU E4 is characterised by sandy loam soils with 60% yellow and 40% red interfingering loamy earths. SMU E4 occurs in the central and northern areas of the project site and exhibits very similar characteristics to SMU E3 as well as E1 and E2.

The main difference is that SMU E4 shows an interfingering pattern of red and yellow earths. It is approximated that 60% of the area are yellow earths with 40% red earths. Deep silty loams which overlie sandy loam are the dominate soils from which the representative SMU profile was taken.

Soil Characteristics and Chemistry

For this SMU, a total of 14 soil samples were collected at five sites. Thirty seven samples were analysed in the field and three samples at one site underwent laboratory analysis. The representative laboratory and field data are presented below. Laboratory data for this SMU (Site 47) is presented below.

The major chemistry data indicate that this SMU is characterised by:

- acidic reaction trends throughout profile indicating favourable conditions for nutrient and chemical availability for plant growth;
- chloride ratings and electrical conductivity are low to very low indicating low to very low salinity;
- CEC ratings are low indicating low soil fertility levels due to limitations in adsorbing and holding nutrient cations leading to a reduced supply of nutrients available to plants;
- particle size assessment confirms field textures of uniform loamy sand;
- R1 dispersion indicates the amount of silt and clay that dispersed compared with the total amount present was moderate to high, ESP levels were non-sodic with Ca:Mg ratios high to moderate indicating soils having very low to low dispersive qualities; and
- moderate available phosphorus levels and moderate nutrients indicating favourable existing nutrient levels within the topsoil horizon.

Land Suitability

Land suitability assessment is determined using the available detailed soil profile descriptions, soil chemistry and landform properties. The limitations and definitions are detailed in Section 5.

The SMU is not suitable for agricultural use with the major limitation for rainfed cropping being that plant available water capacity is generally less than 75mm at 55mm up to 1.1m depth.

The SMU is suitable for limited grazing use of native pastures with the major limitation for beef cattle grazing being that plant available water capacity is between 50-75mm at 55mm up to 1.1m depth.

Available Soil Resources

These soils are suitable for reuse with a maximum topsoil stripping depth of 1.3m recommended.

Representative Site

A total of 18 detailed soil profile descriptions were undertaken across this SMU. Detailed soil profile description Site 47 is presented below as a representative site for this SMU.

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Land Summary

SMU	E4	Representative site number	Site 47
Representative site photograph			
Site type	Detailed, 50mm hand auger	Main vegetation	Eucalyptus open woodland
Location	mE413867 mN7588836	Disturbance	No effective disturbance other than grazing by hoofed animals
Landform pattern	Gently undulating plains	Micro relief	Nil microrelief present
Slope	1.0%	Permeability	Highly
Surface coarse fragments	No coarse fragments	Drainage	Rapidly drained
ASC Order (s) present in SMU	Kandosol	Surface condition	Firm silty sand
CSIRO soil type	Annandale 40% Struan 60%	Land use	Grazing pastures
Erosion potential (Bourne and Tuck 1993)	Low / medium	Substrate	-
Land suitability summary	Effective rooting depth: 0.70-1.10m Estimated plant available water capacity: 35-65mm Rainfed Cropping: Class 5 Beef Cattle Grazing: Class 4 Agricultural Land Class: C3		
Soil resources	SMU E4 exhibit similar characteristics to the deep silty loam soils E3 however SMU E3 plant available water capacity is considered improved <u>Recommended Topsoil Strip Depth: 1.3m</u>		
Land condition	Deep Silty Loam on gently undulating in mid to high lying plains		

Soil profile morphology

Site 47	Horizon Depth (m)	Colour Mottles Bleach	Moisture Field pH Drainage	Texture Structure Consistency	Coarse fragments, segregations Roots
	Horizon: A11 Horizon depth: 0.0-0.10 Boundary: Abrupt	Colour: 10YR5/3 Dull yellowish brown No mottles	Moisture: Dry, Field pH: n/a Drainage: Rapid	Texture: Sandy loam, Structure: single grain, Consistency: loose	Nil surface rock Nil segregations
	Horizon: A12 Horizon depth: 0.10-0.50 Boundary: Abrupt	Colour: 10YR5/4 Dull yellowish brown No mottles	Moisture: Dry, Field pH: n/a Drainage: Rapid	Texture: Sandy loam Structure: single grain, Consistency: loose	Nil surface rock Nil segregations
	Horizon: A2 Horizon depth: 0.50-1.00+	Colour: 10YR5/6 yellowish brown No mottles	Moisture: Dry, Field pH: n/a Drainage: Rapid	Texture: Coarse sandy loam, Structure: single grain, Consistency: loose	Nil surface rock Nil segregations

Soil Chemistry Results for Site 47

Analysis (Unit)	Site, Horizon, Sample Depth (m)		
	0.0-0.1	0.30-0.40	0.70-0.80
Lab pH (1:5 water)	6.2	6.1	6
EC (dS/cm)	0.09	0.04	0.02
Soil Chloride (mg/kg)	35	27	24
P Olsen (mg/kg)	10	-	-
Exch. Ca (meq/100g)	5.54	3.31	1.59
Exch. Mg (meq/100g)	4.84	3.53	3.89
Exch. K (meq/100g)	0.64	0.43	0.28
Exch. Na (meq/100g)	0.1	<0.1	<0.1
CEC (meq/100g)	11.5	7.7	6.2
Ca/Mg (ratio)	1.1	0.9	0.4
ESP (%Na/CEC)	1	1	1
Total N (%)	0.09	-	-
Nitrate N (%)	<1	-	-
Organic Matter (%)	4	-	-
PSA-CS (%)	20	27	41
PSA-FS (%)	32	38	35
PSA-Silt (%)	25	17	7
PSA-Clay (%)	24	20	18
Disp Ratio (R1)	0.71	0.83	0.89
ADMC (%)	2.1	1.3	1.1
Emerson (Number)	5	5	5
Sulfate-S (mg/kg)	5	-	-
Mn (mg/kg)	62.9	-	-
Boron (mg/kg)	0.4	-	-
Copper (mg/kg)	1	-	-
Iron (mg/kg)	61	-	-
Zinc (mg/kg)	2.1	-	-
Al (meq/100g)	0.34	0.35	0.37
Al/CEC (%)	3	5	6

"-" indicates no laboratory analysis undertaken for the selected sample

4.1.8 Soil Mapping Unit E5

Overview

SMU E5 is characterised by duplex, loamy sands above hard silty clay loams which are yellowish grey in colour with possible areas of bleaching. SMU E5 is a duplex soil type with a texture change throughout the soil profile unlike SMUs E1 to E4. This SMU comprises loamy sands above hard silty clay which may have a sporadically bleached A2 horizon.

Soil Characteristics and Chemistry

For this SMU, a total of three soil samples were collected at one site. Seven samples were analysed in the field and three samples at one site underwent laboratory analysis. The representative laboratory and field data are presented below.

The soil chemistry data indicate that this SMU is characterised as follows:

- acidic to neutral reaction trends throughout profile indicating great conditions for nutrient and chemical availability for plant growth;
- chloride ratings are very low to low and electrical conductivity ratings are low to moderate indicating low salinity;
- CEC ratings for overall fertility status are very low indicating low soil fertility levels due to limitations in adsorbing and holding nutrient cations leading to a reduced supply of nutrients available to plants;
- particle size assessment confirms field textures of a loamy sand to a silty clay subsoil;
- R1 dispersion indicates the amount of silt and clay that dispersed compared with the total amount present was moderate to very high with Ca:Mg ratios very high to low indicating soils having very low dispersive qualities within the topsoil horizon. Moderate dispersive qualities and minor soil structure issues for plant growth are within the sub surface horizons;
- strongly sodic conditions are present at 0.30m which increase further with depth indicates dispersive attributes which impacting on water infiltration;
- moderate available phosphorus levels and low nutrient levels indicating moderate existing nutrient levels within the topsoil.

Land Suitability

Land suitability assessment is determined using the available detailed soil profile description, soil chemistry and landform properties. The limitations and definitions are detailed in Section 5.

The SMU is not suitable for agricultural use with the major limitation for rainfed cropping being that plant available water capacity is generally less than 75mm at 64mm up to 0.9m depth.

The SMU is suitable for limited grazing use of native pastures with the major limitation for beef cattle grazing being that plant available water capacity is between 50-75mm at 64mm up to 0.9m depth.

Available Soil Resources

These soils are suitable for reuse with a maximum topsoil stripping depth of 0.1m recommended.

Representative Site

A total of four detailed soil profile descriptions were undertaken across this SMU. Detailed soil profile description Site 148 is presented below as a representative site for this SMU.

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Land Summary

SMU	E5	Representative site numbers	Site 148
Representative site photograph			
Site type	Detailed, 50mm hand auger	Main vegetation	Eucalyptus and Corymbia woodlands
Location	mE407418 mN7599196	Disturbance	No effective disturbance other than grazing by hoofed animals
Landform pattern	Gently undulating plains	Micro relief	No microrelief present
		Permeability	Slowly permeable
Slope	1.0%	Drainage	Rapidly drained in surface and subsoil layer. Imperfectly drained in deeper subsoil
Surface coarse fragments	No coarse fragments	Surface condition	Silty loam
ASC Order (s) present in SMU	Sodosol	Land use	Grazing pastures
CSIRO soil type	Wyseby	Substrate	-
Erosion potential (Bourne and Tuck 1993)	Medium with sound land management. Will increase with exposure of the subsoil layer		
Land suitability summary	Effective rooting depth: 0.40-0.6m (highly dispersive) Estimated plant available water capacity: 32-64mm Rainfed Cropping: Class 5 Beef Cattle Grazing: Class 4 Agricultural Land Class: C3		
Soil resources	SMU unit E5 consists of silty loam topsoil horizon and subsoils however laboratory data reports significant increase in sodicity. <u>Recommended Topsoil Strip Depth:</u> 0.1m		
Land condition	Deep Silty Loam located within small sections of the project area on gently undulating in mid to high lying plains		

Soil profile morphology Site 148

Site 148	Horizon Depth (m)	Colour Mottles Bleach	Moisture Field pH Drainage	Texture Structure Consistency	Coarse fragments, segregations
	Horizon: A11 Horizon depth: 0.0-0.07 Boundary: Clear	Colour: 10YR5/3 Dull yellowish brown No mottles	Moisture: Dry, Field pH: n/a Drainage: Rapid	Texture: Loamy Sands, Structure: single grain.	Nil surface rock Nil segregations
	Horizon: A12 Horizon depth: 0.07-0.20 Boundary: Abrupt	Colour: 10YR4/1 brownish grey No mottles	Moisture: Dry, Field pH: n/a Drainage: Rapid	Texture: Loamy Sands, Structure: single grain	Nil surface rock Nil segregations
	Horizon: B21 Horizon depth: 0.20-0.60 Boundary: Abrupt	Colour: 10YR6/3 Dull yellow orange No mottles	Moisture: Dry, Field pH: n/a Drainage: Rapid	Texture: Clay loam, Structure: single grain, Consistency: massive	Notes: Sporadic bleach at 40-45cm
	Horizon: B22 Horizon depth: 0.60-0.90	Colour: 10YR4/4 brown No mottles	Moisture: Dry, Field pH: n/a Drainage: Imperfect	Texture: Silty Clay Loam, Structure: single grain, Consistency: weak.	Nil surface rock Nil segregations

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Soil Chemistry Results for Site 148

Analysis (Unit)	Site, Horizon, Sample Depth (m)		
	0.0-0.07	0.30-0.40	0.70-0.80
Lab pH (1:5 water)	5.6	5.8	7.4
EC (dS/cm)	0.11	0.03	0.012
Soil Chloride (mg/kg)	25	26	226
P Olsen (mg/kg)	10	-	-
Exch. Ca (meq/100g)	2.89	0.18	0.31
Exch. Mg (meq/100g)	1.25	0.86	3.13
Exch. K (meq/100g)	0.36	0.06	0.07
Exch. Na (meq/100g)	0.13	0.27	1.33
CEC (meq/100g)	5.0	1.8	5.3
Ca/Mg (ratio)	2.3	0.2	0.1
ESP (%Na/CEC)	3	15	25
Total N (%)	0.08	-	-
Nitrate N (%)	<1	-	-
Organic Matter (%)	4.2	-	-
PSA-CS (%)	40	42	30
PSA-FS (%)	35	39	32
PSA-Silt (%)	13	9	9
PSA-Clay (%)	12	12	30
Disp Ratio (R1)	0.75	0.79	0.95
ADMC (%)	1.0	0.4	1.4
Emerson (Number)	5	2	2
Sulfate-S (mg/kg)	7	-	-
Mn (mg/kg)	27.7	-	-
Boron (mg/kg)	0.4	-	-
Copper (mg/kg)	0.2	-	-
Iron (mg/kg)	51	-	-
Zinc (mg/kg)	0.3	-	-
Al (meq/100g)	0.38	0.39	0.43
Al/CEC (%)	8	22	8

"-" indicates no laboratory analysis undertaken for the selected sample

4.1.9 Soil Mapping Unit U1

Overview

SMU U1 is characterised by silty rocky channels and loamy foot slope areas associated with rocky uplands. This SMU is associated with the upper rugged lands where active drainage lines are present between the undulating plains and steep landforms associated with SMU U2(a).

Soil Characteristics and Chemistry

For this SMU, a total of three soil samples were collected at one site. Three samples were analysed in the field and three samples for one site underwent laboratory analysis. The representative laboratory and field data are presented below.

The soil chemistry data indicate that this SMU is characterised as follows:

- strongly acidic to acidic reaction trends indicating marginal conditions for nutrient and chemical availability for plant growth;
- very low chloride and electrical conductivity throughout profile indicating low salinity;
- CEC ratings for overall fertility status are very low indicating low soil fertility levels due to limitations in adsorbing and holding nutrient cations leading to a reduced supply of nutrients available to plants;
- particle size assessment confirm a coarse sandy dominated profile;
- R1 dispersion indicates the amount of silt and clay that dispersed compared with the total amount present was moderate to low;
- ESP levels were non-sodic with Ca:Mg ratios very high indicating soils having insignificant dispersive qualities within the soil structure; and
- moderate available phosphorus levels and low nutrient levels indicating moderate existing nutrient levels within the topsoil.

Land Suitability

Land suitability assessment is determined using the available detailed soil profile descriptions, soil chemistry and landform properties. The limitations and definitions are detailed in Section 5.

The SMU is not suitable for agricultural use with the major limitation for rainfed cropping being that the landform contains abundant deep gullies prevent any practical cultivation.

The SMU is suitable for limited native grazing use with the major limitation for beef cattle grazing being that plant available water capacity is between 50mm and 75mm at 72mm at 1.2m depth.

Available Soil Resources

These soils are suitable for reuse with a maximum topsoil stripping depth of 1.1m recommended.

Representative Site

A total of four detailed soil profile descriptions were undertaken across this SMU. Detailed soil profile description Site 69 is presented below as a representative site for this SMU.

Land Summary

SMU	U1	Representative site numbers	Site 69
Representative site photograph			
Site type	Detailed, 50mm hand auger	Main vegetation	Eucalyptus open woodland
Location	mE410386 mN7604792	Disturbance	No effective disturbance other than grazing by hoofed animals
Landform pattern	Gently undulating plains	Micro relief	No microrelief present
Slope	3.0%	Permeability	moderate to highly
Surface coarse fragments	No coarse fragments	Drainage	Rapidly drained
ASC Order (s) present in SMU	Tenosol	Surface condition	Firm, silty loam
CSIRO soil type	Davy/Gregory	Land use	Grazing pastures
Erosion potential (Bourne and Tuck 1993)	Medium to high	Substrate	-
Land suitability summary	Effective rooting depth: 1.20m Estimated plant available water capacity: 72mm Rainfed Cropping: Class 5 Beef Cattle Grazing: Class 4 Agricultural Land Class: C3		
Soil resources	Active drainage lines , SMU U1 throughout the upland regions consist of silty loams which may be taken quite deep through the horizons <u>Recommended Topsoil Strip Depth:</u> 1.1m		
Land condition	Stable across the upper rugged lands with erosive gullying near watercourses		

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Soil profile morphology Site

Site 69	Horizon Depth (m)	Colour Mottles Bleach	Moisture Field pH Drainage	Texture Structure Consistency	Coarse fragments, segregations Roots
	Horizon: A11 Horizon depth: 0.0-0.05 Boundary: Clear	Colour: 10YR5/4 Dull yellowish brown No mottles	Moisture: Dry, Field pH: 0.05 m- pH 6.5, Drainage: Rapid	Texture: Silty loam, Structure: single grain, Consistency: massive/loose	Coarse Fragments: Gravels <5mm at <5% throughout profile
	Horizon: A12 Horizon depth: 0.05-0.35 Boundary: Abrupt	Colour: 10YR5/4 Dull yellowish brown No mottles	Moisture: Dry, Field pH: 0.30 m- pH 6.5, Drainage: Rapid	Texture: Silty loam, Structure: single grain, Consistency: massive/loose	Coarse Fragments: Gravels <5mm at <5% throughout profile
	Horizon: A13 Horizon depth: 0.35-1.20	Colour: 10YR4/4 brown No mottles	Moisture: Dry, Field pH: 0.60 m- pH 6.5, Drainage: Rapid	Texture: Silty loam, Structure: single grain, Consistency: massive/loose	Coarse Fragments: Gravels <5mm at <5% throughout profile

Soil Chemistry Results for Site 69

Analysis (Unit)	Site, Horizon, Sample Depth (m)		
	0.0-0.10	0.20-0.30	0.80-0.90
Lab pH (1:5 water)	5.5	5.3	5.5
EC (dS/cm)	0.02	0.01	0.02
Soil Chloride (mg/kg)	19	21	19
P Olsen (mg/kg)	12	-	-
Exch. Ca (meq/100g)	0.72	0.52	0.19
Exch. Mg (meq/100g)	0.21	0.35	0.30
Exch. K (meq/100g)	0.1	0.12	0.25
Exch. Na (meq/100g)	<0.1	<0.1	<0.1
CEC (meq/100g)	1.5	1.6	1.6
Ca/Mg (ratio)	3.4	1.5	0.6
ESP (%Na/CEC)	1	3	3
Total N (%)	<0.01	-	-
Nitrate N (%)	1	-	-
Organic Matter (%)	1.2	-	-
PSA-CS (%)	34	40	31
PSA-FS (%)	56	50	50
PSA-Silt (%)	2	3	6
PSA-Clay (%)	9	8	13
Disp Ratio (R1)	0.70	0.79	0.55
ADMC (%)	0.4	0.3	1.1
Emerson (Number)	5	5	5
Sulfate-S (mg/kg)	3	-	-
Mn (mg/kg)	3.1	-	-
Boron (mg/kg)	-0.1	-	-
Copper (mg/kg)	0.2	-	-
Iron (mg/kg)	23	-	-
Zinc (mg/kg)	<0.1	-	-
Al (meq/100g)	0.46	0.56	0.85
Al/CEC (%)	31	35	32

"-" indicates no laboratory analysis undertaken for the selected sample

4.1.10 Soil Mapping Unit U2(a)

Overview

SMU U2(a) is characterised by rugged scarps, ridges and valleys with extensive outcropping hard laterite and gravelly skeletal soils. SMU located within the upper lands of the project site comprise of skeletal ridges with shallow loamy sands to moderate in depth sandy loams. SMU U2a is generally shallow sandy loam with gravels and boulders overlying laterite outcrops and formations. The landform is rugged with undulating plains with steep slopes limit the quantity of topsoil present.

Soil Characteristics and Chemistry

For this SMU, a total of two soil samples were collected at one site. The soil sample was analysed in the field and underwent laboratory analysis. The representative laboratory and field data are presented below.

The soil chemistry data indicate that this SMU is characterised as follows:

- strongly acidic reaction trends throughout topsoil indicating marginal conditions for nutrient and chemical availability for plant growth;
- chloride ratings and electrical conductivity levels are very low indicating very low salinity conditions within the soil;
- CEC ratings are very low indicating low soil fertility levels due to limitations in adsorbing and holding nutrient cations leading to a reduced supply of nutrients available to plants;
- particle size assessment confirms field textures of shallow uniform loamy sand; and
- R1 dispersion indicates the amount of silt and clay that dispersed compared with the total amount present was moderate, ESP levels were non-sodic with Ca:Mg ratios very low indicating soils having low dispersive qualities within the soil structure.

Land Suitability

Land suitability assessment is determined using the available detailed soil profile descriptions, soil chemistry and landform properties. The limitations and definitions are detailed in Section 5.

The SMU is not suitable for agricultural use with the major limitation for rainfed cropping include: being

- plant available water capacity is less than 50mm at 8mm; and
- rockiness of >90% surface cobble and rock outcrop.

The SMU is suitable for limited native grazing use with the major limitation for beef cattle grazing being that plant available water capacity is less than 50mm at 8mm.

Available Soil Resources

These soils are suitable for reuse with a maximum topsoil stripping depth of 0.2m recommended.

Representative Site

A total of nine detailed soil profile descriptions were undertaken across this SMU. Detailed soil profile description Site 60 is presented below as a representative site for this SMU.

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Land Summary

SMU	U2(a)	Representative site numbers	Site 60
Representative site photograph			
Site type	Detailed, 50mm hand auger	Main vegetation	Acacia and Eucalyptus woodlands
Location	mE413045 mN7590239	Disturbance	No effective disturbance other than grazing by hoofed animals
Landform pattern	Gently undulating plains	Micro relief	No microrelief present
		Permeability	Highly
Slope	3.0%	Drainage	Well drained
Surface coarse fragments	Silcrete and laterite rock <70% cover	Surface condition	Loamy sand, firm
ASC Order (s) present in SMU	Rudosol	Land use	Grazing pastures
CSIRO soil type	Shotover	Substrate	Laterite
Erosion potential (Bourne and Tuck 1993)	Moderately high due to steep slopes		
Land suitability summary	Effective rooting depth: 0.20m Estimated plant available water capacity: 8mm Rainfed Cropping: Class 5 Beef Cattle Grazing: Class 5 Agricultural Land Class: D		
Soil resources	SMU U2a is generally shallow loamy sand with gravels and boulders overlying laterite outcrops to laterite outcrops formations. Laboratory data of the representative site allows the topsoil stripping based on depth to the laterite <u>Recommended Topsoil Strip Depth: 0.2m</u>		
Land condition	Very hard areas of land consisting of sandy loams on top of laterite material		

Soil profile morphology

Site 60	Horizon Depth (m)	Colour Mottles Bleach	Moisture Field pH Drainage	Texture Structure Consistency	Coarse fragments, segregations Roots
	Horizon: A11 Horizon depth: 0.0-0.20 Boundary: Sharp	Colour: 7.5YR4/2 brown No mottles	Moisture: Dry, Field pH: n/a Drainage: Rapid	Texture: Loamy sand, Structure: single grain, Consistency: massive/loose	Coarse Fragments: Silcrete and laterite rock <70% cover at surface Gravels and cobbles 10-100mm at <20% cover
	Horizon: C1 Horizon depth: 0.20+	-	Moisture: Dry Field pH: n/a Drainage: drainage	Laterite, very hard, very dense	Laterite outcrop

Soil Chemistry Results for Site 60

Analysis (Unit)	Site, Horizon, Sample Depth (m)
	0.0-0.10
Lab pH (1:5 water)	4.7
EC (dS/cm)	0.03
Soil Chloride (mg/kg)	23
P Olsen (mg/kg)	-
Exch. Ca (meq/100g)	0.26
Exch. Mg (meq/100g)	0.56
Exch. K (meq/100g)	0.05
Exch. Na (meq/100g)	<0.1
CEC (meq/100g)	1.7
Ca/Mg (ratio)	0.5
ESP (%Na/CEC)	4
Total N (%)	-
Nitrate N (%)	-
Organic Matter (%)	-
PSA-CS (%)	38
PSA-FS (%)	35
PSA-Silt (%)	6
PSA-Clay (%)	22
Disp Ratio (R1)	0.66
ADMC (%)	0.3
Emerson (Number)	5
Sulfate-S (mg/kg)	-
Mn (mg/kg)	-
Boron (mg/kg)	-
Copper (mg/kg)	-
Iron (mg/kg)	-
Zinc (mg/kg)	-
Al (meq/100g)	0.79
Al/CEC (%)	46

" - " indicates no laboratory analysis undertaken for the selected sample

4.1.11 Soil Mapping Unit U2(b)

Overview

SMU U2 (b) is characterised by lower sloping plateaus and drainage basins with shallow to moderately deep loams. These soils are often quite gravelly with laterite. SMU U2(b) is located usually between the upper rugged landforms and the undulating plans of the mid to lower land forms. The soil comprises of a sandy loam with favourable salinity and sodicity levels.

Soil Characteristics and Chemistry

For this SMU, a total of three soil samples were collected at one site. Eight samples were analysed in the field and three samples from one site underwent laboratory analysis. The representative laboratory and field data are presented below.

The soil chemistry data indicate that this SMU is characterised as follows:

- acidic to neutral reaction trends throughout profile indicating great for conditions for nutrient and chemical availability for plant growth;
- chloride ratings and electrical conductivity are very low indicating very low salinity conditions within the soil;
- CEC ratings are low indicating low soil fertility levels due to limitations in adsorbing and holding nutrient cations leading to a reduced supply of nutrients available to plants;
- particle size assessment confirm a uniform silty loam dominated profile;
- R1 dispersion indicates the amount of silt and clay that dispersed compared with the total amount present was moderate, ESP levels were non-sodic with Ca:Mg ratios very low indicating soils having low to moderate dispersive qualities within the soil structure; and
- moderate available phosphorus levels and low nutrient levels indicate low nutrient levels within the topsoil.

Land Suitability

Land suitability assessment is determined using the available detailed soil profile descriptions, soil chemistry and landform properties. The limitations and definitions are detailed in Section 5.

The SMU is not suitable for agricultural use with the major limitation for rainfed cropping being that plant available water capacity is less than 75mm at 55mm up to 0.9m depth.

The SMU is suitable for limited native grazing use with the major limitation for beef cattle grazing being that plant available water capacity is between 50-75mm at 55mm up to 0.9m depth.

Available Soil Resources

These soils are suitable for reuse with a maximum topsoil stripping depth of 0.1m recommended.

Representative Site

A total of four detailed soil profile descriptions were undertaken across this SMU. Detailed soil profile description Site 142 is presented below as a representative site for this SMU.

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Land Summary

SMU	U2(b)	Representative site numbers	Site 142
Representative site photograph			
Site type	Detailed, 50mm hand auger	Main vegetation	Eucalyptus, Acacia and Corymbia woodlands
Location	mE412748 mN7589542	Disturbance	No effective disturbance other than grazing by hoofed animals
Landform pattern	Gently undulating plains	Micro relief	Nil
		Permeability	Highly
Slope	<0.5%	Drainage	Well drained
Surface coarse fragments	Gravels <20%	Surface condition	Sandy loam, firm
ASC Order (s) present in SMU	Kandosol	Land use	Grazing pastures
CSIRO soil type	Highmont Petrona	Substrate	Laterite
Erosion potential (Bourne and Tuck 1993)	Moderate due to fine silty medium on sloping terrain		
Land suitability summary	Effective rooting depth: 0.80-0.90m Estimated plant available water capacity: 45-55mm Rainfed Cropping: Class 5 Beef Cattle Grazing: Class 4 Agricultural Land Class: C3		
Soil resources	The soil comprises of a sandy loam with favourable salinity and sodicity levels. Laterite may be found within one metre below ground level <u>Recommended Topsoil Strip Depth:</u> 0.1m pending Laterite depth		
Land condition	Shallow to deep sandy loam on top of laterite material		

Soil profile morphology Site 142

Site 142	Horizon Depth (m)	Colour Mottles Bleach	Moisture Field pH Drainage	Texture Structure Consistency	Coarse fragments, segregations Roots
	Horizon: A11 Horizon depth: 0.0-0.10 Boundary: Sharp	Colour: 10YR4/4 brown. No mottles	Moisture: Dry, Field pH: 0.05 m- pH 6.5, Drainage: well	Texture: Silty loam, Structure: massive	Nil surface rock Nil segregations
	Horizon: A12 Horizon depth: 0.10-0.20 Boundary: Abrupt	Colour: 10YR5/6 yellowish brown. No mottles	Moisture: Dry, Field pH: 0.30 m- pH 6.5, Drainage: well	Texture: Silty loam, Structure: massive	Coarse Fragments: 0.10-0.80m+ 5% Laterite 10-20mm
	Horizon: A13 Horizon depth: 0.20-0.80	Colour: 10YR5/6 yellowish brown No mottles	Moisture: Dry, Field pH: 0.60 m- pH 6.5, Drainage: well	Texture: Silty loam, Structure: massive	

Soil Chemistry Results for Site 142

Analysis (Unit)	Site, Horizon, Sample Depth (m)		
	0.0-0.10	0.30-0.40	0.70-0.80
Lab pH (1:5 water)	5.6	6.2	7.2
EC (dS/cm)	0.05	0.04	0.05
Soil Chloride (mg/kg)	35	30	28
P Olsen (mg/kg)	12	-	-
Exch. Ca (meq/100g)	2.75	0.26	0.4
Exch. Mg (meq/100g)	5.21	9.61	11.43
Exch. K (meq/100g)	0.25	0.21	0.22
Exch. Na (meq/100g)	0.21	0.43	0.44
CEC (meq/100g)	8.8	10.9	12.8
Ca/Mg (ratio)	0.5	0.0	0.0
ESP (%Na/CEC)	2	4	3
Total N (%)	0.03	-	-
Nitrate N (%)	2	-	-
Organic Matter (%)	2.8	-	-
PSA-CS (%)	40	36	29
PSA-FS (%)	37	34	42
PSA-Silt (%)	5	5	7
PSA-Clay (%)	18	25	22
Disp Ratio (R1)	0.73	0.68	0.64
ADMC (%)	1.7	2.2	2.4
Emerson (Number)	5	5	5
Sulfate-S (mg/kg)	5	-	-
Mn (mg/kg)	0.6	-	-
Boron (mg/kg)	0.1	-	-
Copper (mg/kg)	0.5	-	-
Iron (mg/kg)	48	-	-
Zinc (mg/kg)	<0.1	-	-
Al (meq/100g)	0.39	0.36	0.35
Al/CEC (%)	4	3	3

"-" indicates no laboratory analysis undertaken for the selected sample

4.2 Soil Resources

This section describes the soil resources available for reuse in rehabilitation activities and outlines the management measures required to ensure that soil resources are maintained in a suitable condition throughout the project construction and operation phases.

4.2.1 Topsoil Resources

Areas of the site will be subject to ground disturbance due to construction activities and operations associated with the project. Proposed soil disturbance resulting from the project will be associated with the open cut mining area and development of mine infrastructure. Topsoil resources will be stripped from the soil disturbance areas for subsequent reuse in rehabilitation activities.

All soil types present within the project site have therefore been assessed to determine their suitability for stripping and reuse in rehabilitation activities. The project site has been found to contain significant reserves of topsoil that may be used in rehabilitation activities. The suitability and limitations for each SMU is discussed in Section 4.1. The recommended maximum stripping depths for each SMU are summarised in Table 5 and shown on Figure 4.

Table 5: Topsoil Stripping Depths

Soil Unit	Soil Name	Recommended Topsoil Stripping Depth (m)	Specific Management Measures
A1	Active drainage lines, lower fluvial deep sandy loams	0.6	None
A1sv	Relic drainage lines, hard setting and scalded surface sandy loams	0.1	None
A2	Palustrine area with silty clays	0.3	None
E1	Low lying red deep >150cm red sandy earth	1.0	None
E2	Low lying greyish / yellow deep > 150cm yellow sandy earth	1.0	None
E3	Mid to upland red sandy loam, firmer surface with silty loam	1.0	None
E4	Mid to upland sandy loam with 60% yellow and 40 % red interfingering loamy earths	1.3	None
E5	Mid to upland duplex, loamy sands above hard silty clay loams, Yellowish grey, minor conspicuous bleach	0.1	None
U1	Silty rocky channels and loamy foot slope areas associated with rocky uplands	1.1	None
U2(a)	Upland skeletal, rugged scarps, ridges and valleys. Extensive outcropping hard laterite and gravelly skeletal soils	0.2	None
U2(b)	Lower sloping plateaus and drainage basins with shallow to moderately deep loams	0.1	None

Topsoil used in rehabilitation will be applied in accordance with the specifications in a topsoil management plan.

4.2.2 Capping Materials of Tailings Storage and Power Station Waste Facilities

Tailings waste produced by the processing of coal will be stored in a dedicated TSF while waste produced by the power station will initially be stored in a Power Station Waste Storage Facility (PSWSF), adjoining the TSF.

As part of the proposed rehabilitation activities, these facilities will be covered with a capping layer, prior to application of topsoil as a medium for plant growth.

The footprint of these facilities and their surrounds (including the adjacent mine infrastructure) are dominated by SMU E4. SMU E4 does not exhibit any major limitations that would inhibit use as a capping material. Soils placed to a depth of 1.0 m are recommended as suitable for TSF and PSWSF capping activities.

4.2.3 SMU-Specific Resources and Management Measures

The following comments are provided to further assist in the management decisions for each specific SMU.

SMU A1

As detailed in Section 4.1.1 SMU A1 may be taken down to 0.6m. However, this SMU is not preferred as a plant growth medium on rehabilitation as it is likely to set hard and seal.

Its main value for rehabilitation is as part of the capping layer between the mine waste material and the topsoil. It is recommended that SMU A1 is stockpiled separate from other SMUs.

SMU A1sv

This soil is located within areas which are generally bare of vegetation and eroded by surface wash, and consists of hard setting silty loams. Laboratory data for the subsoils show significant increase in salinity and sodicity levels at 0.3m below ground level. The topsoil itself is considered to be strongly acidic so use of this as a rehabilitation medium should be limited. Accordingly a conservative stripping depth of 0.1m has been recommended in acquiring this topsoil. It is recommended that SMU A1sv is stockpiled separate from other SMUs.

SMU A2

This soil is useful on a range of rehabilitation applications. Potential problems may be encountered in the initial establishment of fine seeded pastures due to poor soil to seed contact as a result of potential shrinking / swelling soil attributes unlike other rigid SMUs identified within the project site.

This is a moderate to reasonably good quality topsoil. However, the SMU shows variable sodic characteristics in the subsoils. An average stripping depth of 0.3m has been recommended.

It is recommended that SMU A2 is stockpiled separate from other SMUs.

SMU E1 and E2

Soil origin contributes to these soils exhibiting generally coarser textured (i.e. sandier) surface layers overlying either deep loamy and clayey sands or hard and possibly sodic silty loam subsoils. Stripping depth varies with the depth of the sandy upper horizon. However, most of these units can be conservatively stripped to 1.0m.

Laboratory data suggests that salinity is not an area of concern and general fertility is low but acceptable. These soils are better suited to application on lower sloping sites due to a higher erosion potential. However, they readily germinate and support both grasses and native trees. Stripped soil from both SMU E1 and SMU E2 may be stockpiled together if required.

SMU E3 and E4

SMU E3 and E4 exhibit similar characteristics to the deep sandy low lying soils E1 and E2. However, these SMUs are made up of slightly less coarse textured (i.e. siltier) subsoils. E3 and E4 may be conservatively stripped to 1.0m and 1.3m respectively below ground level with no major salinity or sodicity issues indicated by laboratory data. Both SMUs would be suitable for topsoil and capping reuse.

Stripped soil from both SMU E3 and SMU E4 may be stockpiled together if required.

SMU E5

SMU E5 consists of silty loam topsoil horizon and subsoils, however laboratory data reports significant increase in sodicity and therefore shall be conservatively stripped to 0.1m for use of topsoil.

It is recommended that E5 is stockpiled separately from all SMUs.

SMU U1

SMU U1 is located along active drainage lines throughout the upland regions, consisting of silty loams which may be taken quite deep through the horizons to 1.1m. As noted above for SMU A1, the soil is not preferred as a plant growth medium on rehabilitation as it is likely to set hard and seal.

Its main value would be part of the capping layer between the mine waste material and the topsoil. It is recommended that SMU U1 is stockpiled separate from other SMUs.

SMU U2 (a)

SMU U2 (a) is located within the upper lands of the project site and is comprised of skeletal ridges and jump ups with shallow loamy sands to moderate in depth sandy loams.

SMU U2(a) is generally shallow sandy loam with gravels and boulders overlying laterite outcrops to laterite outcrops formations. It is recommended for stripping to 0.2m based on depth to the laterite.

Its main value would be for reuse as a capping layer. It is recommended that SMU U2(a) is stockpiled separate from other SMUs.

SMU U2b

SMU U2(b) is located usually between the upper rugged landforms and the undulating plans of the mid to lower land forms. The soil comprises of a sandy loam with favourable salinity and sodicity levels.

It is recommended for stripping to 0.1m based on depth to the laterite.

Its main value would be for reuse as a capping layer. It is recommended that SMU U2(b) is stockpiled separate from other SMUs.

5 AGRICULTURAL LAND SUITABILITY ASSESSMENT

The classification of agricultural land in Queensland involves the determination of land use suitability against a range of limitations, and application of a hierarchy of ALC. Application of this approach to mining projects is described in the LSAT provided within the DME Guidelines (1995). This approach is further discussed in the recent Draft ALE Guidelines and associated ALE Frameworks. GTE has undertaken the assessment of the ALC in accordance with these requirements.

As discussed in Section 2.1, Queensland Government mapping shows that there are no Strategic Cropping Areas within the project site.

The ALC approach also forms the basis of the assessment of agricultural land within PAAs defined under the SPP. A search of Queensland Government mapping shows that no PAAs are present in the vicinity of the project site. It is noted that the SPP supersedes the State Planning Policy 1/92: Development and Conservation of Good Quality Agricultural Land.

5.1 Land Suitability Classes

The ALE land suitability class definitions (Draft ALE Guidelines 2013), as shown in Table 6, were employed to assist in determination of land suitability across the study area.

Table 6: Land Suitability Classes

Land Suitability Class	Definition
Class 1	Suitable land with negligible limitations. This is highly productive land requiring only simple management practices to maintain economic production.
Class 2	Suitable land with minor limitations which either reduce production or require more than the simple management practices of class 1 land to maintain economic production.
Class 3	Suitable land with moderate limitations which either further lower production or require more than those management practices of class 2 land to maintain economic production.
Class 4	Marginal land , which is presently considered unsuitable due to severe limitations. The 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	Unsuitable land with extreme limitations that preclude its use.

Source: Draft ALE Guidelines (2013)

The LSAT (DME Guidelines. 1995) also provides general criteria and threshold values for assessment of a range of soil limitations to rainfed cropping and beef cattle grazing land use.

The cropping classification evaluates the broad acre potential for growing non-irrigated cash and forage crops which would be mainly sorghum, wheat and sunflower. Only major limiting factors have been considered, including:

- plant available water capacity (m)
- nutrient deficiency (n)
- soil physical factors (p)
- salinity (s)
- rockiness (r)
- microrelief (g)
- susceptibility to water erosion (e)
- topography (t)
- flooding (f)

Major limiting factors are described in detail in Section 5.1.1.

Grazing suitability used the same approach as cropping but with varied interpretation of severity of limiting factors.

Field and laboratory data was used to assess the severity of any limitations and the land suitability class of each of the SMUs against the LSAT Guidelines (DME Guidelines 1995). Methods from Burgess (2003) and Shields and Williams (1991) have been used to support the land suitability classification of soils mapped at the project site.

The suitability of each SMU for rainfed cropping and beef cattle grazing has been assessed and presented in Table 7. Suitability classes and major limiting factors of each soil type for rainfed cropping and beef cattle grazing are shown in Figure 5 and Figure 6.

Table 7: Suitability Classes for Rainfed Cropping and Beef Cattle Grazing for SMUs

Soil Mapping Unit	Description	Cropping		Grazing	
		Major Limitations and Severity	Class	Major limitations and severity	Class
A1	Active drainage lines, lower fluvial deep sandy loams	plant available water capacity – m5 nutrients – n1 physical factors – p1 salinity – s1 rockiness – r1 microrelief – g1 water erosion - e1 topography - t5 flooding – f5	5	plant available water capacity – m5 nutrients – n1 physical factors – p1 salinity – s1 rockiness – r1 microrelief – g1 water erosion - e1 topography –t4 flooding – f2	5
A1sv	Relic drainage lines, hard setting and scalded surface sandy loams	plant available water capacity – m5 nutrients – n1 physical factors – p3	5	plant available water capacity – m5 nutrients – n2 physical factors – p2	5

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Soil Mapping Unit	Description	Cropping		Grazing	
		Major Limitations and Severity	Class	Major limitations and severity	Class
		salinity – s5 rockiness – r3 microrelief – g1 water erosion - e2 topography – t3 flooding – f3		salinity – s5 rockiness – r2 microrelief – g1 topography –t4 water erosion - e2 flooding – f2	
A2	Palustrine area with silty clays	plant available water capacity – m5 nutrients – n1 physical factors – p2 salinity – s1 rockiness – r1 microrelief – g2 water erosion - e1 topography – t1 flooding – f1	5	plant available water capacity – m4 nutrients – n1 physical factors – p2 salinity – s1 rockiness – r1 microrelief – g2 water erosion - e1 topography - n/a ¹ flooding – f1	4
E1	Low lying red deep >150cm red sandy earth	plant available water capacity – m4/5 nutrients – n3 physical factors – p1 salinity – s1 rockiness – r1 microrelief – g1 water erosion - e1 topography – t1 flooding – f2	5	plant available water capacity – m4 nutrients – n3 physical factors – p1 salinity – s1 rockiness – r1 microrelief – g1 water erosion - e1 topography - n/a ¹ flooding – f2	4
E2	Low lying greyish / yellow deep > 150 cm yellow sandy earth	plant available water capacity – m4/5 nutrients – n3 physical factors – p1 salinity – s1 rockiness – r1 microrelief – g1 water erosion - e1 topography – t1 flooding – f2	5	plant available water capacity – m4 nutrients – n3 physical factors – p1 salinity – s1 rockiness – r1 microrelief – g1 water erosion - e1 topography - n/a ¹ flooding – f2	4
E3	Mid to upland red sandy loam, firmer surface with silty loam	plant available water capacity – m5 nutrients – n3 physical factors – p3 salinity – s2 rockiness – r1 microrelief – g1 water erosion - e3 topography – t1 flooding – f1	5	plant available water capacity – m4 nutrients – n4 physical factors – p2 salinity – s2 rockiness – r1 microrelief – g1 water erosion - e2 topography - n/a ¹ flooding – f1	4
E4	Mid to upland sandy loam with 60% yellow and 40 % red interfingering loamy earths	plant available water capacity – m4/5 nutrients – n3 physical factors – p1 salinity – s1 rockiness – r1 microrelief – g1 water erosion - e2 topography – t1 flooding – f1	5	plant available water capacity – m4 nutrients – n3 physical factors – p1 salinity – s1 rockiness – r1 microrelief – g1 water erosion - e1 topography - n/a ¹ flooding – f1	4
E5	Mid to upland duplex, loamy sands above hard silty clay loams, Yellowish grey, minor conspicuous bleach	plant available water capacity – m5 nutrients – n2 physical factors – p3 salinity – s1	5	plant available water capacity – m4 nutrients – n3 physical factors – p2 salinity – s1	4

Soil Mapping Unit	Description	Cropping		Grazing	
		Major Limitations and Severity	Class	Major limitations and severity	Class
		rockiness – r1 microrelief – g1 water erosion - e2 topography – t1 flooding – f1		rockiness – r1 microrelief – g1 water erosion - e2 topography - n/a ¹ flooding – f1	
U1	Silty rocky channels and loamy foot slope areas associated with rocky uplands	plant available water capacity – m4 nutrients – n1 physical factors – p1 salinity – s2 rockiness – r1 microrelief – g1 water erosion - e3 topography – t5 flooding – f4	5	plant available water capacity – m4 nutrients – n2 physical factors – p1 salinity – s2 rockiness – r1 microrelief – g1 water erosion - e2 topography - n/a ¹ flooding – f2	4
U2(a)	Upland skeletal, rugged scarps, ridges and valleys. Extensive outcropping hard laterite and gravelly skeletal soils	plant available water capacity – m5 nutrients – 5 ² physical factors – p3 salinity – s1 rockiness – r5 microrelief – g1 water erosion - e3 topography – t3 flooding – f1	5	plant available water capacity – m5 nutrients – n/a ² physical factors – p2 salinity – s1 rockiness – r3 microrelief – g1 water erosion - e3 topography - n/a ¹ flooding – f1	5
U2(b)	Lower sloping plateaus and drainage basins with shallow to moderately deep loams	plant available water capacity – m5 nutrients – 1 physical factors – p1 salinity – s1 rockiness – r2 microrelief – g1 water erosion - e1 topography – t1 flooding – f1	5	plant available water capacity – m4 nutrients – 1 physical factors – p1 salinity – s1 rockiness – r1 microrelief – g1 water erosion - e1 topography - n/a ¹ flooding – f1	4

1 – No appropriate land suitability class for the selected limitation

2 – Results should be considered indicative due to no available Bicarbonate P laboratory results

5.1.1 Rainfed Cropping

Plant Available Water Capacity (m)

Plant available water capacity is a significant soil property in this locality as cropping is based on fallow storage of moisture in the soil profile. Effective rooting depth is defined as the depth to which approximately 90% of plant roots will extract water. It is normally limited either by the presence of underlying rock or other hard materials or by chemical or physical attributes within the subsoil that restrict root growth (QDPI, 1990).

Field morphology observations and chemical data used included soil texture and barriers to root growth such as high sodium, gravel, poor soil structure, high electrical conductivity and chloride. Plant available water capacity is classically defined as the moisture present between field capacity and permanent wilting point. In addition, field assessments of effective rooting depth, and subsequently potential plant available water capacity, was undertaken which followed the method used by Burgess (2003). This involved estimates of field texture combined with field pH, electrical conductivity and depths to hard soil horizons.

Table 8 shows the criteria which Shields and Williams (1991) proposed for assessment of the moisture availability limitation for crops in this region. Table 9 shows plant available water capacity limitation severity for each SMU.

Table 8: Criteria for Plant Available Water Capacity Limitations for Rainfed Cropping

LIMITATION LEVEL	PAWC (mm)	EFFECTIVE ROOTING DEPTH	PREDICTED CROPPING SUCCESS
2	>130	900mm	70-75%
3	100-130	600mm	40-70%
4	75-100	400mm	<40%
5	<75	<400mm	<30%

The deep sandy soil types present at the project site have an effective rooting depth often exceeding 1.5m and this can result in classification as marginal cropping soils (i.e. possibly Class 4). However, consideration of local climatic variability (including extremes of temperature and rainfall), in addition to the lack of historical cropping record, provides a strong indication that the soils should be deemed unsuitable for rainfed cropping.

Table 9: Plant Available Water Capacity Limitation Levels for SMUs

Soil Mapping Unit	Concept	Estimated effective rooting depth (m)	PAWC (mm)*	Rainfed cropping limitation level	Beef cattle grazing limitation level
A1	Active drainage lines, lower fluvial deep sandy loams	0.9-1.10	36-50	5	5
A1sv	Relic drainage lines, hard setting and scalded surface sandy loams	0.3	25-30	5	5
A2	Palustrine area with silty clays	0.3-0.6	24-55	5	4
E1	Low lying red deep >150cm red sandy earth	0.80-1.40	32-56	5	4
E2	Low lying greyish / yellow deep > 150 cm yellow sandy earth	0.90-1.40	36-56	5	4
E3	Mid to upland red sandy loam, firmer surface with silty loam	0.70-1.10	36-54	5	4
E4	Mid to upland sandy loam with 60% yellow and 40 % red interfingering loamy earths	0.70-1.10	35-65	5	4
E5	Mid to upland duplex, loamy sands above hard silty clay loams, Yellowish grey, minor conspicuous bleach	0.40-0.60	32-64	5	4
U1	Silty rocky channels and loamy foot slope areas associated with rocky uplands	1.20	72	5	4
U2(a)	Upland skeletal, rugged scarps, ridges and valleys. Extensive outcropping hard laterite and gravelly skeletal soils	0.20	8	5	5
U2(b)	Lower sloping plateaus and drainage basins with shallow to moderately deep loams	0.80-0.90	45-55	5	4

* Deduced from soil texture look-up table within *Regional Planning Interests Regulation 2014*, previously referenced within SCL Act

Nutrient deficiency (n)

The lower and midland sandy soils that characterise SMUs E1, E2 E3, E4 and E5 have minor levels of limitation as a result of nutrient deficiency. SMU U2(a) indicated having major limitations based upon exchangeable K, exchangeable Ca and pH. Analysis was not conducted for Bicarbonate P so these results may be indicative of lower levels of nutrient deficiency.

Soil Physical Factors (p)

This limitation deals with conditions that determine sufficient seed contact with moist soil to prevent desiccation prior to germination and establishment. In this survey, no significant limitations of this nature were found, with SMUs A1sv, E2, E3 E5 and U2(a) having minor levels of limitation.

Salinity (s)

This refers to the reduction in dry matter yield as a result of soluble salt in the soil profile. It also contributes to reduced plant available water capacity limitation. The only soil type which indicated subsoil salinity was

SMU A1sv and minor limitations in SMUs E3 and U1. These soils exhibited salinity at levels sufficient to restrict effective soil depth to below 0.3m and severely limit the cropping and grazing potential of these soils.

Rockiness (r)

Surface rockiness was typically not a limiting factor to cropping or grazing in the project site. SMUs A1sv and U2(a) did exhibit surface rockiness that resulted in limitation levels of three and five, and SMU U2(b) showed a minor limitation level of two.

Coarse gravel and large pebbles less than 30% are present at SMU A1sv on the surface. Coarse gravel, large pebbles and rock outcrops are present at SMU U2(a). Depth to outcrops varies across SMU U2(a), however coarse rock fragments are typically present on the surface. Gravels are present on SMU U2(b) covering less than 20% of the surface.

Microrelief (g)

Microrelief (commonly referred to as gilgai or melon holes) refers to localised depressions along the land surface (McDonald et al. 1990). No areas of normal and linear gilgai were recorded within the project site. Minor microrelief was found in SMU A2.

Susceptibility to Water Erosion (e)

The risk of soil loss from water erosion magnifies with increased water velocity when land is devoid of vegetation for cropping. Such effects are directly proportional to slope gradient. The soils that occur along gently undulating plains with less than 2% slope may increase in soil erosion risk under a cropping use.

During this survey, only minor evidence of erosion was observed throughout the majority of the site. SMU A1sv showed evidence of erosion outside drainage lines, and SMUs E3, E4, E5, U1 and U2(a) showed minor limitations due to erosion.

Topography (t)

Topography is assessed in terms of slope and micro-relief. Slope may limit the effective and safe use of machinery and contribute to erosion hazard. Topography limitations were evident in SMUs A1, A1av, A2, U1, U2(a) and U2(b).

Flooding (f)

Flooding is assessed against the LSAT guidelines (DME 1995) and the associated SMU attributes and does not reflect other flooding

assessments for the EIS. Flooding limitation is based on five categories for rainfed cropping and two for beef cattle grazing.

SMU A1 is associated with floodplains and active drainage lines which fall within the limitations of regular flooding for rainfed cropping and periodic flooding for beef cattle grazing.

SMU A1sv is associated with overland flow which falls within the limitations of infrequent flooding for rainfed cropping and periodic flooding for beef cattle grazing.

SMU E1 is associated with relic alluvial plains which fall within the limitations of rare flooding for rainfed cropping and periodic flooding for beef cattle grazing.

SMU E2 is associated with relic alluvial plains which fall within the limitations of rare flooding for rainfed cropping and periodic flooding for beef cattle grazing.

SMU U1 is associated with upper rugged lands where active drainage lines are present which are fall within the limitations of occasional flooding for rainfed cropping and periodic flooding for beef cattle grazing.

5.1.2 Beef Cattle Grazing

Land suitability class 1 to 3 grazing land is considered suitable for significant pasture improvement. Land suitability class 4 land offers marginal potential for pasture improvement, while class 5 land is not considered suitable for improvement and restricted to grazing of native pastures with low productivity.

All SMUs are suited to beef cattle grazing with significant areas having marginal potential for improved pastures. However, the gravelly skeletal soils (SMUs U1, U2(a) and U2(b)) and hard setting sandy loams (SMUs A1 and A1sv) may be less productive overall due to more severe limitations from restricted soil water availability, rockiness, salinity and topography.

Pasture growing on the sandier soils can respond quickly to limited rainfall events as soil moisture is not bound in a heavy clay matrix and is therefore freely available to plants. Thus, during extended dry periods in which only sporadic rainfall events occur and the clay soil moisture store is heavily depleted, these sandy soils can still offer rapid pasture growth for cattle grazing.

On this basis, no significant limitations to grazing use are present for a large proportion of the project site. This is supported by the sustained

use of the project site for cattle grazing with limited evidence of adverse impacts on soil condition.

5.2 Agricultural Land Classes

ALCs are described in the Draft ALE Guidelines. Table 10 summarises ALCs and illustrates the relationship between ALCs and land suitability classes for rainfed cropping and beef cattle grazing.

Table 10: Agricultural and Land Suitability Class with Descriptions

Agricultural Land Class	Land Suitability (Cropping)	Land Suitability (Grazing)	Description
A			Crop Land Land that is suitable for a wide range of current and potential crops with nil to moderate limitations to production.
A1	1-3	1-3	Land that is suitable for a wide range ¹ of current and potential broadacre and horticulture crops with limitations to production that range from none to moderate levels.
A2	1-3	1-3	Land that is suitable for a wide range of current and potential horticultural crops only, with limitations to production that range from none to moderate levels.
B	4	1-3	Limited Crop Land Land that is suitable for a narrow range ² of current and potential crops. Land that is marginal for current and potential crops due to severe limitations but is suitable for pastures. Land may be suitable for cropping with engineering and/or agronomic improvements.
C			Pasture land Land that is suitable only for improved or native pastures due to limitations which preclude continuous cultivation for crop production. Some areas may tolerate a short period of ground disturbance for pasture establishment.
C1	5	1-2	Suitable for grazing sown pastures (with ground disturbance for establishment) or native pastures on higher fertility soils
C2	5	3	Suitable for grazing native pastures with or without the introduction of pasture species and are lower fertility soils than C1
C3	5	4	Suitable for light grazing of native pastures in accessible areas, and includes steep land more suited to forestry or catchment protection.
D	5	5	Non-Agricultural Land Land not suitable for agricultural uses due to extreme limitations. This includes: undisturbed land with significant conservation and/or catchment values; land that may be unsuitable because of very steep slopes, shallow soils, rock outcrop, poor drainage, salinity, acidic drainage; severe degradation; areas within stream beds, channels; or areas of disturbed lands and water bodies (e.g. urbanised, industrial, mining voids, quarries, dams, aquaculture and feedlots etc).

Agricultural Land Class	Land Suitability (Cropping)	Land Suitability (Grazing)	Description
A/C, A/D B/C, C/D			Land that is a complex of Class A, B, C or D land where it is not possible to delineate the land class at the map scale. The dominant class is assumed to be > 50% in area, but <70% ³ and is the first code in the sequence.

Sourced from the draft Guidelines for Agricultural Land Evaluation in Queensland, Second Edition (2013)

¹ A wide range of crops is defined as four or more existing crops of local commercial significance. In areas where there is an infrastructure requirement to support an industry, the land may only be suitable for two or more crops, providing the crop is considered to be a regionally significant crop.

² A narrow range of crops is defined as three or less existing crops of local commercial significance, with the exception of areas where there is an infrastructure requirement to support an industry.

³ The dominant land class will be listed first in the definition. In cases where three land classes are equally dominant and none are greater than 50%, judgement will be used to identify the two most appropriate classes for the unit.

GTE note that no ALC areas have been identified on mapping for the project site (e.g. under the Belyando Shire Council Shire Planning Scheme for Belyando Shire, 2008). GTE has therefore determined ALCs for the project site from the information gathered from the current soils assessment. ALC boundaries are mapped on Figure 7. Table 11 provides a breakdown of the ALC applied to each SMU.

Table 11: Summary of ALCs by SMU

ALC	DESCRIPTION	SMU
A	Crop land – Land that is suitable for a wide range of current and potential crops with nil to moderate limitations to production.	N/A
A1	Land that is suitable for a wide range ¹ of current and potential broadacre and horticulture crops with limitations to production that range from none to moderate levels.	N/A
A2	Land that is suitable for a wide range of current and potential horticultural crops only, with limitations to production that range from none to moderate levels.	N/A
B	Limited Crop Land – Land that is suitable for a narrow range ² of current and potential crops. Land that is marginal for current and potential crops due to severe limitations but is suitable for pastures. Land may be suitable for cropping with engineering and/or agronomic improvements.	N/A
C	Pasture land Land that is suitable only for improved or native pastures due to limitations which preclude continuous cultivation for crop production. Some areas may tolerate a short period of ground disturbance for pasture establishment.	N/A
C1	Suitable for grazing sown pastures (with ground disturbance for establishment) or native pastures on higher fertility soils	N/A
C2	Suitable for grazing native pastures with or without the introduction of pasture species and are lower fertility soils than C1	N/A
C3	Suitable for light grazing of native pastures in accessible areas, and includes steep land more suited to forestry or catchment protection.	A2, E1, E2, E3, E4, E5, U1, U2(b)
D	Non-Agricultural Land Land not suitable for agricultural uses due to extreme limitations. This includes: undisturbed land with significant conservation and/or catchment values; land that may be unsuitable because of very steep slopes, shallow soils, rock outcrop, poor drainage, salinity, acidic drainage; severe degradation; areas within stream beds, channels; or areas of	A1, A1sv, U2(a)

ALC	DESCRIPTION	SMU
	disturbed lands and water bodies (e.g. urbanised, industrial, mining voids, quarries, dams, aquaculture and feedlots etc).	

Sourced from the draft Guidelines for Agricultural Land Evaluation in Queensland, Second Edition (2013)

¹ A wide range of crops is defined as four or more existing crops of local commercial significance. In areas where there is an infrastructure requirement to support an industry, the land may only be suitable for two or more crops, providing the crop is considered to be a regionally significant crop.

² A narrow range of crops is defined as three or less existing crops of local commercial significance, with the exception of areas where there is an infrastructure requirement to support an industry.

5.3 Summary of Existing Agricultural Land Suitability

Table 12 provides a summary the areas of existing agricultural land suitability on the project site.

Table 12: Summary of Existing Agricultural Land Suitability

Land Suitability - Cropping		Land Suitability – Grazing		ALC	
Class	Area (ha)	Class	Area (ha)	Class	Area (ha)
1	-	1	-	A	-
2	-	2	-	B	-
3	-	3	-	C1	-
4	-	4	14,751.9	C2	-
5	20,087.9	5	5,336.0	C3	14,751.9
-	-	-	-	D	5,336.0

6 CONCLUSION

Based on the scope of the report, the following is concluded and summarised in Table 13:

- eleven SMUs are present within the project site, A1, A1sv, A2, E1, E2, E3, E4, E5, U1, U2(a) and U2(b);
- no SMUs are considered rainfed cropping land;
- the project site includes eight SMUs with moderate limitations on beef cattle grazing. These limitations are mainly associated with restricted effective rooting depth and plant water available capacity. However, with the incorporation of sound management practices, the majority of the project site is productive grazing land; and
- all SMUs are suitable for stripping and reuse in mine rehabilitation activities as either topsoil for plant growth medium or capping material.

Table 13: Soil Mapping Unit Summary

Soil Mapping Unit	Description	Topsoil Stripping Depth (m)	Land Suitability Classes		Agricultural Land Classes
			Rainfed Cropping	Beef Cattle Grazing	
A1	Active drainage lines, lower fluvial deep sandy loams	0.6	5	5	D
A1sv	Relic drainage lines, hard setting and scalded surface sandy loams	0.1	5	5	D
A2	Palustrine area with silty clays	0.3	5	4	C3
E1	Low lying red deep >150cm red sandy earth	1.0	5	4	C3
E2	Low lying greyish / yellow deep > 150 cm yellow sandy earth	1.0	5	4	C3
E3	Mid to upland red sandy loam, firmer surface with silty loam	1.0	5	4	C3
E4	Mid to upland sandy loam with 60% yellow and 40 % red interfingering loamy earths	1.3	5	4	C3
E5	Mid to upland duplex, loamy sands above hard silty clay loams, Yellowish grey, minor conspicuous bleach	0.1	5	4	C3
U1	Silty rocky channels and loamy foot slope areas associated with rocky uplands	1.1	5	4	C3
U2(a)	Upland skeletal, rugged scarps, ridges and valleys. Extensive outcropping hard laterite and gravelly skeletal soils	0.2	5	5	D
U2(b)	Lower sloping plateaus and drainage basins with shallow to moderately deep loams	0.1	5	4	C3

7 REFERENCES

Bourne, G.F. and Tuck, G.A. 1993, *Understanding and Managing Soils in the Central Highlands*, QDPI QE93002. Brisbane, Qld.

Burgess, J.W., 2003, *Land Resource Assessment of the Windeyers Hill Area, Isaac–Connors and Mackenzie River Catchments, Central Queensland*, Report QNRM02189, Queensland Department of Natural Resources & Mines, Brisbane, Qld.

Department of Mines and Energy 1995, *Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques*, Environmental Protection Agency, Brisbane, Qld.

Department of Natural Resources and Mines 2013, *Draft Guidelines for Agricultural Land Evaluation in Queensland*, 2nd Edition, Queensland Government, Brisbane, Qld.

Department of Natural Resources and Mines 2013, *Regional Land Suitability Frameworks for Queensland*, Queensland Government, Brisbane, Qld.

Department of State Development, Infrastructure and Planning 2014, *Regional Planning Interests Regulation*. DSDIP, Brisbane, Qld.

Department of State Development 2014, *Infrastructure and Planning, State Planning Policy (July 2014)*, Queensland Government, Brisbane, Qld.

Galloway, R.W., Gunn, R.H. Story, R., & Fitzpatrick, E.A. 1967, *Lands of the Nogoa-Belyando Area, Queensland*, CSIRO Publishing, Melbourne, Vic.

GHD 2012, *Carmichael Coal Mine and Rail Project Environmental Impact Statement*, GHD, Brisbane, Qld.

Google Earth 2014, CNES/Spot Image 414501mE 7589966mN GDA94 zone 55 elevation 348M, Google, retrieved 24 April 2013, <<http://www.google.com/earth/index.html>>.

Isbell, R.F. 2002, *The Australian Soil Classification*, CSIRO Publishing, Collingwood, Vic.

McDonald, R.C., Isbell, R.F., Speight, J.G., Walker, J. and Hopkins, M.S. 1990, *Australian Soil and Land Survey: Field Handbook*, 2nd Edition, Inkata Press, Melbourne, Vic.

McKenzie, N.J., Grundy, M.J., Webster, R. Ringrose-Voase. A.J. 2008, *Guidelines for Surveying Soils and Land Resources*, 2nd Edition, CSIRO Publishing, Melbourne, Vic.

Munsell Soil Color Charts 2009 Year Revised, Munsell Color Co x-rite, Grand Rapids, Michigan.

National Committee on Soil and Terrain 2009, *Australian Soil and Land Survey: Field Handbook*, 3rd Edition, CSIRO Publishing, Melbourne, Vic.

Queensland Government 2014, *Regional Planning Interests Act, Act No 11*, Queensland Government, Brisbane, Queensland.

Queensland Department of Primary Industries 1990, Guidelines for agricultural land evaluation in Queensland. QI9005.

Queensland Government 1992, *State Planning Policy 1/92: Development and Conservation of Good Quality Agricultural Land*, Queensland Government, Brisbane, Qld.

Queensland Government 2011, *Strategic Cropping Land Act, Act No. 47*, Queensland Government, Brisbane, Qld.

Shields & Williams, 1991, *Soils and Land Suitability for the Kilcummin Area, Central Queensland*. QDPI, Brisbane, Qld.

8 GLOSSARY OF TERMS

The following descriptions are of terms used in the text of this report.

ASC. Australian soil class

Cation Exchange Capacity (CEC). The maximum positive charge required to balance the negative charge on colloids (clays and other charged particles). The units are milli-equivalents per 100 grams of material or centimoles of charge per kilogram of exchanger. CEC is often used as a measure of soil fertility and nutrient retention capacity.

Clay. A soil material composed of particles finer than 0.002 mm. When used as a soil texture group such soils contain at least 35% clay.

Detailed Soil Profile. A location deemed very representative of the soil mapping unit for which detailed characterisation is to be done.

Dispersion. A process by which species in solution mix with a second solution, thus reducing in concentration. In the case of sodic soils it will predispose the soil material to lose structure and disseminate into the solution.

Electrical Conductivity (EC). The amount of sodium as a proportion of all cations in a soil is termed the Exchangeable Sodium Percentage. It is calculated by dividing the exchangeable sodium by the cation exchange capacity (CEC), multiplied by 100. ESP values greater than 6% are considered sodic, with values greater than 15% considered very sodic. $ESP = (\text{Exchangeable sodium (meq/100g)} / \text{Cation exchange capacity (meq/100g)}) \times 100$

ESP. The amount of sodium as a proportion of all cations in a soil is termed the Exchangeable Sodium Percentage. It is calculated by dividing the exchangeable sodium by the cation exchange capacity (CEC), multiplied by 100. ESP values greater than 6% are considered sodic, with values greater than 15% considered very sodic. $ESP = (\text{Exchangeable sodium (meq/100g)} / \text{Cation exchange capacity (meq/100g)}) \times 100$

Field pH The measurement of the pH in the field by utilising Manutec Pty Ltd, Soil pH Test Kit. This kit consists of pH dye indicator, Barium Sulphate and reference colour chart.

Fluvial Of or pertaining to a river.

Gradational. The lower boundary between soil layers (horizons) has a gradual transition to the next layer. The solum (soil horizon) becomes gradually more clayey with depth.

Gradient. The rate of inclination of a slope. The degree of deviation from the horizontal.

Horizon. An individual soil layer, based on texture and colour, which differs from those above and below.

Imperfectly drained. Water is removed only slowly in relation to supply.

Infiltration. The passage of water, under the influence of gravity, from the land surface into the subsurface.

Kandosols Soils other than Hydrosols which have all of the following:

- B2 horizons in which the major part is massive or has only a weak grade of structure;
- A maximum clay content in some part of the B2 horizon which exceeds 15% (ie. heavy sandy loam, SL+);
- Do not have a tenic B horizon;
- Do not have clear or abrupt textural B horizons; and
- Are not calcareous throughout the solum, or below the A1 or Ap horizon or to a depth of 0.2m if the A1 horizon is only weakly developed.

Loam. A medium textured soil of approximate composition 10-25% clay, 25-50% silt and >50% sand.

Massive. Refers to the condition of the soil layer in which the layer appears to be as a coherent or solid mass which is largely devoid of peds.

Meter pH The measurement of the pH in the field by utilising a TPS Aqua-CP/A meter.

Moderately Well Drained. Water is removed from the soil somewhat slowly in relation to supply.

Mottles. Areas of contrasting colour within the overall soil colour which are caused by anerobic conditions as a result of poor aeration. Usually an indicator of poor drainage and retention of water.

Ped. An individual natural soil aggregate. In an undisturbed state peds will group together to form larger aggregates.

Pedal. Describes a soil in which some or all of the soil material occurs in the form of peds in the moist state.

pH. A logarithmic index for the concentration of hydrogen ions in an aqueous solution, which is used as a measure of acidity.

Profile. The solum. This includes the soil A and B horizons and is basically the depth of soil to weathered rock.

Rapidly drained. Water is removed from the soil rapidly in relation to supply.

Rudosols Soil with negligible (rudimentary) pedologic organisation apart from (a) minimal development of an A1 horizon or (b) the presence of less than 10% of B horizon material (including pedogenic carbonate) in fissures in the parent rock or saprolite. The soils are apedal or only weakly structured in the A1 horizon and show no pedological colour changes apart from the darkening of an A1 horizon. There is little or no texture or colour change with depth unless stratified or buried soils are present.

SMU. Soil Mapping Unit. Soils grouped into a single management unit on the basis of similar morphology, position on the landscape, substrate and chemistry.

Sheet erosion. The removal of surface material from a wide area of gently sloping or graded land by broad continuous sheets of running water rather than by streams.

Sodic. Also commonly referred to as a non-saline alkali soil. It is a soil that contains sufficient exchangeable sodium and does not contain appreciable quantities of soluble salts. A term given to soil with a level of exchangeable sodium cations greater than 10-15% of the soils cation exchange capacity (CEC), or soluble sodium cations greater than 10-15 times the square root of soluble calcium and magnesium cations.

Subsoil. Subsurface material comprising the B and C horizons of soils with distinct profiles. They often have brighter colours and higher clay content than topsoils.

Sodosol Soils with a clear or abrupt textural B horizon and in which the major part of the upper 0.2 m of the B2 horizon (or the major part of the entire B2 horizon if it is less than 0.2m thick) is sodic and not strongly acid. Hydrosols and soils with strongly subplastic upper B2 horizons are excluded

Tenosols Soils that do not fit the requirements of any other soil orders and generally with one or more of the following:

- A peaty horizon;
- A humose, melacic or melanic horizon, or conspicuously bleached A2 horizon, which overlies a calcrete pan, hard unweathered rock or other hard materials; or partially weathered or decomposed rock or saprolite, or unconsolidated mineral materials;
- A horizons which meet all the conditions for a peaty, humose, melacic or melanic horizon except the depth requirement, and directly overlie a calcrete pan, hard unweathered rock or other hard materials; or partially weathered or decomposed rock or saprolite, or unconsolidated mineral materials;
- A1 horizons which have more than a weak development of structure and directly overlie a calcrete pan, hard unweathered rock or other hard materials; or partially weathered or decomposed rock or saprolite, or unconsolidated mineral materials;
- An A2 horizon which overlies a calcrete pan, hard unweathered rock or other hard materials; or partially weathered or decomposed rock or saprolite, or unconsolidated mineral materials;
- Either a tenic B horizon, or a B2 horizon with 15% clay (SL) or less¹, or a transitional horizon (C/B) occurring in fissures in the parent rock or saprolite which contains between 10 and 50% of B horizon material (including pedogenic carbonate);
- A ferric or bauxitic horizon >0.2 m thick; and
- A calcareous horizon >0.2 m thick.

Texture. The size of particles in the soil. Texture is divided into six groups, depending on the amount of coarse sand, fine sand, silt and clay in the soil.

Topsoil. Part of the soil profile, typically the A1 horizon, containing material which is usually darker, more fertile and better structured than the underlying layers.

Vertosol Soils with the following:

- A clay field texture or 35% or more clay throughout the solum except for thin, surface crusty horizons 0.03 m or less thick and.
- When dry, open cracks occur at some time in most years¹. These are at least 5 mm wide and extend upward to the surface or to the base of any plough layer, self-mulching horizon, or thin, surface crusty horizon; and
- Slickensides and/or lenticular peds occur at some depth in the solum. See Comment below.

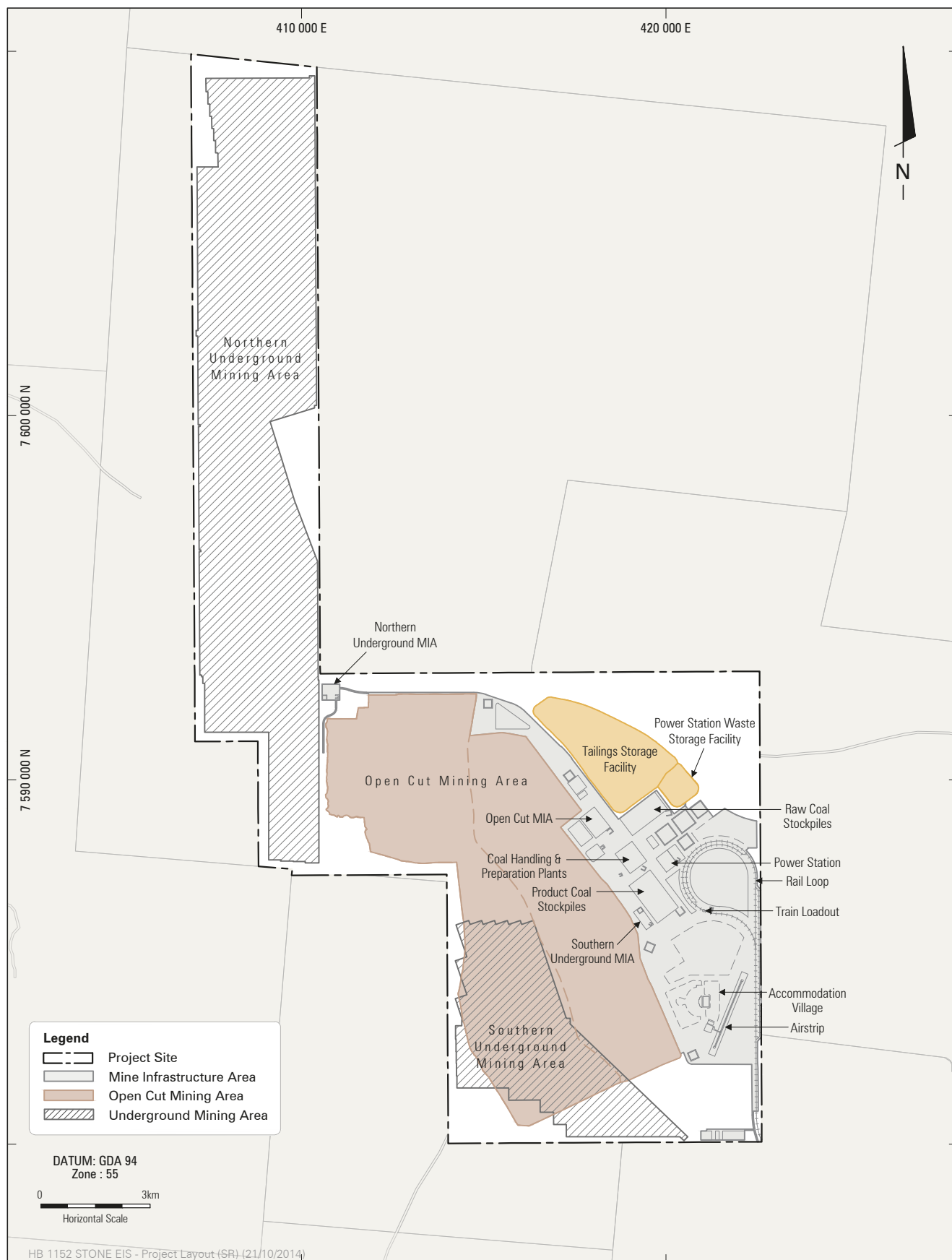
Well drained. Water is removed from the soil readily but not rapidly.

9 FIGURES

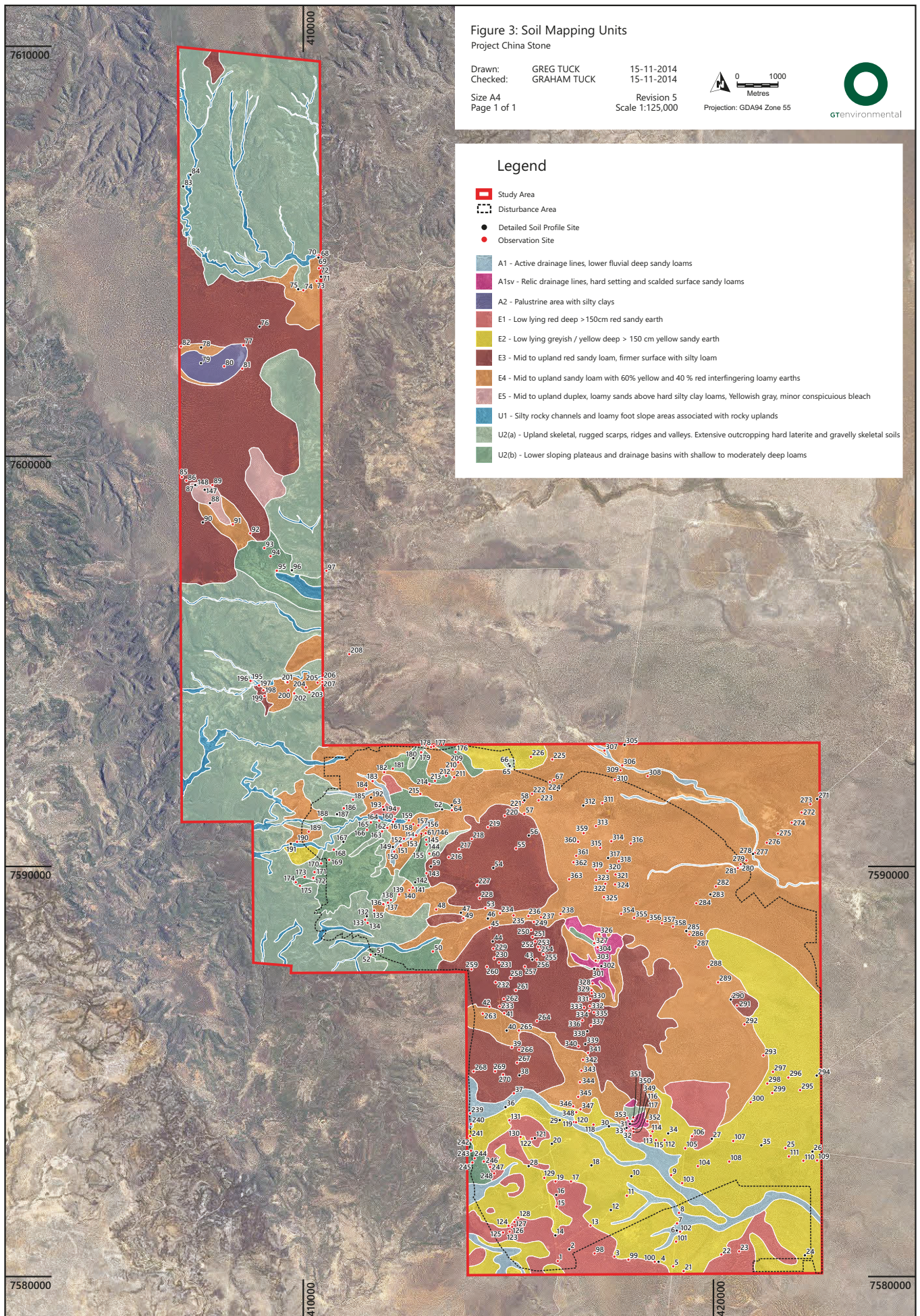
Figure 1	Project Location
Figure 2	Project Layout
Figure 3	Soil Mapping Units
Figure 4	Topsoil Stripping Depths
Figure 5	Existing Land Suitability – Rainfed Cropping
Figure 6	Existing Land Suitability – Beef Cattle Grazing
Figure 7	Existing Land Suitability – Australian Land Classification

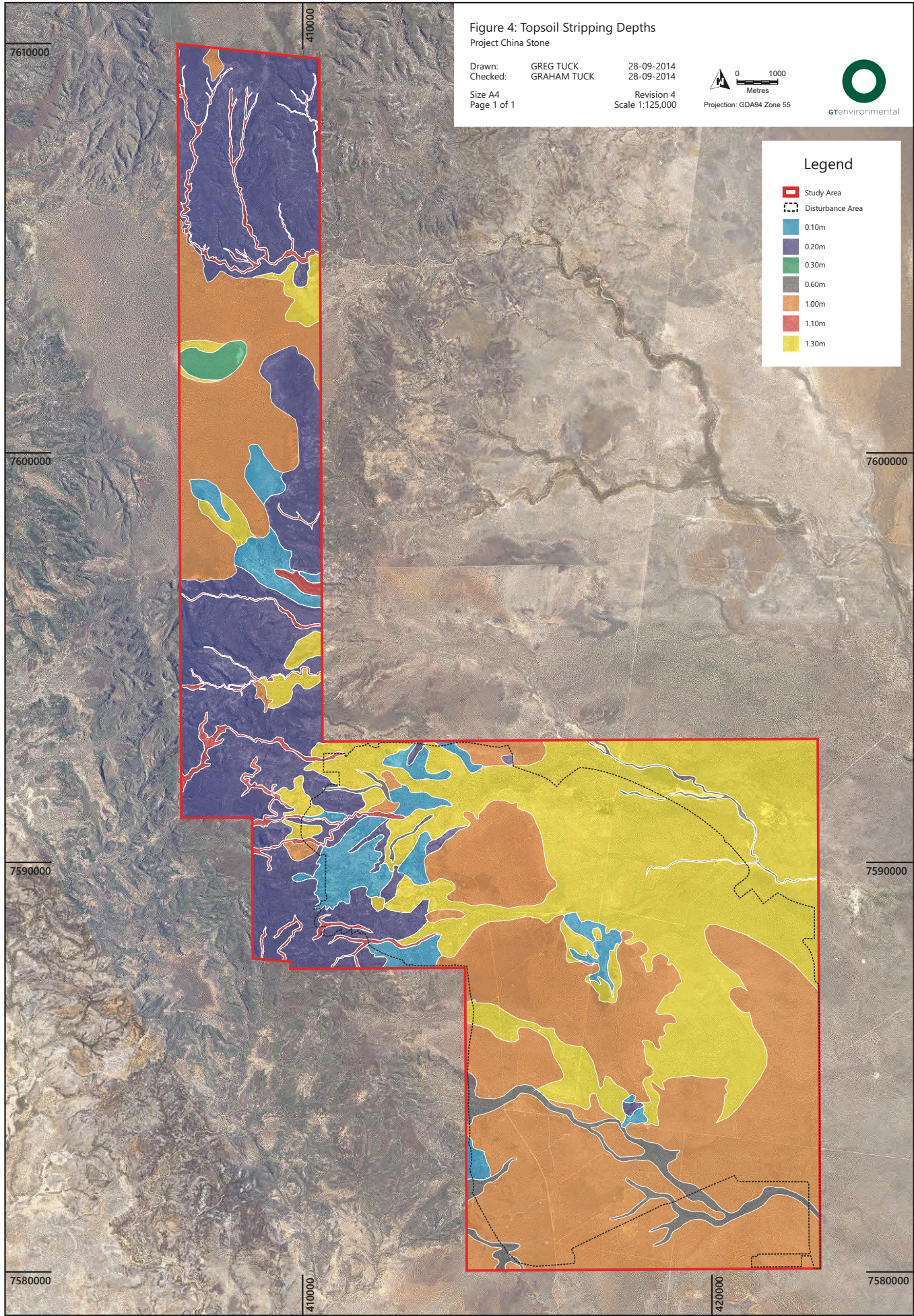


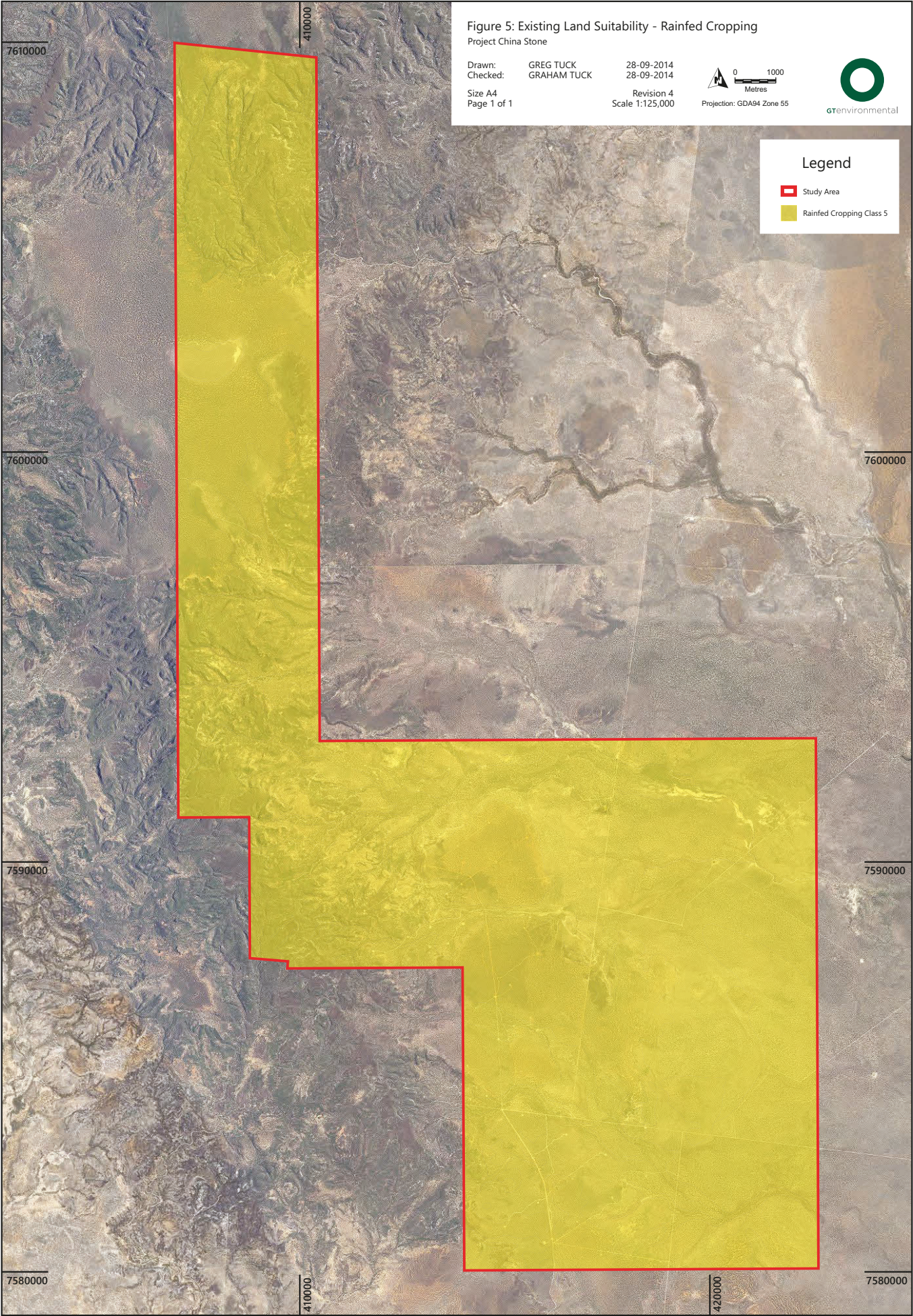
PROJECT CHINA STONE

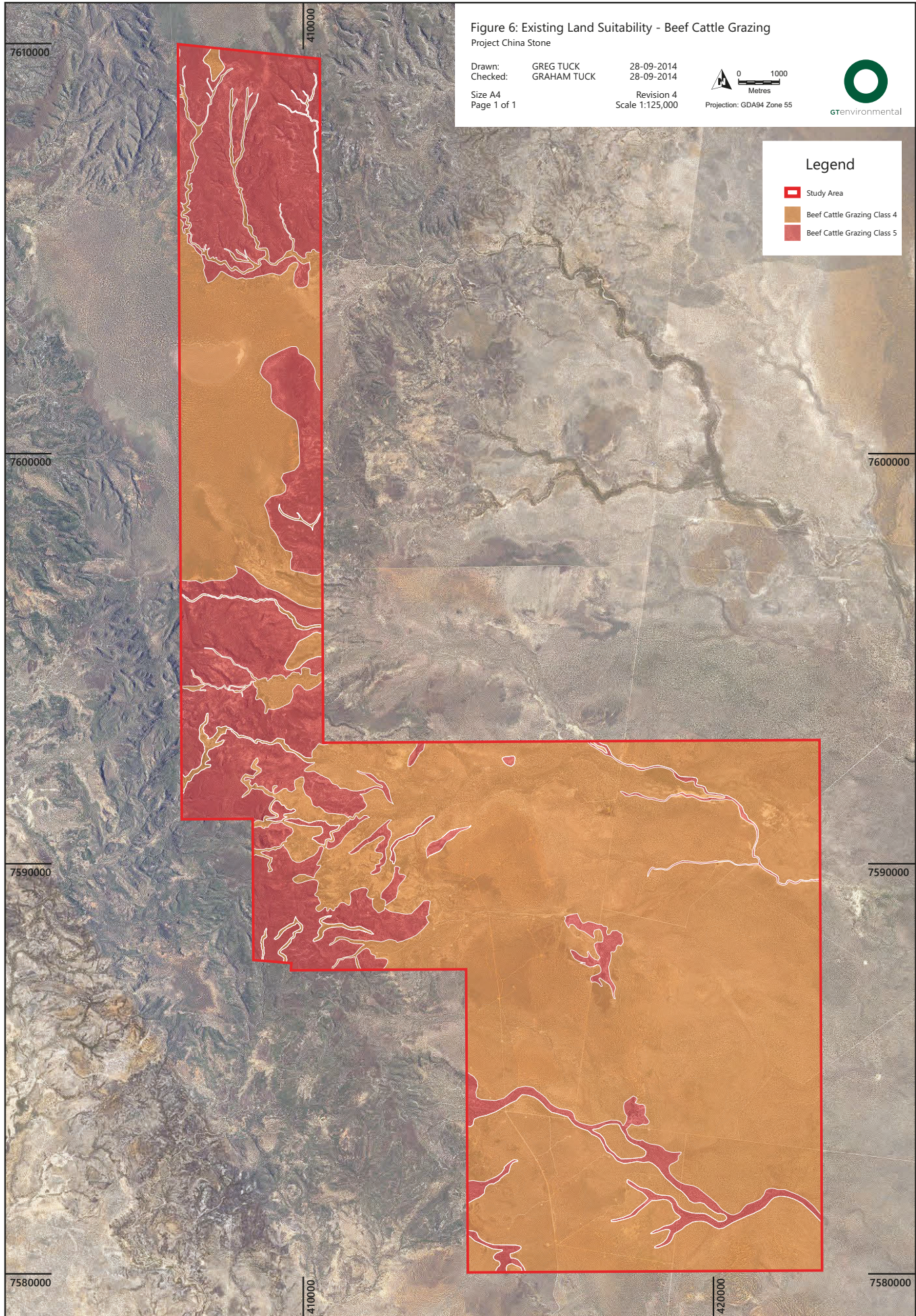


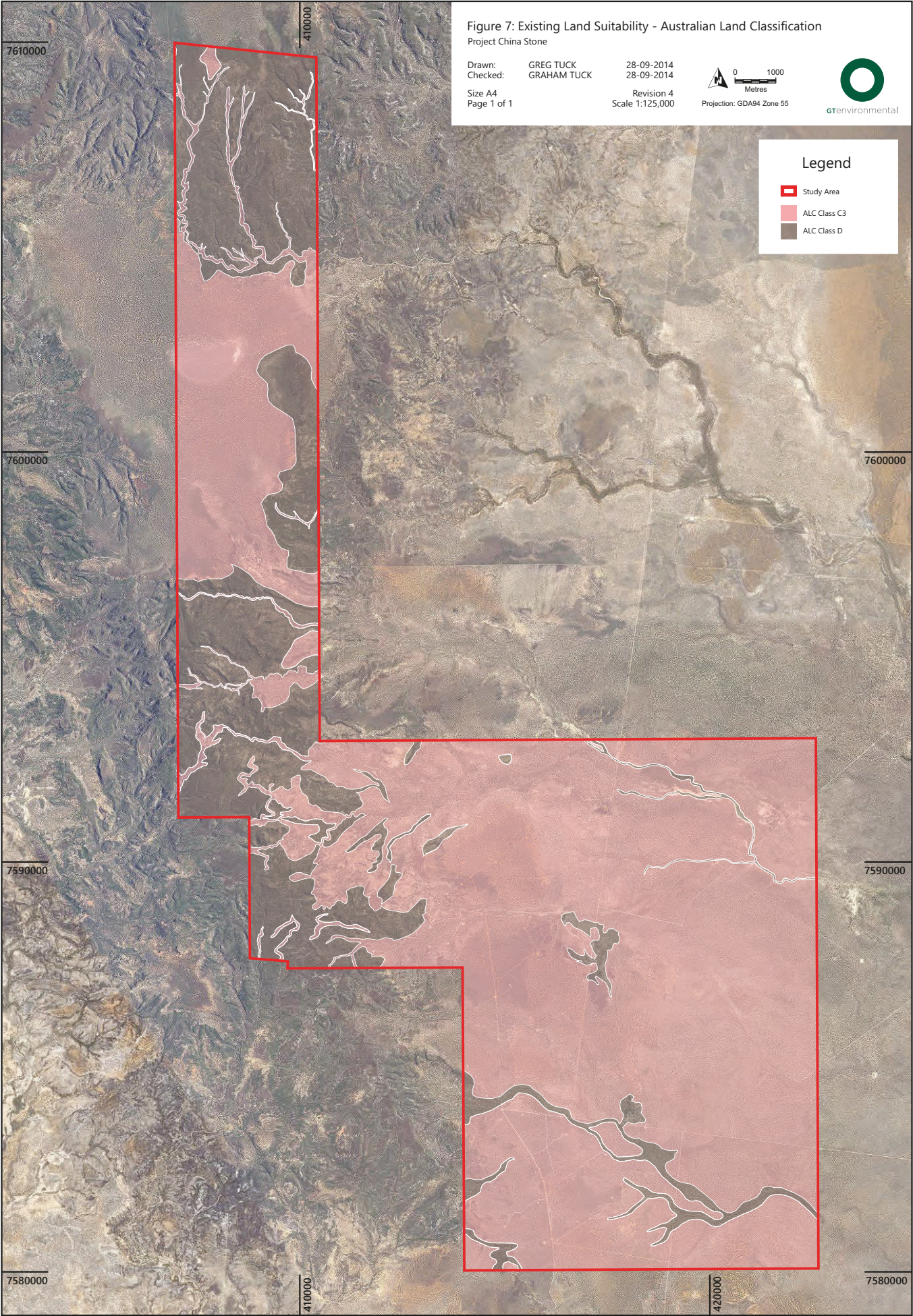
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10 ATTACHMENTS

Attachment A	Detailed Soil Profile and Observation Site Descriptions
Attachment B	Laboratory Certificates

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
1 Ob	416186 7580376	Grazing	Flat plain <0.5%	Ironbark, Bloodwood, Yellow Jack	Nil microrelief Nil disturbance Nil erosion	Soft, sandy, no course fragments, dry	-	-	-	-	-	-	-	-	-	-	-
2 De	416473 7580665	Grazing	Flat plain <0.5%	Ironbark, Bloodwood, Yellow Jack	Nil microrelief Nil disturbance Nil erosion	Sandy, firm, no course fragments	A11 0.0-0.04 Sharp A12 0.04-2.00	Loamy sand, sticky large grains Loamy sand, sticky large grains	Single grain, loose Single grain, loose	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	7.5YR5/4 Dull brown 2.5YR5/8 Bright brown	Dry Dry	Rapid Rapid	Meter pH/EC 4cm 6.31 0.03 40cm 6.12 0.02 70cm 6.40 0.01 170cm 7.02 0.06	0.0-0.04 0.30-0.40 0.60-0.70 1.30-1.40	E1	-
3 Ob	417572 7580480	Grazing	Gentle undulating plain, Midslope <2.0%	Sparse Ironbark, Bloodwood, Yellow Jack	Nil microrelief Nil disturbance Nil erosion	Sandy, soft, fine and coarse grain sands, no course fragments	-	-	-	-	-	-	-	-	-	-	E1/E2 Boundary, Red surface west, yellow surface east
4 De	418592 7580312	Grazing	Gentle undulating plain, Flat plain, 1.0%	Sparse Ironbark, Bloodwood, Yellow Jack	Nil microrelief Nil disturbance Nil erosion	Sandy, soft, no course fragments	A11 0.0-0.20 Abrupt A12 0.20- 0.60 Abrupt 0.60-0.70	Loamy sand Loamy sand Loamy sand	Single grain, loose Single grain, loose Single grain, loose	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	10YR4/4 Brown 10YR5/6 Yellowish brown 10YR5/6 Yellowish brown Mottle 10YR4/1 Brownish grey (cobbles)	Dry Dry Dry	Rapid Rapid Rapid	Field pH 5cm 6.5 45cm 6.5	-	E2	Refusal of hand auger at 0.70m
5 Ob	419002 7580243	Grazing	Gentle undulating plain,, Flat plain, 0.0%	Silver leaf Ironbark	Nil microrelief Nil disturbance Nil ero sion	Sandy, soft, no course fragments	-	-	-	-	-	-	-	-	-	-	-
6 De	419091 7581100	Grazing	Gentle undulating plain, Fluvial, Lower slope <1.0%	Flooded Coolibah	Nil microrelief Nil disturbance Nil erosion	Soft, No coarse fragments	A11 0.0-20 A12 0.20- 0.60 A13 0.60- 0.80 A14 0.80- 0.90	Loamy sand Loamy sand Loamy sand Loamy sand	Single grain, loose Single grain, loose Single grain, loose Single grain, loose	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	7.5YR5/1 Brownish grey 10YR6/2 Greyish yellow brown 10YR7/2 Dull yellow orange 7.5YR8/2 Light grey	Dry Dry Dry Dry	Rapid Rapid Rapid Rapid	Meter pH/EC 0-10cm 6.19 0.04 30-40cm 6.16 0.02 60-70cm 6.78 0.02 80- 90cm 7.42 0.02	0-10 30-40 60-70 80-90	A1	No recovery at 0.90m+
7 Ob	419113 7581294	Grazing	Gentle undulating	Ironbark, Silverleaf	Nil microrelief	-	-	-	-	-	-	-	-	-	-	-	Boundary, vegetation to north as per Site 2, vegetation to the south

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
			plain, Flat plain, 1.0%	Ironbark, Gumtop Box	Nil disturbance Nil erosion												as per Site 6.
8 Ob	419139 7581547	Grazing	Gentle undulating plain, Gully/ depression	Flooded Coolibah	Nil microrelief Nil disturbance Gully erosion	-	-	-	-	-	-	-	-	-	-	A1	Vegetation as per Site 6
9 Ob	418958 7582451	Grazing	Gentle undulating plain, Flat Plain	Boundary of vegetation, Ironbark to the north and eucalyptus to the south	Nil microrelief Nil disturbance Nil erosion	-	-	-	-	-	-	-	-	-	-	-	A1 to the south
10 De	417997 7582438	Grazing	Gentle undulating plain, Flat Plain 0.0%	Mixed vegetation	Nil microrelief Nil disturbance Nil erosion	Sandy, soft, fine to medium grain size	0.0-0.10 Clear	Loamy sand	Single grain, loose	Nil Inclusions Nil Segregations	10YR5/3 Dull yellowish brown	Dry	Rapid	Meter pH/EC 0-5cm 6.26 0.02 40-50cm 6.32 0.02 80-90cm 6.22 0.05	0-5 40-50 80-90	E2	-
							0.10-0.70 Abrupt	Loamy sand	Single grain, loose	Nil Inclusions Nil Segregations	10YR5/4 Dull yellowish brown	Dry	Rapid				
							0.70-1.10	Clayey sand	Single grain, loose	Nil Inclusions Nil Segregations	10YR5/6 Yellowish brown	Dry	Rapid				
11 Ob	417878 7581975	Grazing	Gentle undulating plain, Flat Plain 0.0%	Mixed sparse vegetation, grasses and shrubs	Nil microrelief Nil disturbance Nil erosion	Sandy, soft, fine and medium grain size	-	-	-	-	-	-	-	-	-	-	-
12 De	417492 7581622	Grazing	Gentle undulating plain, Flat Plain 0.0%	Ironbark, Yellow jack and bloodwood	Nil microrelief Nil disturbance Nil erosion	Soft to firm, no coarse fragments	A11 0.0-0.10	Loamy sand	Single grain, loose	Nil Inclusions Nil Segregations	10YR5/3 Dull yellowish brown	Dry	Rapid	Field pH 5cm 6.5 50cm 7.0 80cm 7.0	-	E2	Refusal to 0.80m on suspected gravel pan.
							A12 0.10-0.70	Loamy sand	Single grain, loose	Nil Inclusions Nil Segregations	10YR5/4 Dull yellowish brown	Dry	Rapid				
							B21 0.70-0.80	Clayey sand	Single grain, loose	Gravel observed at 65-70cm	10YR5/6 Yellowish brown	Dry	Rapid				
13 Ob	416994 7581243	Grazing	Gentle undulating plain, Flat Plain 0.0%	Ironbark, Yellow jack and bloodwood	Nil microrelief Nil disturbance Nil erosion	-	-	-	-	-	-	-	-	-	-	-	Boundary of vegetation, yellow jack to the south and ironbark to the north
14 Ob	416132 7581020	Grazing	Gentle undulating plain, Flat Plain 0.0%	Mixed Vegetation	Nil microrelief Nil disturbance Nil erosion	-	-	-	-	-	-	-	-	-	-	-	Boundary Red surface soils to the south, grey surface to the north.

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
15 Ob	416161 7581709	Grazing	Gentle undulating plain, Flat Plain 0.0%	Mixed Vegetation	Nil microrelief Nil disturbance Nil erosion	-	-	-	-	-	-	-	-	-	-	-	Boundary, red surface to the north, grey surface to the south.
16 De	416163 7581987	Grazing	Gentle undulating plain, Flat Plain 0.0%	Mixed Vegetation	Nil microrelief Nil disturbance Nil erosion	Soft, minor self-mulching, no coarse fragments	0.0-0.05 Sharp 0.05-0.80	Loamy sand Loamy sand	Single grain, loose Single grain, loose	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	7.5YR5/4 Dull brown 2.5YR5/8 Bright brown	Dry Dry	Rapid Rapid		-	E1	Site similar to Site 2.
17 Ob	416526 7582313	Grazing	Gentle undulating plain, Flat Plain 0.0%	Mixed Vegetation	Nil microrelief Nil disturbance Nil erosion	-	-	-	-	-	-	-	-	-	-	-	Boundary, red surface to the south, grey surface to the north.
18 De	417020 7582693	Grazing	Gentle undulating plain, Flat Plain 0.0%	Bloodwood, Ironbark	Nil microrelief Nil disturbance Nil erosion	Soft to firm, Dry, no coarse fragments	0.00-0.05 0.05-0.25 0.25-0.90 0.90-1.20	Loamy sand sharp Loamy sand sharp Loamy sand abrupt Clayey sand	Single grain, loose Single grain, loose Single grain, loose Single grain/massive, loose	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	10YR5/3 Dull yellowish brown 10YR5/4 Dull yellowish brown 10YR5/6 Yellowish brown 10YR6/6 Bright yellowish brown	Dry Dry Humid Humid	Rapid Rapid Rapid Well	0-5cm 6.29 0.03 10-20cm 6.12 0.02 50-60cm 6.05 0.02 100-110cm 7.13 0.02	0-5 10-20 50-60 100-110	E2	-
19 Ob	416137 7582316	Grazing	Gentle undulating plain, Flat Plain 0.5%	Mixed Vegetation, Ironbark, Bloodwood and Yellowjack	Nil microrelief Nil disturbance Nil erosion	Soft, sandy, no coarse fragments	-	-	-	-	-	-	-	-	-	-	Boundary , red surface soils to the south and grey surface soils to the north.
20 De	416054 7583235	Grazing	Gentle undulating plain, Flat Plain 0.5%	Mixed Vegetation, Ironbark, Bloodwood and Yellowjack	Nil microrelief Nil disturbance Nil erosion	Soft, sandy, no coarse fragments	0.0-0.05 Sharp 0.05-0.15 Sharp 0.15-0.55 Sharp 0.55-0.90	Loamy sand Loamy sand Loamy sand Clayey sand	Single grain, loose Single grain, loose Single grain, loose Single grain/massive, loose	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	10YR5/3 Dull yellowish brown 10YR5/4 Dull yellowish brown 10YR5/6 Yellowish brown 10YR4/6 Brown Mottle 10YR6/6 Bright yellowish brown <10%	Dry Dry Dry Dry	Rapid Rapid Well Well	-	-	E2	Site similar to Site 18.

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
21 De	419249 7580127	Grazing	Gentle undulating plain, Flat Plain 0.5%	-	Nil microrelief Nil disturbance Nil erosion	Firm, self mulching, dry, no coarse fragments	0.0-0.15 Abrupt 0.15-0.50 Diffuse 0.50-1.00 Abrupt 1.00-1.10	Loamy sand Loamy sand Loamy sand Clayey sand	Single grain, loose Single grain, loose Single grain, loose Single grain, loose	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Gravels <2%	10YR5/3 Dull yellowish brown 10YR5/6 Yellowish brown 10YR5/6 Yellowish brown 10YR5/6 Yellowish brown Mottle 7.5YR5/8 Bright brown	Dry Dry Dry Dry	Rapid Rapid Rapid Well	-	-	E2	Site similar to Site 12 and 18.
22 De	420296 7580497	Grazing	Gentle undulating plain, Lower slope 1.5%	Bloodwood, Ironbark	Nil microrelief Nil disturbance Nil erosion	Firm, <100mm gravels at <2% cover	0.0-0.05 0.05-0.50 Diffuse 0.50-0.80 0.80-0.90	Loamy sand Loamy sand Loamy sand Loamy sand	Single grain, loose Single grain, loose Single grain, loose Single grain, loose	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	7.5YR5/2 Greyish brown 7.5YR4/4 Brown Brown 10YR4/4 Brown 10YR5/6 Yellowish brown Mottle 7.5YR5/2 Greyish brown	Dry Dry Dry Dry	Rapid Rapid Rapid Rapid	Field pH(BaSO4) 5cm 6.5 30cm 6.5 60cm 6.5	-	E2	Nearby Boundary to E1
23 Ob	420615 7580616	Grazing	Gentle undulating plain, Flat plain 0.0%	Bloodwood, Ironbark and Yellow jack boundary	Nil microrelief Nil disturbance Nil erosion	-	-	-	-	-	-	-	-	-	-	-	Boundary, red surface soils to the north.
24 De	422220 7580510	Grazing	Gentle undulating plain, Flat plain <0.5%	Ironbark	Nil microrelief Nil disturbance Nil erosion	Firm, self mulching, dry and no coarse fragments	0.0-0.15 diffuse 0.15-0.30 Abrupt 0.30-0.80	Loamy sand, Loamy sand Loamy sand	Single grain, loose Single grain, loose Single grain, loose	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations 30-80, 7.5YR5/8 Bright brown red gravels observed 45% cover	10YR5/3 Dull yellowish brown 10YR5/4 Dull yellowish brown 10YR5/4 Dull yellowish brown	Dry Dry Dry	Rapid Imperfect Imperfect	Field pH(BaSO4) 10cm 7.0 25cm 7.0 70cm 7.0	-	E2	No recovery at 0.80m
25 Ob	421757 7583118	Grazing	Gentle undulating plain, Flat plain 0.0%	Ironbark, bloodwood	Nil microrelief Nil disturbance Nil erosion	-	-	-	-	-	-	-	-	-	-	E2	Boundary nearby

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
26 De	422413 7583036	Grazing	Gentle undulating plain, Flat plain 0.0%	Ironbark, bloodwood	Nil microrelief Nil disturbance Nil erosion	Firm, sandy, no coarse fragments	0.0-0.10	Loamy sand	Single grain, loose	Nil Inclusions Nil Segregations	10YR5/3 Dull yellowish brown	Dry	Rapid	Meter pH/EC 0-10cm 6.01 0.01 30-40cm 6.02 0.02 70-80cm 6.34 0.02 90-100cm 6.35 0.04	0-10 30-40 70-80	E2	Site similar to Site 18.
							0.10-0.30	Loamy sand	Single grain, loose	Nil Inclusions Nil Segregations	10YR5/6 Yellowish brown	Dry	Rapid				
							0.50-1.00	Clayey sand	Single grain/massive, loose	Nil Inclusions Nil Segregations	10YR6/6 Bright yellowish brown Mottle 10YR6/6 Bright yellowish brown <10% cover 10YR5/3 Dull yellowish brown Dull yellowish brown <5% cover	Dry	Well				
27 De	419946 7583339	Grazing	Gentle undulating plain, mid slope 1.5%	Grey box	Nil microrelief Nil disturbance Nil erosion	Firm, no coarse fragments	0.0-0.20 Abrupt	Loamy sand	Single grain, loose	Nil Inclusions Nil Segregations	7.5YR4/4 Brown Brown	Dry	Rapid	Meter pH/EC 0-10cm 6.10 0.02 30-40cm 6.20 0.02 70-80cm 6.33 0.01	0-10 30-40 70-80	E1	No roots observed throughout the profile Area cleared potentially 15-20 years ago due to current regrowth.
							0.20-0.60 Abrupt	Loamy sand	Single grain/massive, loose	Nil Inclusions Nil Segregations	7.5YR5/6 Bright brown Mottle 7.5YR4/4 Brown <2%	Dry	Well				
							0.60-1.00	Sandy loam	Weak structure	Nil Inclusions Nil Segregations	7.5YR5/8 Bright brown	Dry	Well				
28 De	415489 7582683	Grazing	Gentle undulating plain, lower slope <2.0%	Ironbark, bloodwood	Nil microrelief Nil disturbance Nil erosion	Firm, no coarse fragments	0.0-0.12 abrupt	Loamy sand	Single grain, loose	Nil Inclusions Nil Segregations	7.5YR5/2 Greyish brown	Dry	Rapid	Field pH(BaSO4) 5cm 6.5 30cm 6.5 60cm 6.5 90cm 6.5	-	E2	30.0m from boundary
							0.12-0.55 abrupt	Loamy sand	Single grain, loose	Nil Inclusions Nil Segregations	10YR6/2 Greyish yellow brown	Dry	Rapid				
							0.55-1.00 Abrupt	Loamy sand	Single grain, loose	Nil Inclusions Nil Segregations	10YR6/4 Dull yellow orange	Dry	Rapid				
							1.00-1.20	Clayey sand	Single grain, loose	Nil Inclusions Nil Segregations	10YR5/4 Dull yellowish brown Mottle 10YR6/8 Bright yellowish brown <55 cover	Dry	Rapid				
29 De	416245 7583794	Grazing	Gentle undulating plain, flat plain 0.0%	Ironbark	Nil microrelief Nil disturbance Nil erosion	Dry, firm	0.0-0.40 Gradual	Loamy sand	Single grain, loose	Nil Inclusions Nil Segregations	10YR5/3 Dull yellowish brown Dull yellowish brown	Dry	Rapid	Field pH(BaSO4) 10cm 6.5 80cm 6.5 180cm 7.0 EC 0.02	180-190	E2	
							0.40-0.80	Loamy sand	Single grain, loose	Nil Inclusions Nil Segregations	10YR5/4 Dull yellowish brown	Dry	Rapid				

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
							0.80-1.30 1.30-2.00	Loamy sand Clayey sand	Single grain, loose Single grain, loose	Nil Inclusions Nil Segregations <5% quartz, <5% mixed gravels	10YR5/4 Dull yellowish brown 7.5YR5/6 Bright brown	Dry Humid	Rapid Rapid				
30 De	417452 7583646	Grazing	Gentle undulating plain, drainage line/ depression	Narrow leaf Ironbark, Silver leaf ironbark	Nil microrelief Nil disturbance Gully erosion	Very soft, sand, no coarse fragments	-	-	-	-	-	-	-	-	-	A1	-
31 De	417867 417867	Grazing	Gentle undulating plain, mid slope 1.0%	Ironbark	Nil microrelief Nil disturbance Nil erosion	Firm – hard setting <2% gravels 10- 20mm	0.0-0.20 0.20-0.50 0.50-0.60	Silty loam Loamy Sand Loamy sand	Single grain, loose Single grain/massive, loose Single grain, loose	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	10YR6/2 Greyish yellow brown 10YR6/3 Dull yellow orange 10YR5/6 Yellowish brown	Dry Dry Dry	Rapid Well Well	Meter pH/EC 0-10cm 6.13 0.02 30-40cm 6.45 0.04	0-10 30-40 50-60	A1sv	-
32 Ob	417851 7583528	Grazing	Gentle undulating plain, mid slope 1.0%	Ironbark	Nil microrelief Nil disturbance Nil erosion	Firm – hard setting <2% gravels 10- 20mm	-	-	-	-	-	-	-	-	-	A1sv	-
33 De	417845 7583585	Grazing	Gentle undulating plain, mid slope 2.0%	Ironbark	Nil microrelief Nil disturbance Nil Erosion	Firm – hard setting, sandy, <5% gravels 10mm, dry	0.0-0.05 0.05-0.60 0.60-0.70	Silty loam Loamy sand Loamy sand	Single grain, loose Single grain/massive, loose Single grain, loose	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	10YR6/2 Greyish yellow brown 10YR6/3 Dull yellow orange 10YR5/6 Yellowish brown	Dry Dry Dry	Rapid Rapid Rapid	-	-	A1sv	
34 De	418891 7583471	Grazing	Gentle undulating plain, mid slope 1.0%	Ironbark, wattles	Nil microrelief Nil disturbance Nil Erosion	Firm, sandy, dry	0.0-0.25 0.25-0.70 0.70-1.00	Loamy sand Loamy sand Clayey sand	Single grain, loose Single grain/massive Weak, sub-angular	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	10YR6/1 Brownish grey 7.5YR5/6 Bright brown 10YR5/8 Yellowish brown Mottle 7.5YR5/8 Bright brown <2% cover	Dry Dry Humid	Rapid Rapid Well	Field pH(BaSO4) 10cm 6.5 30cm 6.5 60cm 6.5 90cm 6.5	-	E2	Roots observed to 0.60m
35 De	421167 7583188	Grazing	Gentle undulating plain, Flat	Ironbark, Bloodwood	Nil microrelief Nil	Firm, self- mulching, no coarse	0.0-0.15 Abrupt	Loamy sand	Single grain, loose	Nil Inclusions Nil Segregations	10YR6/1 Brownish grey	Dry	Rapid	-	-	E2	-

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
			plain 0.0%		disturbance Nil Erosion	fragments	0.15-0.60 Abrupt 0.60-1.00	Loamy sand Clayey sand	Single grain/massive Single grain/massive	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	7.5YR5/6 Bright brown 10YR5/8 Yellowish brown Mottle 7.5YR5/8 Bright brown <10% cover	Dry Humid	Rapid Well				
36 De	414928 7584124	Grazing	Gentle undulating plain, Flat plain <0.5%	Ironbark at 70% cover, eucalyptus 30%	Nil microrelief Nil disturbance Nil Erosion	Firm, self- mulching, no coarse fragments	0.0-0.30 Abrupt 0.30-0.80 Clear 0.80-1.20	Loamy sand Loamy sand Clayey sand	Single grain, loose Single grain/loose Single grain/loose	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	10YR4/2 Greyish yellow brown 10YR4/3 Dull yellowish brown 10YR5/4 Dull yellowish brown	Dry Dry Dry	Rapid Rapid Rapid	Meter pH/EC 0-10cm 6.75 0.03 50-60cm 5.88 0.02 90-100cm 6.65 0.02	0-10 50-60 90-100	A1 .	Site similar to Site 31 and 33 except on drainage line
37 Ob	415160 7584474	Grazing	Gentle undulating plain, Lower slope 2.5%	Ironbark	Nil microrelief Nil disturbance Nil Erosion	-	-	-	-	-	-	-	-	-	-	-	Boundary, red surface soil north and grey surface soil to the south.
38 De	415235 7584875	Grazing	Gentle undulating plain, mid slope 3.0%	Ironbark, bloodwood and Yellow jack	Nil microrelief Nil disturbance Nil Erosion	Hard setting, no coarse fragments	0.0-0.30 0.30-0.70+	Sandy loam Silty Loam	Single grain, loose Single grain/loose	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	7.5YR5/6 Bright brown 2.5YR4/8 Reddish brown	Dry Dry	Rapid Rapid	Meter pH/EC 0-10cm 5.87 0.02 30-40cm 5.80 0.02 60-70cm 6.05 0.02	0-10 30-40 60-70	E3	No recovery at 0.30 on first borehole. No recovery at 0.70 on second borehole
39 Ob	415120 7585581	Grazing	Gentle undulating plain, lower slope <1.5%	Ironbark	Nil microrelief Nil disturbance Nil Erosion	-	-	-	-	-	-	-	-	-	-	-	Boundary
40 De	414989 7585994	Grazing	Gentle undulating plain, mid slope 3.0%	Ironbark, medium cover	Nil microrelief Nil disturbance Nil Erosion	Hard-setting	0.0-0.10 Clear 0.10-0.50 Abrupt 0.50-0.80 Abrupt 0.80-1.20	Sandy loam Sandy loam Sandy loam Sandy loam	Single grain, loose Single grain/loose Single grain/loose Single grain/loose	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	10YR4/3 Dull yellowish brown 10YR5/4 Dull yellowish brown 10YR6/6 Bright yellowish brown 10YR6/8 Bright yellowish brown	Dry Dry Dry Dry	Rapid Rapid Rapid Rapid	Field pH(BaSO4) 10cm 6.5 30cm 6.5 60cm 6.5 90cm 7.0	-	E4	
41 Ob	414869 7586376	Grazing	Gentle undulating	Ironbark, wattle	Nil microrelief	-	-	-	-	-	-	-	-	-	-	-	Boundary, grey surface soils to the south and red surface soils to the

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
			plain, upper slope 2.5%		Nil disturbance Nil Erosion												north.
42 Ob	414521 7586532	Grazing	Gentle undulating plain, Upper slope 1.5%	Ironbark	Nil microrelief Nil disturbance Nil Erosion	-	-	-	-	-	-	-	-	-	-	-	Boundary, grey surface soils to the south west and red surface soils to the north east.
43 De	415571 7587685	Grazing	Gentle undulating plain, Mid slope 1.0%	Ironbark	Nil microrelief Nil disturbance Nil Erosion	Hard-setting, no coarse fragments	0.0-0.30 0.30-0.70+	Sandy Loam Silty Loam	Single grain, loose Single grain/loose	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	7.5YR5/6 Bright brown 2.5YR4/8 Reddish brown	Dry Dry	Rapid Rapid	-	-	E3	Site similar to Site 38
44 De	414608 7588127	Grazing	Gentle undulating plain, Mid slope 2.0%	Ironbark	Nil microrelief Nil disturbance Nil Erosion	Hard-setting, no coarse fragments	0.0-0.10 0.10-0.70	Sandy Loam Silty loam	Single grain, loose Single grain/loose	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	7.5YR5/6 Bright brown 2.5YR4/8 Reddish Brown	Dry Dry	Rapid Rapid	-	-	E3	Very hard packed soil.
45 Ob	414565 7588482	Grazing	Gentle undulating plain, Lower slope 3.0%	Ironbark	-	-	-	-	-	-	-	-	-	-	-	-	Boundary, grey surface soils to the north and red surface soils to the south
46 De	414535 7588699	Grazing	Gentle undulating plain, Flat plain <0.5%	Ironbark and Coolibah	Nil microrelief Nil disturbance Nil Erosion	Firm, no coarse fragments	0.0-0.05 abrupt 0.05-0.60 abrupt 0.60-1.00	Sandy loam Sandy loam Sandy loam	Single grain, loose Single grain/loose Single grain/loose	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	10YR5/3 Dull yellowish brown 10YR5/4 Dull yellowish brown 10YR5/6 Yellowish brown	Dry Dry Dry	Rapid Rapid Rapid	-	-	E4	
47 De	413867 7588836	Grazing	Gentle undulating plain, Lower slope 1.0%	Ironbark	Nil microrelief Nil disturbance Nil Erosion	Firm, no coarse fragments	0.0-0.10 abrupt 0.10-0.50 Abrupt 0.50-1.00	Sandy Loam Sandy loam Sandy loam	Single grain, loose Single grain/loose Single grain/loose	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	10YR5/3 Dull yellowish brown 10YR5/4 Dull yellowish brown 10YR5/6 Yellowish brown	Dry Dry Dry	Rapid Rapid Rapid	Meter pH/EC 0-10cm 6.11 0.11 20-30cm 6.16 0.03 60-70cm 6.21 0.02 70-80cm 6.22 0.02	0-10 30-40 70-80	E4	-
48 Ob	413284 7588922	Grazing	Gentle undulating plain, Simple	Eucalyptus	Nil microrelief Nil disturbance	Firm, no coarse fragments	-	-	-	-	-	-	-	-	-	E4	Within 100m north and south, Ironbark vegetation is present

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
			slope 4.0%		Minor overland runoff erosion with gullies nearby <50m												
49 Ob	413927 7588693	Grazing	Gentle undulating plain, Lower slope 1.0%	Ironbark	Nil microrelief Nil disturbance Nil Erosion	Firm, <2% 10- 70mm gravels/cobbles	-	-	-	-	-	-	-	-	-	-	Red surface soils appear within a 100m strip north and south.
50 Ob	413191 7587889	Grazing	Gentle undulating plain, Upper / Rock outcrop . Slope <1%	Ironbark	Nil microrelief Nil disturbance Minor overland flow	Laterite	-	-	-	-	-	-	-	-	-	U2(b)	-
51 De	411779 7587808	Grazing	Gentle undulating plain, Upper / Rock outcrop. Slope <1%	Ironbark	Nil microrelief Nil disturbance, drill pad nearby <20m Minor overland flow	Soft, gravels <5mm at 5% cover	0.0-0.20 Gradual 0.20-0.90	Sandy loam Sandy loam	Single grain, loose Single grain/loose	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	10YR4/3 Dull yellowish brown 10YR5/4 Dull yellowish brown	Dry Dry	Rapid Rapid	Meter pH/EC 0-10cm 6.13 0.03 50-60cm 6.33 0.06	0-10 50-60	U2(b)	Refusal to 0.90m. Rocky outcrop located within 100m ..
52 Ob	411696 7587825	Grazing	Scarp, Rocky outcrop, > 30m approx. in height	Mount Coolibah	Nil microrelief Nil disturbance Runoff from overland flow on outcrop	Laterite	-	-	-	-	-	-	-	-	-	U2(b)	-
53 Ob	414465 7588942	Grazing	Gentle undulating plain, Simple slope	Ironbark	Nil microrelief Nil disturbance Nil Erosion	Firm, no coarse fragments	-	-	-	-	-	-	-	-	-	-	Boundary, red surface soils to the north, grey surface soils to the south.
54 De	414658 7589928	Grazing	Gentle undulating plain, Flat plain	Ironbark and bloodwood	Nil microrelief Nil disturbance	Firm, dry, no coarse fragments	0.0-0.07 abrupt 0.07-0.28	Sandy loam Sandy loam	Single grain, loose Single grain/loose	Nil Inclusions Nil Segregations Nil Inclusions	7.5YR5/6 Bright brown 2.5YR4/6 Reddish	Dry Dry	Rapid Rapid	Field pH(BaSO4) 5cm 6.5 15cm 6.5 60cm 6.5	-	E3	Site similar to Site 38, 43 and 44

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
					Nil Erosion		Gradual 0.28-1.00	Silty loam	Single grain/loose	Nil Segregations Nil Inclusions Nil Segregations	brown 2.5YR4/8 Reddish brown	Dry	Rapid	90cm 6.5			
55 Ob	415211 7590391	Grazing	Gentle undulating plain, Flat plain	Ironbark and bloodwood	Nil microrelief Nil disturbance Nil Erosion	Firm, dry, no coarse fragments	-	-	-	-	-	-	-	-	-	-	-
56 De	415518 7590692	Grazing	Gentle undulating plain, Flat plain	Ironbark and bloodwood	Nil microrelief Nil disturbance however appears to be historically cleared Nil Erosion	Firm, dry, no rocks	0.0-0.10 Gradual 0.10-0.47 0.47+	Sandy loam Loam Silty Loam	Single grain, loose Single grain, loose Single grain, loose	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	7.5YR5/6 Bright brown 2.5YR4/6 Reddish brown 2.5YR4/8 Reddish brown	Dry Dry Dry	Rapid Rapid Rapid	-	-	E3	-
57 Ob	415402 7591218	Grazing	Gentle undulating plain, Upper slope	Ironbark	Nil microrelief Nil disturbance Nil Erosion	-	-	-	-	-	-	-	-	-	-	-	Boundary, red surface soils to the north, grey surface soils to the south.
58 De	415407 7591569	Grazing	Gentle undulating plain, mid slope, 2.0%	Ironbark	Nil microrelief Nil disturbance Nil Erosion	Dry, firm, no coarse fragments	0.0-0.10 Abrupt 0.10-0.30 Gradual 0.30-0.80 Abrupt 0.80-1.10	Sandy loam Sandy loam Sandy loam Sandy loam	Single grain, loose Single grain, loose Single grain, loose Single grain, loose	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	10YR5/3 Dull yellowish brown 10YR5/4 Dull yellowish brown 10YR5/6 Yellowish brown 10YR5/6 Yellowish brown Mottle 7.5YR5/8 Bright brown	Dry Dry Dry Dry	Rapid Rapid Rapid Rapid	-	-	E4	-
59 De	413132 7589953	Grazing	Gentle undulating plain, upper slope, 2.0%	Grevillia species, Bloodwood, ironbark, grey gum	Nil microrelief Nil disturbance Nil Erosion	Firm to hard setting, no coarse fragments	0.0-0.10 Abrupt 0.10-0.60 Abrupt 0.60-1.00	Sandy loam Sandy loam Sandy loam	Single grain, loose Single grain, loose Weak, blocky	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	10YR5/4 Dull yellowish brown 10YR5/6 Yellowish brown 10YR5/6 Yellowish brown	Dry Dry Dry	Rapid Rapid Rapid	Meter pH/EC 0-10cm 6.31 0.01 30-40cm 6.05 0.03 70-80cm 6.31 0.02	0-10 30-40 70-80	E4	

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
60 De	413045 7590239	Grazing	Gentle undulating plain, Ridge, 3.0%	Lancewood, Silverleaf Ironbark	Nil microrelief Nil disturbance Minor overland flow	Silcrete and laterite rock <70% cover	0.0-0.20 20+	Loamy sand Laterite	Single grain, loose -	Gravels and cobbles 10-100mm at <20% cover	7.5YR4/2 Brown -	Dry -	Well -	Meter pH/EC 0-10cm 4.88 0.03	0-10	U2(b)	Elements of U2(a) nearby
61 Ob	413004 7590755	Grazing	Gentle undulating plain, low slope	Bloodwood, Ironbark, narrow leaf ironbark	Nil microrelief Minor clearing present Nil Erosion	-	-	-	-	-	-	-	-	-	-	-	Boundary, light brown surface soils to the north.
62 De	413427 7591314	Grazing	Gentle undulating plain,	Blue gum, Silverleaf ironbark	Nil microrelief Nil disturbance Drainage line erosion	-	0.0-0.30 Abrupt 0.30+	Sandy loam Sandy loam	Single grain, loose Hard, blocky	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	10YR5/4 Dull yellowish brown 10YR5/6 Yellowish brown Mottle 7.5YR5/8 Bright brown	Dry Dry	Rapid Imperfect	Meter pH/EC 0-10cm 6.87 0.06 40-50cm 6.70 0.11	0-10 40-50	E4	Cutting profile
63 De	413643 7591425	Grazing	Gentle undulating plain,	Blue gum, Silverleaf ironbark	Nil microrelief Nil disturbance Drainage line erosion	-	0.0-0.40 0.40+	Sandy loam Sandy loam	Single grain, loose Hard, blocky	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	10YR5/4 Dull yellowish brown 10YR5/6 Yellowish brown Mottle 7.5YR5/8 Bright brown	Dry Dry	Rapid Imperfect	-	-	E4	Effective rooting depth to 0.40m
64 Ob	413649 7591351	Grazing	Ridge, Upper slope 4%	Bloodwood and Ironbark	Nil microrelief Nil disturbance Nil Erosion	Hard, rocky	-	-	-	-	-	-	-	-	-	U2(b)	-
65 De	415062 7592404	Grazing	Gentle undulating plain,	Ghostgum, Silverleaf Ironbark	Nil microrelief Nil disturbance Nil Erosion	Soft, dry, no coarse fragments	0.0-0.15 abrupt 0.15-0.40 Abrupt 0.40-1.00	Loamy sand Loamy sand Loamy sand	Single grain, loose Single grain, loose Single grain, loose	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	Light yellow brown, Yellow brown Yellow brown	Dry Dry Dry	Rapid Rapid Rapid	Field pH(BaSO4) 10cm 6.5 30cm 6.5 60cm 6.5 90cm 6.5	-	E2	
66 De	415050 7592440	Grazing	Gentle undulating plain, Lower slope	Silverleaf Ironbark, Bloodwood	Nil microrelief Nil disturbance Washout erosion	Firm, dry	0.0-0.20 0.20-0.50	Loamy sand Loamy sand with 80% founded gravels	Single grain, loose Single grain, loose	Nil Inclusions Nil Segregations Gravel present	Pale 	- 	Imperfect Imperfect	-	-	U2(a)	Old Laterite ridge, Cutting profile. Isolated U2(a) observed, E2 in surrounding areas.

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
							0.50-1.20	Hard laterite substrate	-	Substrate present			-				
67 Ob	416136 7592066	Grazing	Flat plain	Ghostgum, Silverleaf Ironbark	Nil microrelief Nil disturbance Nil Erosion	Hard, dry, no coarse fragments	-	-	-	-	-	-	-	-	-	E4	Site similar to Site 65
68 De	410381 7604829	Grazing	Gentle undulating plain, drainage line	Reid River Gum, Yellow Jack, Blue Gum, Narrow leaf Ironbark	Nil microrelief Nil disturbance Drainage line Erosion	Soft, sandy, laterite rock present	-	-	-	-	-	-	-	-	-	U1	Drainage line cutting
69 De	410386 7604792	Grazing	Gentle undulating plain, mid- lower slope, 3.0%	Narrow leaf Ironbark	Nil microrelief Nil disturbance Minor erosion present.	Firm, no coarse fragments	0.0-0.05 clear 0.05-0.35 abrupt 0.35-1.20	Silty loam Silty loam Silty loam	Single grain/massive, loose Single grain/massive, loose Single grain/massive, loose	Gravels <5mm at <5% throughout profile	10YR5/4 Dull yellowish brown 10YR5/4 Dull yellowish brown 10YR4/4 Brown	Dry Dry Dry	Rapid Rapid Rapid	Meter pH/EC 0-5cm 5.19 0.02 20-30cm 5.16 0.01 80-90cm 5.30 0.02	0-10 0.20-0.30 0.80-0.90	U1	0-5, fine roots were observed.
70 Ob	412124 7604540	Grazing	Laterite Ridges	Silver leaf Ironbark, Yellow Jack	Nil microrelief Nil disturbance Drainage line present.	Laterite rock 90% cover	-	-	-	-	-	-	-		-		Near drainage line
71 De	410432 7604320	Grazing	Ridge/ Upper slope 1.0%,	Mixed Acacias, bloodwood, lancewood, yellow jack	Nil microrelief Nil disturbance Nil Erosion	Sandy, soft, no coarse fragments	0.0-0.05 Sharp 0.05-1.00 Abrupt 1.00-1.40	Sandy loam Sandy loam Sandy loam	Single grain, loose Single grain, loose Single grain, loose	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	10YR5/4 Dull yellowish brown 10YR6/4 Dull yellow orange 7.5YR6/2 Greyish brown	Dry Dry Dry	Rapid Rapid Rapid	Meter pH/EC 0-5cm 6.13 0.01 40-50cm 6.45 0.03 100-110cm 7.02 0.02	-	E4	Silica Sand type
72 Ob	410374 7604530	Grazing	Gentle undulating plain, Midslope, 8.0%	Ironwood, Yellow jack	Nil microrelief Nil disturbance Nil Erosion	Gravels/Cobbles 10-100m <50% cover	-	-	-	-	-	-	-	-	-		Boundary
73 Ob	410324 7604222	Grazing	Gentle undulating plain,	Ironwood, Bloodwood	Nil microrelief Nil	Firm, sandy, no coarse fragments	-	-	-	-	-	-	-	-	-		Yellow surface sands observed

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
			Midslope,		disturbance Nil Erosion												
74 Ob	409998 7604004	Grazing	Gentle undulating plain, Midslope,	Lancewood	Nil microrelief Nil disturbance Nil Erosion	-	-	-	-	-	-	-	-	-	-	-	Boundary between U2(a) rugged uplands and E4 sandy flat plains
75 De	409900 7604003	Grazing	Gentle undulating plain, Depression	Lancewood,	Nil microrelief Nil disturbance Drainage line/depression erosion	Laterite bedrock <40mm cobble at <80% cover	0.0-0.20 0.20-0.70 0.70+	Loamy Sand Sandy loam Laterite	Single grain/massive, loose Single grain, loose -	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	2.5Y7/4 Light yellow 10YR5/6 Yellowish brown Mottle2.5YR5/4 -	Dry Dry -	Rapid Well -	-	-	U2(a)	Cutting profile
76 De	408939 7603126	Grazing	Gentle undulating plain, Flat plain <0.5%	Bloodwood, Yellow jack, Narrow leaf Ironbark	Nil microrelief Nil disturbance Nil Erosion	Firm, no coarse fragments	0.0-0.10 Abrupt 0.10-0.50 Abrupt 0.50-1.10	Sandy Loam Sandy Loam Silty loam	Single grain, loose Single grain, loose Massive	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	2.5YR4/6 Reddish brown 2.5YR4/8 Reddish brown 2.5YR5/8 Bright brown	Dry Dry Dry	Rapid Rapid Rapid	Field pH(BaSO4) 5cm 6.5 50cm 7.0 80cm 7.0	-	E3	-
77 Ob	408540 7602682	Grazing	Gentle undulating plain, Flat plain <0.5%	Bloodwood, Ironbark	Nil microrelief Nil disturbance Nil Erosion	Firm, no coarse fragments	-	-	-	-	-	-	-	-	-	-	Boundary, grey surface soils to the west and red surface soils to the east
78 De	407514 7602607	Grazing	Gentle undulating plain, Flat plain <0.5%	Ironbark	Nil microrelief Nil disturbance except recent drill pad and excavation pad nearby Minor runoff observed	Firm, no coarse fragments	0.0-0.40 Gradual 0.40+	Sandy loam Sandy loam	Single grain/massive, loose Single grain/massive, loose	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	10YR5/3 Dull yellowish brown Dull yellowish brown 5Y7/4 Light yellow	Dry Dry	Rapid Rapid	-	-	E4	Profile Cutting. Light grey/brown sands with Ironbark and Light grey/brown clayey sands with poplar box
79 De	407515 7602242	Grazing	Gentle undulating plain, Flat plain <0.5%	Reid River Box	Irregular/ crabhole gilgai present <2.0m wide	Cracking, no coarse fragments	0.0-0.10 Abrupt 0.10-0.30 Abrupt	Silty clay loam Silty clay loam	Weak structure Weak structure	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	10YR5/2 Greyish yellow brown 10YR5/2 Greyish yellow brown	Dry Dry	Imperfect Imperfect	Meter pH/EC 0-10cm 5.87 0.07 30-40cm 6.80 0.07 90-100cm 5.05 0.55	0-10 30-40 90-100	A2	Effective rooting depth of 10cm

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
					and <20cm deep Nil disturbance with the exception of recent back burning Nil Erosion		0.30-1.20	Light clay	Rough polyhedral peds	Nil Inclusions Nil Segregations	10YR4/1 Brownish grey	Dry	Imperfect				
80 Ob	408057 7602176	Grazing	Gentle undulating plain, Flat plain <0.5%	Reid River Box	Irregular/ crabhole gilgai present <2.0m wide and <20cm deep Nil disturbance with the exception of recent back burning Nil Erosion	Cracking, no coarse fragments	-	-	-	-	-	-	-	-	-	A2	Site similar to Site 79
81 Ob	408514 7602099	Grazing	Gentle undulating plain, Flat plain 0.0%	Ironbark, minor Bloodwood growth	Nil microrelief Nil disturbance with the exception of recent back burning Nil Erosion	Hard-setting, sandy and no coarse fragments	-	-	-	-	-	-	-	-	-		Red surface soils to the east
82 Ob	407014 7602633	Grazing	Gentle undulating plain, Lower slope 2.0%	Yellow jack	Nil microrelief Nil disturbance Nil Erosion	-	-	-	-	-	-	-	-	-	-		Boundary, red surface soils and grey surface soils.
83 De	407077 7606510	Grazing	Gentle undulating plain, Ridge, scarp	Lancewood, bloodwood	Nil microrelief Nil disturbance Minor overland flow	Laterite rock and skeletal soils	0.0-3.00	Laterite rock	Hard	-	-	-	-	-	-	U2(a)	Major 3m cutting visible, entirely laterite / rigid. Site similar to Site 84

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
84 De	407249 7606808	Grazing	Gentle undulating plain, Ridge, scarp	Lancewood, bloodwood	Nil microrelief Nil disturbance Minor overland flow	Laterite rock and skeletal soils	0-0.1 Clear 0.1-3.00	Silty loam Laterite rock	Single grain Hard	Nil -	10YR5/2 Greyish yellow brown	D D	R -	-	-	Bound ary of U1 and U2(a)	Very deep, wide rocky drainage line /cliff cutting, U2(a) surrounding
85 Ob	407073 7599383	Grazing	Gentle undulating plain, mid slope <1.0%	Silverleaf Ironbark, Yellow jack	Nil microrelief Nil disturbance with the exception of recent back burning Nil Erosion	Firm, sandy, no coarse fragments	-	-	-	-	-	-	-	-	-	-	Red surface soils present
86 Ob	407193 7599329	Grazing	Gentle undulating plain, mid slope <1.0%	Yellow jack, Silver leaf Ironbark	-	-	-	-	-	-	-	-	-	-	-		Boundary
87 De	407407 7599205	Grazing	Gentle undulating plain, mid slope <1.0%	Silver leaf Ironbark	Nil microrelief Nil disturbance with the exception of recent back burning Nil Erosion	Firm, no coarse fragments	0.0-0.07 Abrupt 0.07-0.18 Abrupt 0.18-0.40 Abrupt 0.40-0.70	Loamy sand Loamy Sand Clay Loam Silty clay loam	Single grain, loose Single grain, loose Single grain, loose Weak/massive, very hard	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	10YR5/3 Dull yellowish brown 10YR4/3 Dull yellowish brown 10YR6/3 Dull yellow orange 10YR4/4 Brown	Dry Dry Dry Dry	Rapid Rapid Rapid Imperfect	Field pH(BaSO4) 5cm 6.0 15cm 6.5 30cm 6.5 80cm 8.0	-	E5	--
88 De	407752 7598752	Grazing	Gentle undulating plain, Flat plain <0.5%	Silver leaf Ironbark	Nil microrelief Nil disturbance with the exception of recent back burning Nil Erosion	Firm, no surface rock	0.0-0.10 Abrupt 0.10-0.20 Abrupt 0.20-0.50 Abrupt 0.50+	Loamy sand Loamy Sand Clay Loam Silty clay loam	Single grain, loose Single grain, loose Single grain, loose Weak/massive, very hard	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	10YR5/3 Dull yellowish brown 10YR4/3 Dull yellowish brown 10YR6/3 Dull yellow orange 10YR4/4 Brown	Dry Dry Dry Dry	Rapid Rapid Rapid Imperfect	-	-	E5	Site similar to Site 87
89 Ob	407817 7599209	Grazing	Gentle undulating plain, Flat plain <0.5%	Silver leaf Ironbark	Nil microrelief Nil disturbance with the	Firm, no surface rock	-	-	-	-	-	-	-	-	-		Site similar to Site 87

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
					exception of recent back burning Nil Erosion												
90 De	407592 7598314	Grazing	Gently undulating plain, flat plain 0%	Ironbark	Near Drillpad, area recently back burned	Firm, no rocks	0.0-0.70	Silty loam	Single grain	Nil Inclusions Nil Segregations	Red/brown	Dry	Rapid	Field pH(BaSO4) 5cm 6.5 50cm 7.0 80cm 7.0	-	E3	Cutting created from hole dug through drilling activities, Red surface boundary nearby
91 De	408325 7598261	Grazing	Gently undulating plain, flat plain 0%	Ironbark	Nil, area recently back burned	Firm, no rocks	0.0-0.15 Abrupt 0.15-1.10	Sandy loam Sandy loam	Single grain Single grain	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	10YR5/4 Dull yellowish brown 10YR5/6 Yellowish brown	Dry Dry	Rapid Rapid	Meter pH/EC 0-10cm 5.80 0.02 50-60cm 5.80 0.02 80-90cm 6.45 0.02	0-10 50-60 80-90	E4	Effective rooting depth 30cm
92 Ob	408737 7598053	Grazing	Gently undulating plain, mid slope <1%	Ironbark, Yellow Jack	Nil, area recently back burned	Firm, no rocks	-	-	-	-	-	-	-	-	-	-	Boundary, change of vegetation
93 Ob	409098 7597713	Grazing	Ridge	Ironbark		Firm, with laterite	-	-	-	-	-	-	-	-	-	U2(b)	
94 Ob	409221 7597467	Grazing	Gently undulating plain, upper slope 3%	Ironbark, Yellow Jack		Firm, with common laterite	-	-	-	-	-	-	-	-	-	U2(b)	
95 Ob	409366 7597151	Grazing	Gently undulating plain, lower slope <1%	Ironbark		Firm, no rocks	-	-	-	-	-	-	-	-	-	-	<50m laterite gully/drainage line
96 De	409747 7597159	Grazing	Gently undulating plain, crest	Lancewood		Shallow gravel, skeletal soils	0.0-0.30 Clear 0.30+	Loamy sand with gravel Skeletal silty loam with laterite	Single grain -	<80% <10mm gravel		Dry Dry	Imperfect -	-	-	U2(a)	
97 Ob	410564 7597171	Grazing	Gently undulating plain, mid slope <1%	Mixed Lancewood, Ironbark	Nil, area recently back burned	Shallow gravel, skeletal soils	-	-	-	-	-	-	-	-	-	U2(a) / U2(b)	
98 Ob	417087 7580558	Grazing	Flat plain <0.5%	Ironbark, Bloodwood, Yellow Jack	Nil	Soft, sandy, no course fragments, dry, red-brown	-	-	-	-	-	-	-	-	-	E1	

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
						surface											
99 Ob	417913 7580417	Grazing	Flat plain <0.5%	Ironbark, Bloodwood, Yellow Jack	Nil	-	-	-	-	-	-	-	-	-	-	-	Boundary between E1 and E2
100 Ob	418470 7580329	Grazing	Flat plain <0.5%	Ironbark, Bloodwood, Yellow Jack	Nil	-	-	-	-	-	-	-	-	-	-	E1	
101 Ob	419071 7580865	Grazing	Flat plain <0.5%	Ironbark, Bloodwood, Yellow Jack	Nil	Soft, sandy, no course fragments, dry,	-	-	-	-	-	-	-	-	-	E2	
102 Ob	419179 7581086	Grazing	Drainage line nearby	Flooded Coolabah	Nil	-	-	-	-	-	-	-	-	-	-	A1	
103 Ob	419214 7582275	Grazing	Flat Plain	Ghost Gum, Silver Leaved Ironbark	Nil	-	-	-	-	-	-	-	-	-	-	E2	
104 Ob	419609 7582677	Grazing	Gently undulating plain, flat plain 0%	Ghost Gum, Silver Leaved Ironbark	Nil	-	-	-	-	-	-	-	-	-	-	E2	
105 Ob	419302 7583097	Grazing	Gently undulating plain, flat plain 0%	Ironbark	Nil	-	-	-	-	-	-	-	-	-	-	E2	
106 Ob	419475 7583400	Grazing	Gently undulating plain, flat plain 0%	Ghost Gum, Silver Leaved Ironbark	Nil	-	-	-	-	-	-	-	-	-	-	E1	
107 Ob	420472 7583278	Grazing	Gently undulating plain, flat plain 0%	Ironbark	Nil	-	-	-	-	-	-	-	-	-	-	E2	
108 Ob	420383 7582789	Grazing	Gently undulating plain, flat plain 0%	Ironbark	Nil	-	-	-	-	-	-	-	-	-	-	E2	
109 Ob	422522 7582799	Grazing	Gently undulating plain, flat plain 0%	Ironbark, Bloodwood	Nil	-	-	-	-	-	-	-	-	-	-	E2	

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
110 Ob	422189 7582795	Grazing	Gently undulating plain, flat plain 0%	Ironbark, Bloodwood	Nil	-	-	-	-	-	-	-	-	-	-	E2	
111 Ob	421837 7582909	Grazing	Gently undulating plain, flat plain 0%	Ironbark, Bloodwood	Nil	-	-	-	-	-	-	-	-	-	-	E2	
112 Ob	418803 7583318	Grazing	Gently undulating plain, flat plain 0%	Ironbark, Wattle regrowth	Nil	-	-	-	-	-	-	-	-	-	-	E2	Possibly cleared 10+ years ago based on size of regrowth
113 Ob	418585 7583308	Grazing	Gently undulating plain, flat plain 0%	Ironbark, Wattle regrowth	Nil	-	-	-	-	-	-	-	-	-	-	E2	Possibly cleared 10+ years ago based on size of regrowth
114 Ob	418511 7583519	Grazing	Gently undulating plain, flat plain 0%	Ironbark, Bauhinia regrowth	Nil	-	-	-	-	-	-	-	-	-	-	E2	
115 Ob	418461 7583415	Grazing	Gently undulating plain, flat plain 0%	Ironbark, Bauhinia regrowth	Nil	-	-	-	-	-	-	-	-	-	-	E2	Approximate boundary - Interfingering soil types E1 and E2
116 Ob	418031 7583574	Grazing	Gently undulating plain, upper slope 0.5%	Ironbark, Ghost Gum, Bloodwood	Nil	-	-	-	-	-	-	-	-	-	-	E1 / E2	Approximate boundary - Interfingering soil types E1 and E2
117 Ob	418040 7583510	Grazing	Gently undulating plain, upper slope 0.5%	Ironbark, Ghost Gum, Bloodwood	Nil	-	-	-	-	-	-	-	-	-	-	E1	
118 Ob	417074 7583696	Grazing	Gently undulating plain, flat plain	Silver Leaved Ironbark	Nil, overland flow	-	-	-	-	-	-	-	-	-	-	-	Boundary of A1 and E2
119 De	416589 7583750	Grazing	Gently undulating plain, flat plain 0%	Silver Leaved Ironbark	Nearby road, <2m runoff flow	Soft, moist <10% gravels <20mm	0.0-0.10 Abrupt 0.10-0.40 Abrupt	Loamy sand Loamy sand	Single grain Single grain	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	-	Moist Dry	Rapid Rapid	-	-	A1	Cutting

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
							0.40-0.70	Loamy sand	Single grain	Nil Inclusions Nil Segregations		Dry	Rapid				
120 De	416639 7583741	Grazing	Drainage line	Blue Gum, Ironbark	Drainage line erosion	Soft, moist, sandy <5% gravels <20mm	0.0-0.80 Clear 0.80+	Loamy sand Parent material	Single grain -	Nil Inclusions Nil Segregations -	-	Moist 0- 20 Dry 20+	Rapid -	-	-	A1	Cutting
121 De	415640 7583364	Grazing	Gently undulating plain, flat plain 0%	Ironbark, Bloodwood, Yellow Jack	Nil, Drillpad nearby with excavation pit	Firm, moist <20% gravels <10mm, Red- brown in colour	0.0-0.10 Abrupt 0.10-1.80 Clear 1.80+	Loamy sand Loamy sand Parent material/Laterite base	Single grain Single grain -	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations -	10YR4/4 Brown 10YR5/6 Yellowish brown -	Moist 0- 20 Dry 20+	Rapid Rapid -	-	-	E1	
122 Ob	415566 7583351	Grazing	Gently undulating plain, flat plain 0%	Ironbark, Bloodwood	Nil	Firm/slightly soft, sandy, no rock	-	-	-	-	-	-	-	-	-	E1	
123 Ob	415016 7581098	Grazing	Gently undulating plain, mid slope 1.5%	Ironbark, Bloodwood, Yellow Jack	Nil, Drillpad nearby	Firm/slightly soft, sandy, no rock	-	-	-	-	-	-	-	-	-	E1	
124 Ob	415017 7581242	Grazing	Gently undulating plain, mid slope 1.5%	Ironbark, Bloodwood	Nil	Firm/slightly soft, sandy, no rock	-	-	-	-	-	-	-	-	-	E2	
125 Ob	414856 7581078	Grazing	Gently undulating plain, mid slope 1.5%	Ironbark, Bloodwood	Nil	Firm/slightly soft, sandy, no rock	-	-	-	-	-	-	-	-	-	E1	
126 Ob	415091 7581213	Grazing	Gently undulating plain, mid slope <1%	Ironbark, Bloodwood	Nil	Sandy, firm, no rock	-	-	-	-	-	-	-	-	-		Boundary of E1 and E2
127 Ob	415138 7581319	Grazing	Gently undulating plain, mid slope <1%	Ironbark, Bloodwood	Nil	Sandy, firm, no rock	-	-	-	-	-	-	-	-	-	-	Boundary, E1 east, E2 west
128 Ob	415220 7581428	Grazing	Gently undulating plain, mid slope <0.5%	Ironbark, Bloodwood	Nil	Sandy, firm, no rock	-	-	-	-	-	-	-	-	-	-	Boundary, E1 west, E2 west

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
129 Ob	415870 7582397	Grazing	Gently undulating plain, drainage depression	Ironbark, Bloodwood	Nil, cleared path, overland flow	Soft/firm, sandy, fluvial	-	-	-	-	-	-	-	-	-	A1	
130 Ob	415295 7583392	Grazing	Gently undulating plain, mid slope 2%	Bloodwood, Yellw Jack	Nil	Firm, sandy, no rocks, dry	-	-	-	-	-	-	-	-	-	-	Boundary of E1 and E2
131 Ob	415022 7583804	Grazing	Gently undulating plain, mid slope 2%	Bloodwood, Yellw Jack	Nil	Firm, sandy, no rocks, dry	-	-	-	-	-	-	-	-	-	-	Boundary of E1 and E2
132 De	411578 7588733	Grazing	Gently undulating plain, mid slope 4%	Lancewood regrowth	Drillpad nearby	90% gravels/ cobbles, 10% laterite outcrops	0.0-0.05 Abrupt 0.05-0.60 Abrupt 0.60+	Gravels/Boulders Sandy loam Laterite	Hard Massive Hard	As per surface <20% gravels -	10YR4/2 Greyish yellow brown 10YR8/8 Yellow orange Yellow orange Yellow orange 10YR8/8 Yellow orange Yellow orange Mottle 10YR4/4 Brown	Dry Dry Dry	Moderate Imperfect -	Meter pH/EC 0-10cm 5.19 0.02 40-50cm 6.16 0.02 60-70cm 6.11 0.02	5-10 40-50	U2(a)	Tree uprooted Effective rooting depth 60cm
133 Ob	411548 7588648	Grazing	Gently undulating plain, depression	Lancewood	Overland flow	-	-	-	-	-	-	-	-	-	-	U2(a)	
134 Ob	411586 7588574	Grazing	Scarp >40m height	Lancewood, Ironbark	Nil		-	-	-	-	-	-	-	-	-	U2(a)	
135 Ob	411752 7588889	Grazing	Flat plain	Lancewood	Nil	Firm, silty loam, <5% 5mm gravels	-	-	-	-	-	-	-	-	-		Boundary of U2(a) and E4
136 Ob	411983 7589011	Grazing	Flat plain	Wattle regrowth	Nil	Firm, silty loam, no rocks	-	-	-	-	-	-	-	-	-	E4	
137 Ob	412045 7589061	Grazing	Gently undulating plain, lower slope <0.5%	Wattle regrowth, Lancewood	Nil	Firm, skeletal soils, gravels <30% 2mm	-	-	-	-	-	-	-	-	-		Boundary of E4 and U2(a)

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
138 Ob	412139 7589127	Grazing	Gently undulating plain, ridge	Wattle regrowth, Lancewood	Nil	Hard skeletal soils with rock cover, <90% gravels/ cobbles	-	-	-	-	-	-	-	-	-	U2(a)	
139 Ob	412339 7589261	Grazing	Gently undulating plain, lower slope <2%	Ironbark, Bloodwood	Nil	Firm, silty loam	-	-	-	-	-	-	-	-	-		Boundary of U2(a) and E4
140 Ob	412610 7589361	Grazing	Gently undulating plain, lower slope <0.5%	Narrow Leaved Ironback	Nil	Soft, sandy	-	-	-	-	-	-	-	-	-	E4	
141 Ob	412699 7589414	Grazing	Gently undulating plain, depression	Narrow Leaved Ironback	Depression, drainage line	Soft, sandy	-	-	-	-	-	-	-	-	-	U2(b)	Boundary of U2(b) to North East
142 De	412748 7589542	Grazing	Gently undulating plain, mid slope <0.5%	Narrow Leaved Ironback		Sandy loam with gravels <20%	0.0-0.10 Sharp 0.10-0.20 Abrupt 0.20-0.80	Sandy loam Sandy loam Sandy clay loam	Massive Massive Massive	Nil Inclusions Nil Segregations 0.10-0.80m+ 5% rocks 10-20mm Nil Inclusions Nil Segregations	10YR4/4 Brown 10YR5/6 Yellowish brown 10YR5/6 Yellowish brown	Dry Dry Dry	Well Well Well	Meter pH/EC 0-10cm 5.13 0.03 30-40cm 6.45 0.02 70-80cm 6.84 0.05		U2(b)	No recovery at 80cm
143 Ob	413029 7589780	Grazing	Gently undulating plain, mid slope 2%	Yellow Jack, Bloodwood, Ironbark	Nil	Sandy loam, no rocks	-	-	-	-	-	-	-	-	-		Boundary of U2(b) and E3
144 Ob	413020 7590466	Grazing	Gently undulating plain, upper slope 12%	Yellow Jack, Bloodwood, Ironbark	Nil	Laterite and sandy loam	-	-	-	-	-	-	-	-	-	U2(b)	Minor areas of U2(a) nearby
145 Ob	413018 7590580	Grazing	Gently undulating plain, mid slope 8%	Ironbark	Nil	Sandy loam with gravels <80%	-	-	-	-	-	-	-	-	-	U2(b)	
146 Ob	413007 7590752	Grazing	Gently undulating plain, lower slope 2%	Ironbark	Nil	Sandy loam	-	-	-	-	-	-	-	-	-		Boundary of U2(b) and E4

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
147 De	407625 7599077	Grazing	Gently undulating plain, flat plan <0.5%	Silver Leaf Ironbark	Area recently back burned	Firm	0.0-0.10 Abrupt 0.10-0.30 Abrupt 0.30+	Loamy Sand Loamy Sand Silty loam	Single grain Single grain / massive Massive	Nil Inclusions Nil Segregations Rocks from 30cm, 10%, 10-20mm Nil Inclusions Nil Segregations	10YR5/2 Greyish yellow brown 10YR5/8 Yellowish brown 10YR5/4 Dull yellowish brown	Dry Dry Dry	Well Well Imperfect	-	-	E5	
148 De	407418 7599196	Grazing	Gently undulating plain, mid slope 1%	-	Area recently back burned, No microrelief No disturbance	Hard setting	A11 0.0-0.07 Clear A12 0.07-0.20 Abrupt A13 0.20-0.60 Abrupt A14 0.60-0.90	Loamy Sand Loamy Sand Silty Loam Silty clay loam	Single grain Single grain Single grain / massive Weak	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations Slight conspicuous bleach at 40-45cm Nil Inclusions Nil Segregations	10YR5/3 Dull yellowish brown 10YR4/1 Brownish grey 10YR6/3 Dull yellow orange 10YR4/4 Brown	Dry Dry Dry Dry	Rapid Rapid Rapid Imperfect	Meter pH/EC 0-7cm 5.87 0.15 30-40cm 5.80 0.05 70-80cm 7.34 0.16	0-7 30-40 70-80	E5	10m from site 87, returned to area with a crow bar to acquire sub soil samples for this soil type
149 De	412222 7590415	Grazing	Drainage line (dry)	Ironbark, Flooded Coolabah	Gully erosion	Soft, no rock	0.0-0.10 Abrupt 0.10-0.25 Abrupt 0.25-0.50 Abrupt 0.50-1.00+	Loamy sand Loamy sand Loamy sand Loamy course sand	Single grain Single grain Single grain Single grain	Roots Nil Inclusions Nil Segregations Fine gravels <50% Fine gravels <30%	7.5YR5/3 10YR5/4 Dull yellowish brown 10YR5/6 Yellowish brown 7.5YR5/6 Bright brown	Dry Dry Dry Dry	Rapid Rapid Rapid Rapid	-	-	A1	Drainage line cutting
150 Ob	412240 7590295	Grazing	Gently undulating plain, mid slope 20%	Ironbark	Drillpad nearby	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
151 Ob	412416 7590456	Grazing	Gently undulating plain, lower slope 1%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-		Approx boundary, interfering E4 west and E3 east
152 Ob	412487 7590599	Grazing	Drainage line	Flooded Coolabah	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	A1	Drainage line cutting, as per 149
153 Ob	412646 7590589	Grazing	Gently undulating plain, lower slope	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-		Approx boundary, interfering E4 east and E3 west

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
			<0.5%														
154 Ob	412771 7590684	Grazing	Gently undulating plain, drainage line	Ironbark, Flooded Coolabah	Nil	Firm, gravels <10% 10-100mm	-	-	-	-	-	-	-	-	-		Nearby boundaries, E3 west, E4 west, A1 north
155 Ob	412898 7590724	Grazing	Gently undulating plain, flat plain 0%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	Boundary, E4 east, very minor E3 west
156 De	413029 7590878	Grazing	Gently undulating plain, flat plain 0%	Ironbark	Nil	Firm, no rock	0-0.10 Clear	Sandy loam	Single grain, loose	Nil Inclusions Nil Segregations	10YR5/3 Dull yellowish brown	Dry	Rapid		-	E4	Tree Cutting
							0.1-1.00	Sandy loam	Single grain/loose	Nil Inclusions Nil Segregations	10YR5/4 Dull yellowish brown	Dry	Rapid				
157 Ob	412817 7590917	Grazing	Gently undulating plain, depression / drainage line	Ironbark, Coolabah	Gully erosion	Soft, gravels <10-30mm <5%	-	-	-	-	-	-	-	-	-	E4	
158 Ob	412703 7590953	Grazing	Gently undulating plain, ridge	Ironbark	Nil	Firm, gravels / cobbles <10-80mm <5%	-	-	-	-	-	-	-	-	-	E4	
159 Ob	412600 7591043	Grazing	Gently undulating plain, flat plain	Narrow Leaved Ironbark	Nil	Hard, gravels / cobbles <80%, 10-70mm	-	-	-	-	-	-	-	-	-	U2(b)	
160 Ob	412250 7591054	Grazing	Drainage line	Flooded Coolabah, Ironbark, Bloowood	Gully erosion	Soft, gravels <5%, 10-100mm	-	-	-	-	-	-	-	-	-	A1	
161 Ob	412210 7591010	Grazing	Gently undulating plain, mid slope 2%	Silver Leaved Ironbark	Nil	Firm, gravel / cobbles <80%, 10-70mm	-	-	-	-	-	-	-	-	-	E4	
162 Ob	412054 7590853	Grazing	Gently undulating plain, flat plain <0.5%	Silver Leaved Ironbark	Nil	Firm, no rocks	-	-	-	-	-	-	-	-	-		Boundary of U2(b) and E4
163	411937	Grazing	Scarp	Lancewood	Minor	Firm and	-	-	-	-	-	-	-	-	-		Boundary nearby of U2(a) and E4

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
Ob	7590789				erosion	laterite											
164 Ob	411864 7591022	Grazing	Gently undulating plain, mid slope 3%	Ironbark	Nil	Firm, no rocks	-	-	-	-	-	-	-	-	-		
165 Ob	411670 7590984	Grazing	Gently undulating plain, upper slope 2%	Ironbark, Lancewood	Nil	Firm, laterite outcrops	-	-	-	-	-	-	-	-	-		
166 Ob	411574 7590805	Grazing	Gently undulating plain, mid slope 2%	Ironbark, Lancewood	Nil	Firm, with 80% rocks	-	-	-	-	-	-	-	-	-		
167 De	411006 7590517	Grazing	Gently undulating plain, mid slope 2.5%	Ironbark	Nil	10-100mm rocks, 80% cover. Firm, dry	0.0-0.05 Abrupt 0.05-0.60 Abrupt 0.60+	Gravels/Boulders Sandy loam Laterite	Hard Massive Hard	As per surface <20% gravels -	10YR4/2 Greyish yellow brown 10YR8/8 Yellow orange 10YR3/8 Mottle 10YR4/4 Brown	Dry Dry Dry	Moderate Imperfect -	Field pH 5-5.5 @5cm 5-5.5 @40cm		U2(b)	
168 Ob	410764 7590319	Grazing	Gently undulating plain, lower slope 60%	Ironbark	Nil	Firm, with laterite	-	-	-	-	-	-	-	-	-	U2(a)	
169 Ob	410654 7590075	Grazing	undulating plain, mid slope 20%	Ironbark, Lancewood	Overland flow	Firm, with laterite	-	-	-	-	-	-	-	-	-	U2(b)	
170 Ob	410467 7589993	Grazing	undulating plain, mid slope 14%	Lancewood	Nil	Firm, with laterite	-	-	-	-	-	-	-	-	-	U2(a)	
171 Ob	410297 7589788	Grazing	undulating plain, mid slope 14%	Lancewood	Nil	Firm, with laterite	-	-	-	-	-	-	-	-	-	U2(a)	
172 Ob	410271 7589640	Grazing	Scarp, mid slope	Lancewood	Minor overland flow	Firm, with laterite	-	-	-	-	-	-	-	-	-	U2(a)	
173 Ob	410066 7589661	Grazing	undulating plain, mid slope 5%	Ironbark, Lancewood	Nil	Firm, with laterite	-	-	-	-	-	-	-	-	-		Boundary, E3 east, U2(a) west

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174 Ob	409858 7589540	Grazing	Gently undulating plain, upper slope 7.5%	Ironbark, Lancewood	Drillpad nearby	Firm, with laterite	-	-	-	-	-	-	-	-	-	U2(b)	
175 De	409951 7589452	Grazing	Gently undulating plain, mid slope 40%	Lancewood	Nil	Laterite	0-50+	Laterite	-	-	-	-	-	-	-	U2(a)	
176 Ob	413751 7592729	Grazing	Gently undulating plain, mid slope 10%	Ironbark, Bloodwood, Yellow Jack	Nil	Firm, with laterite	-	-	-	-	-	-	-	-	-	U2(b)	
177 Ob	413214 7592919	Grazing	depression	Ironbark, Yellow Jack	Gully erosion	Firm, with laterite	-	-	-	-	-	-	-	-	-	U2(b)	
178 Ob	413153 7592882	Grazing	Gently undulating plain, mid slope 3%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
179 Ob	412919 7592736	Grazing	Gently undulating plain, mid slope 4%	Lancewood	Nil	Firm, with laterite	-	-	-	-	-	-	-	-	-	U2(a)	
180 De	412726 7592592	Grazing	Gently undulating plain, lower slope 45%. 10m high scarp	Lancewood, minor Ironbark	Nil	Laterite	0-50+	Laterite	-	-	-	-	-	-	-	U2(a)	
181 Ob	412217 7592323	Grazing	Gently undulating plain, upper slope <2%	Ironbark	Some erosion	Soft, some occasional laterite/rock	-	-	-	-	-	-	-	-	-	-	Boundary, U2(b) north, E4 south
182 Ob	412010 7592238	Grazing	Gently undulating plain, mid slope <1%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
183 Ob	411736 7592036	Grazing	Drainage line	Ironbark, Flooded Coolabah	Gully erosion	Soft, no rock	-	-	-	-	-	-	-	-	-	A1	
184	411568	Grazing	Gently	Ironbark,	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
Ob	7591824		undulating plain, upper slope 1%	Yellow Jack													
185 Ob	411255 7591577	Grazing	Gently undulating plain, mid slope <3%	Ironbark	Nil	Laterite	-	-	-	-	-	-	-	-	-	U2(a)	E4 boundary nearby
186 Ob	411034 7591362	Grazing	Gently undulating plain, ridge	Lancewood	Nil	Firm, with rocks and laterite	-	-	-	-	-	-	-	-	-	U2(a)	
187 De	410839 7591195	Grazing	Gently undulating plain, washout, 2%	Lancewood	Erosion	Firm, 30% rocks 10- 100mm	0.0-0.05 Abrupt	Loamy sand	Single grain	Nil Inclusions Nil Segregations	10YR5/2 Greyish yellow brown	Dry	Well	-	-	-	Boundary nearby for U2(a) and U2(b)
							0.05-0.50 Abrupt	Sandy loam	Single grain / massive	Some rocks from 30cm, <5%, 10- 20mm	10YR5/8 Yellowish brown	Dry	Well				
							0.50+	Silty loam	Massive	Nil Inclusions Nil Segregations	10YR5/4 Dull yellowish brown	Dry	Imperfect				
188 Ob	410466 7591055	Grazing	Gently undulating plain, mid slope 1%	Yellow Jack, Ironbark	Nil	Firm, rocks <5%	-	-	-	-	-	-	-	-	-	U2(b)	U1 drainage line to the south
189 Ob	410165 7590760	Grazing	Gently undulating plain, mid slope 3%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
190 Ob	409873 7590508	Grazing	Gently undulating plain, Drainage line	Yellow Jack, Ironbark	Gully erosion	Laterite	-	-	-	-	-	-	-	-	-	U1	
191 De	409728 7590456	Grazing	Gently undulating plain, mid slope <2%	Yellow Jack, Ironbark	Nil – drill pad nearby	Soft, no rock	0.0-0.10 Abrupt	Loamy sand	Single grain	Nil Inclusions Nil Segregations	10YR5/4 Dull yellowish brown	Dry	Rapid	-	-	E2	
							0.10-1.20	Loamy sand	Single grain	Nil Inclusions Nil Segregations	10YR5/6 Yellowish brown	Dry	Rapid				
192 De	411681 7591617	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	0.0-0.10 Abrupt	Sandy loam	Single grain	Nil Inclusions Nil Segregations	10YR4/3 Dull yellowish brown	Dry	Rapid	-	-	E4	
							0.10-1.10	Sandy loam	Single grain	Nil Inclusions Nil Segregations	10YR5/4 Dull yellowish brown	Dry	Rapid				

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193 Ob	411972 7591378	Grazing	Gently undulating plain, mid slope 1%	Ghost Gum, Ironbark	Nil	Soft, no rock											
194 De	412006 7591305	Grazing	Gently undulating plain, flat plain 0%	Ironbark	Drillpad nearby	Soft, no rock	0.0-0.20 Abrupt 0.20-2.50+	Loamy Sand Loamy Sand	Single grain Single grain	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	Red	Dry Dry	Rapid Rapid	-	-	E1	Exposed backhoe dug hole
195 De	408755 7594383	Grazing	Drainage line	Ironbark, Flooded Coolabah	Gully erosion, recently back burned	Firm, no rocks	0.0-0.05 Abrupt 0.05-1.10+	Silty loam Silty loam	Single grain Single grain	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	10YR5/2 Greyish yellow brown 10YR5/8 Yellowish brown	Dry Dry	Rapid Rapid	-	-	U1	Boundary to E4
196 De	408754 7594382	Grazing	Drainage line	Ironbark, Flooded Coolabah	Gully erosion, recently back burned	Firm, 5% gravel	0.0-0.05 Abrupt 0.05-1.10+	Silty loam Silty loam	Single grain Single grain	Nil Inclusions Nil Segregations Nil Inclusions Nil Segregations	Red/brown	Dry Dry	Rapid Rapid	-	-	U1	Cutting observed on drainage line bank, drainage line floor on laterite, nearby E4 boundary
197 Ob	408969 7594306	Grazing	Gently undulating plain, mid slope 3%	Ironbark	Nil, area recently back burned	Firm, no rocks		Surface loamy sand	-	-	-	-	-	-	-	E3	
198 Ob	409058 7594181	Grazing	Gently undulating plain, flat plain 0%	Bloodwood, Ironbark	Nil, area recently back burned	Firm, no rocks	-	Surface loamy sand	-	-	-	-	-	-	-	E3	
199 Ob	409096 7594058	Grazing	Gently undulating plain, mid slope 40%	Bloodwood, Ironbark	Nil	Firm, no rocks	-	Surface loamy sand	-	-	-	-	-	-	-	E3	
200 Ob	409678 7594195	Grazing	Gently undulating plain, flat plain 0.5%	Bloodwood, Ironbark	Nil, area recently back burned	Firm, no rocks	-	Surface loamy sand	-	-	-	-	-	-	-	-	Approximate boundary, interfingering soil types E3 and E4
201 Ob	409640 7594359	Grazing	Gently undulating plain, flat plain 0.5%	Bloodwood, Ironbark	Nil, area recently back burned	Firm, no rock	-	Surface loamy sand	-	-	-	-	-	-	-	E4	
202 Ob	409806 7594127	Grazing	Scarp, undulating plain 50% slope	Lancewood	Nil	Firm, with laterite	-	-	-	-	-	-	-	-	-	U2(a)	

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203 Ob	410177 7594149	Grazing	Scarp, undulating plain 45% slope	Lancewood	Nil	Firm, with laterite	-	-	-	-	-	-	-	-	-	U2(a)	
204 Ob	410100 7594263	Grazing	Gently undulating plain, mid slope 2%	Ironbark	Nil, area recently back burned	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
205 Ob	410378 7594383	Grazing	Gently undulating plain, mid slope 2.5%	Ironbark	Nil, area recently back burned	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
206 Ob	410490 7594447	Grazing	Gently undulating plain, mid slope 2%	Ironbark	Nil	Firm, <80% gravel / cobble cover	-	-	-	-	-	-	-	-	-	-	Boundary of E4 and U2(b)
207 Ob	410484 7594373	Grazing	Scarp, undulating plain	Lancewood	Nil	Firm, with laterite	-	-	-	-	-	-	-	-	-	U2(a)	
208 Ob	411153 7595130	Grazing	Gently undulating plain	Ironbark, minor Coolabah	Nil, area recently backburned	Firm, no rock	-	Surface sandy loam	-	-	-	-	-	-	-	E4	
209 Ob	413809 7592468	Grazing	Gently undulating plain, flat plan 0%	Ironbark, Ghost Gum	Nil	Firm, some minor rock / laterite	-	-	-	-	-	-	-	-	-	E4	
210 Ob	413675 7592302	Grazing	Gently undulating plain, flat plan 0%	Ironbark	Nil	Firm, no rock	-	Surface sandy loam	-	-	-	-	-	-	-	E4	
211 Ob	413706 7592127	Grazing	Gently undulating plain, flat plan 0%	Ironbark	Nil	Firm, no rock	-	Surface sandy loam	-	-	-	-	-	-	-	E4	
212 Ob	413510 7592149	Grazing	Gently undulating plain, lower slope 8%	Ironbark	Nil	Firm, with areas of laterite	-	-	-	-	-	-	-	-	-	U2(b)	Drainage line to east approx. 20m
213 Ob	413236 7592022	Grazing	Gently undulating plain, mid	Silver Leaved Ironbark	Nil	Firm, with areas of laterite	-	-	-	-	-	-	-	-	-	U2(b)	

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			slope 4%														
214 Ob	413113 7591945	Grazing	Gently undulating plain, upper slope 2%	Ironbark, Wattle regrowth	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-		Boundary of U2(b) and E3
215 Ob	412892 7591715	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-		Interfingering boundary of E3 and E4
216 Ob	413569 7590158	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	
217 Ob	413811 7590359	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	Surface silty loam	-	-	-	-	-	-	-	E3	
218 Ob	414130 7590602	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	Surface sandy loam	-	-	-	-	-	-	-	E3	
219 Ob	414513 7590881	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	Surface sandy loam	-	-	-	-	-	-	-	E3	
220 Ob	414925 7591161	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	Surface sandy loam	-	-	-	-	-	-	-	E3	
221 Ob	415384 7591539	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	Sandy loam	-	-	-	-	-	-	-	E4	
222 Ob	415610 7591738	Grazing	Drainage line	Flooded Coolabah, Ironbark	Gully erosion	Soft, no rock, surface poached (wet)	-	Loamy sand surface	-	-	-	-	-	-	-	A1	

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223 Ob	415758 7591586	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil – Area may have been historically cleared	Firm, no rock	-	Sandy loam	-	-	-	-	-	-	-	E4	
224 Ob	416034 7591998	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	Sandy loam	-	-	-	-	-	-	-	E4	
225 Ob	416097 7592547	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	Sandy / Silty loam	-	-	-	-	-	-	-	E4	
226 Ob	415579 7592622	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark, minor Ghost Gum	Nil	Soft, no rock	-	Loamy Sand	-	-	-	-	-	-	-	E2	Boundary change approximately 100m to the east - E2 west, E4 east.
227 Ob	414261 7589486	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark, Yellow Jack	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	
228 Ob	414332 7589199	Grazing	Gently undulating plain, lower slope 2%	Ironbark, Yellow Jack	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-		Approx boundary, interfingering of soil types E3 and E4
229 Ob	414635 7587946	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark, Yellow Jack	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	
230 Ob	414660 7587711	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark, Yellow Jack	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	
231 Ob	414776 7587603	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark, Yellow Jack	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	

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232 Ob	414697 7587142	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark, Wattle	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	
233 Ob	414810 7586551	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark, Wattle	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	
234 Ob	414827 7588812	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
235 Ob	415166 7588790	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
236 Ob	415512 7588764	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
237 Ob	415824 7588735	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
238 Ob	416277 7588816	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Minor gully erosion, <2m wide <0.3m deep	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
239 Ob	414049 7583959	Grazing	Drainage line cutting	Silver Leaved Ironbark	Gully erosion	Soft, no rock	-	-	-	-	-	-	-	-	-	A1	
240 Ob	414085 7583717	Grazing	Drainage line cutting	Silver Leaved Ironbark	Gully erosion	Soft, no rock	-	-	-	-	-	-	-	-	-	A1	
241 Ob	414061 7583431	Grazing	Gently undulating plain, flat	Ironbark	Nil	Soft, no rock	-	-	-	-	-	-	-	-	-	E2	

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			plain <0.5%														
242 Ob	414096 7583363	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Soft, no rock	-	-	-	-	-	-	-	-	-	E2	
243 Ob	414086 7583078	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, occasional laterite	-	-	-	-	-	-	-	-	-	U2(b)	
244 Ob	414167 7582898	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, occasional laterite	-	-	-	-	-	-	-	-	-	U2(b)	
245 Ob	414126 7582794	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, occasional laterite	-	-	-	-	-	-	-	-	-	U2(b)	
246 Ob	414397 7582804	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, occasional laterite	-	-	-	-	-	-	-	-	-	U2(b)	
247 Ob	414551 7582691	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Soft, no rock, slightly red in colour	-	-	-	-	-	-	-	-	-	E1	
248 Ob	414649 7582525	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Soft, no rock, slightly red in colour	-	-	-	-	-	-	-	-	-	E1	
249 Ob	415619 7588621	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	Boundary between E3 and E4
250 Ob	415541 7588420	Grazing	Gently undulating	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
			plain, flat plain <0.5%														
251 Ob	415575 7588235	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	
252 Ob	415625 7588143	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	
253 Ob	415695 7587993	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	
254 Ob	415742 7587939	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	
255 Ob	415817 7587816	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	
256 Ob	415661 7587702	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	
257 Ob	415393 7587514	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	
258 Ob	415046 7587257	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	
259	414077	Grazing	Gently	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
Ob	7587457		undulating plain, flat plain <0.5%														
260 Ob	414462 7587499	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	
261 Ob	415154 7586925	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	
262 Ob	414894 7586715	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	
263 Ob	414364 7586400	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
264 Ob	415695 7586186	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	
265 Ob	415221 7585947	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
266 Ob	415230 7585511	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	
267 Ob	415218 7585188	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
268 Ob	414156 7584942	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	
269 Ob	414663 7584936	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	
270 Ob	414871 7584895	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	
271 De	422546 7591605	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark and 20% mixed vegetation	Nil	Firm, no rock	0-0.6 Abrupt 0.6-1.00+	Sandy loam Sandy loam	Single grain Single grain/ massive	Nil Nil	10YR6/4 Light yellowish brown No mottles 10YR6/4 Light yellowish brown No mottles	Dry Dry	Rapid Rapid	Meter pH/EC 0-10cm 6.75 0.05 30-40cm 6.88 0.02 60-70cm 6.40 0.01 90-100cm 6.46 0.02	-	E4	
272 Ob	422168 7591283	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
273 Ob	422368 7591468	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
274 Ob	421914 7591036	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark, <70% vegetation cover	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
275 Ob	421576 7590772	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark, <70% vege cover	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
276 Ob	421309 7590544	Grazing	Gently undulating plain, flat plain	Narrow Leaved Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
			<0.5%														
277 Ob	420987 7590247	Grazing	Gently undulating plain, flat plain <0.5% to the east, drainage line to the west	Ironbark, flooded coolabah	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	-	Boundary, E4 to the east, A1 to the west
278 De	420952 7590235	Grazing	Drainage line	Ironbark, flooded coolabah	Drainage line erosion	Soft, no rock, dry	A11 0.0-20 Abrupt A12 0.20-0.60 Abrupt A13 0.60-0.80 Abrupt A14 0.80-0.90	Loamy sand Loamy sand Loamy sand Loamy sand	Single grain, loose Single grain, loose Single grain, loose Single grain, loose	Nil Nil Nil Nil	7.5YR5/1 Brownish grey 10YR6/2 Greyish yellow brown 10YR7/2 Dull yellow orange 7.5YR8/2 Light grey	Dry Dry Dry Dry	Rapid Rapid Rapid Rapid	Field pH 10cm 6.5 30cm 6.5 60cm 6.5 90cm 6.5	-	A1	
279 Ob	420823 7590109	Grazing	Drainage line	Ironbark	Drainage line erosion	Soft, no rock, dry	-	-	-	-	-	-	-	-	-	A1	
280 Ob	420672 7589998	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark and 20% mixed vege	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
281 Ob	420599 7589935	Grazing	Shallow drainage line	Ironbark	Minor erosion	Soft, no rock, dry	-	-	-	-	-	-	-	-	-	A1	
282 Ob	420062 7589478	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark and 20% mixed vege	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
283 De	419949 7589290	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark and 90% buffel grass cover	Nil	Firm, no rock	0-0.1 Abrupt 0.1-0.65 Abrupt 0.65-0.85	Sandy loam Sandy loam Sandy loam	Single grain Single grain Single grain	Nil Nil Nil	10YR6/3 Pale brown 10YR5/4 Dark greyish brown 10YR6/4 Light yellowish brown	Dry Dry Dry	Rapid Rapid Well drained	Field pH 7 @ 10cm 7 @ 30cm 7 @ 60cm	-	E4	

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
284 Ob	419594 7589074	Grazing	Gently undulating plain, flat plain <0.5%	Ironbark and 90% buffel grass cover	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
285 De	419352 7588393	Grazing	Gently undulating plain, mid slope <1%	Ironbark and 90% buffel grass cover	Nil	Firm/hard setting, no rock	0-0.10 Sharp 0.10-0.55 Abrupt 0.55-1.00	Sandy loam Sandy loam Sandy loam	Single grain Single grain Single grain / massive	Nil Nil <5% minor gravels	10YR6/4 Light yellowish brown No mottles 10YR6/4 Light yellowish brown No mottles 10YR5/6 Yellowish brown <5% mottle 10YR7/1	Dry Dry Dry	Rapid Rapid Well drained	Field pH 7 @ 10cm 7 @ 30cm 7 @ 60cm 7 @ 90cm	-	E4	
286 Ob	419411 7588304	Grazing	Gently undulating plain, mid slope <1%	Ironbark and 90% buffel grass cover	Nil	Firm/hard setting, no rock	-	-	-	-	-	-	-	-	-	E4	
287 Ob	419588 7588012	Grazing	Gently undulating plain, mid slope <1%	Ironbark and 90% buffel grass cover	Nil	Firm/hard setting, no rock	-	-	-	-	-	-	-	-	-	E4	
288 Ob	419888 7587524	Grazing	Gently undulating plain, mid slope <1%	Ironbark and 90% buffel grass cover	Nil	Firm/hard setting, no rock	-	-	-	-	-	-	-	-	-	E4	
289 Ob	420115 7587154	Grazing	Gently undulating plain, mid slope <1%	Ironbark and 90% buffel grass cover	Nil	Firm/hard setting, no rock	-	-	-	-	-	-	-	-	-	E4	
290 Ob	420425 7586701	Grazing	Gently undulating plain, mid slope <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	-	Boundary of E3 and E4
291 Ob	420573 7586588	Grazing	Gently undulating plain, mid slope <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
292 Ob	420759 7586110	Grazing	Gently undulating plain, mid	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
			slope <0.5%														
293 Ob	421220 7585358	Grazing	Gently undulating plain, mid slope <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
294 De	422549 7584877	Grazing	Gently undulating plain, mid slope <0.5%	Narrow leaf Ironbark	Nil	Soft, no rock	0-0.3 Abrupt 0.3-0.8 Clear 0.8-1 Abrupt 1-1.1	Loamy sand Loamy sand Loamy sand Sandy loam	Single grain Single grain / massive Single grain / massive Massive	Nil Nil Nil 5% gravel	10YR5/2 Greyish brown 10YR5/3 Brown 10YR5/4 Dark greyish brown 10YR5/4 Dark greyish brown	Dry Dry Dry Dry	Rapid Rapid Rapid Rapid	Meter pH/EC 0-10cm 6.11 0.04 30-40cm 6.16 0.03 60-70cm 5.30 0.16 90-100cm 7.42 0.11 100-110cm 6.02 0.02	0-0.1 0.3-0.4 0.6-0.7 0.9-1 1-1.1	E2	No recovery at 1.1m
295 Ob	422119 7584515	Grazing	Gently undulating plain, mid slope <0.5%	Narrow leaf Ironbark	Nil	Soft, no rock	-	-	-	-	-	-	-	-	-	E2	
296 Ob	421828 7584806	Grazing	Gently undulating plain, mid slope <0.5%	Narrow leaf Ironbark	Nil	Soft, no rock	-	-	-	-	-	-	-	-	-	E2	
297 Ob	421465 7584973	Grazing	Gently undulating plain, mid slope <0.5%	Narrow leaf Ironbark	Nil	Soft, no rock	-	-	-	-	-	-	-	-	-	E2	
298 Ob	421312 7584683	Grazing	Gently undulating plain, mid slope <0.5%	Narrow leaf Ironbark	Nil	Soft, no rock	-	-	-	-	-	-	-	-	-	E2	
299 Ob	421429 7584444	Grazing	Gently undulating plain, mid slope <0.5%	Narrow leaf Ironbark	Nil	Soft, no rock	-	-	-	-	-	-	-	-	-	E2	
300 Ob	420907 7584221	Grazing	Gently undulating	Narrow leaf Ironbark	Nil	Soft, no rock	-	-	-	-	-	-	-	-	-	E2	

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
			plain, mid slope <0.5%														
301 De	417102 7587474	Grazing	Rocky outcrop	Ironbark	Nil	Laterite 60%+ cover	0-1m	Laterite	-	-	-	-	-	-	-	U2(a)	Narrow outcrop acting as boundary between E3 and A1sv
302 De	417240 7587547	Grazing	Washout, 1m deep, laterite at 1m depth	Ironbark	Gully erosion	Dry, hard setting, mixed gravels 10- 20mm <30%	0-0.25 Sharp 0.25-0.7 Abrupt 0.70+	Sandy loam Sandy clay loam Sandy clay loam	Single grain / massive Single grain / massive Single grain / massive	Nil Nil Nil	10YR7/2 Light grey 10YR7/2 Light grey 10% mottle 10YR6/6 10YR7/2 Light grey 10% mottle 10YR6/6	Dry Dry Dry	Rapid Rapid Rapid	Meter pH/EC 0-10cm 5.13 0.06 30-40cm 5.45 1.52 60-70cm 5.84 2.20	0-0.1 0.3-0.4	A1sv	Highly saline below 0.3m depth
303 Ob	417127 7587677	Grazing	Gently undulating plain, mid slope 2%	Ironbark	Nil	Soft-firm, no rock	-	-	-	-	-	-	-	-	-	E4	
304 Ob	417176 7587989	Grazing	Washout, 1m deep, laterite at 1m depth	Ironbark	Gully erosion	Dry, hard setting, mixed gravels 10- 20mm <30%	-	-	-	-	-	-	-	-	-	A1sv	
305 De	417826 7592946	Grazing	Gently undulating plain, mid slope 2%	Ironbark	Nil	Firm, no rock	0-0.15 Abrupt 0.15-0.55 Abrupt 0.55-1.00	Sandy loam Sandy loam Sandy loam	Single grain Single grain Single grain / massive	Nil Nil Nil	10YR5/2 Greyish brown 10YR5/6 Yellowish brown 10YR6/6 Dark yellowish orange	Dry Dry Dry	Rapid Rapid Rapid	Meter pH/EC 0-10cm 5.87 0.03 30-40cm 5.80 0.02 60-70cm 7.05 0.04	0-0.1 0.3-0.4 0.6-0.7	E4	
306 Ob	417756 7592428	Grazing	Drainage line	Flooded Coolabah	Nil	Soft, no rock	-	-	-	-	-	-	-	-	-	A1	
307 Ob	417348 7592778	Grazing	Drainage line	Flooded Coolabah, Ironbark	Nil	Soft, no rock	-	-	-	-	-	-	-	-	-	A1	
308 Ob	418379 7592175	Grazing	Drainage line	Flooded Coolabah, Ironbark	Nil	Soft, no rock	-	-	-	-	-	-	-	-	-	A1	
309 Ob	417733 7592282	Grazing	Gently undulating plain, mid	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
			slope 2%														
310 Ob	417584 7592077	Grazing	Gently undulating plain, mid slope 2%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
311 Ob	417280 417280	Grazing		Flooded Coolabah in large numbers to the south	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
312 De	416815 7591460	Grazing	Gently undulating plain, mid slope <1%	Ironbark	Nil	Firm, no rock	0-0.13 Abrupt 0.13-0.30 Clear 0.3-1.00	Sandy loam Sandy loam Sandy loam	Single grain Single grain Single grain / massive	Nil Nil Nil	10YR5/2 Greyish brown 10YR5/3 Brown 10YR4/3 Brown	Dry Dry Dry	Rapid Rapid Rapid	Field pH 7 @ 10cm 7 @ 30cm 7 @ 60cm 7 @ 90cm	-	E4	
313 Ob	417146 7590959	Grazing	Flat plain, <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
314 Ob	417510 7590587	Grazing	Flat plain, <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
315 Ob	417234 7590434	Grazing	Flat plain, <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
316 Ob	417964 7590523	Grazing	Flat plain, <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
317 De	417428 7590175	Grazing	Wide depression , lower slope, gently undulating plain, broad overland flow, 0% slope	Ironbark	Nil	Firm, no rock	0-0.20 Clear 0.20-0.40	Sandy Loam Sandy Loam	Single grain / massive Single grain / massive	Nil Nil	10YR5/2 Greyish brown 10YR5/4 Dark greyish brown	Dry Dry	Rapid Rapid	-	-	E4	No recovery at 0.4m
318 Ob	417685 7590098	Grazing	Wide depression , lower slope, gently undulating plain, broad	Ironbark	Nil	Firm, no rock	-	Surface sandy loam	-	-	-	-	-	-	-	E4	

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
			overland flow, 0% slope														
319 Ob	417138 7589877	Grazing	Gently undulating plain, Flat plain, <0.5%	Ironbark	Nil	Firm, no rock	-	Surface sandy loam	-	-	-	-	-	-	-	E4	
320 Ob	417413 7589847	Grazing	Gently undulating plain, Flat plain, <0.5%	Ironbark	Nil	Firm, no rock	-	Surface silty loam	-	-	-	-	-	-	-	E4	
321 Ob	417599 7589775	Grazing	Gently undulating plain, Flat plain, <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
322 Ob	417372 7589536	Grazing	Gently undulating plain, Flat plain, <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
323 Ob	417137 7589629	Grazing	Gently undulating plain, Flat plain, <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
324 Ob	417585 7589527	Grazing	Gently undulating plain, Flat plain, <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
325 Ob	417328 7589225	Grazing	Gently undulating plain, Flat plain, <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
326 Ob	417213 7588322	Grazing	Gently undulating plain, Flat plain, <0.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	A1sv nearby to the north
327	417096	Grazing	Rocky	Ironbark	Nil	Laterite 60%+	0-1m	Laterite	-	-	-	-	-	-	-	U2(b)	

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
Ob	7588094		outcrop, <25m wide			cover											
328 Ob	417049 7587115	Grazing	Gently undulating plain, mid slope 2%	Ironbark	Gully erosion	Dry, hard setting, mixed gravels 10- 20mm <30%	0-0.25 Sharp 0.25-0.7	Silty loam Silty loam	Single grain / massive Single grain / massive	Nil Nil	10YR7/2 Light grey 10YR7/2 Light grey 10% mottle 10YR6/6 Brownish yellow	Dry Dry	Rapid Rapid	-	0-0.1 0.3-0.4	A1sv	
329 Ob	417028 7586925	Grazing	Gently undulating plain, mid slope 1%	Ironbark, Yellow Jack	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	
330 Ob	417020 7586855	Grazing	Gently undulating plain, mid slope 1%	Ironbark, Yellow Jack	Nil	Firm, no rock	-	Surface loamy sand	-	-	-	-	-	-	-	E3	
331 Ob	416995 7586725	Grazing	Gently undulating plain, mid slope 2%	Ironbark, Yellow Jack	Nil	Firm, no rock	-	Surface loamy sand	-	-	-	-	-	-	-	E3	
332 Ob	416977 7586546	Grazing	Gently undulating plain, mid slope 2%	Ironbark, Yellow Jack	Nil	Firm, no rock	-	Surface loamy sand	-	-	-	-	-	-	-	E3	
333 Ob	416835 7586502	Grazing	Gently undulating plain, mid slope 2%	Ironbark, Yellow Jack	Nil	Firm, no rock	-	Surface loamy sand	-	-	-	-	-	-	-	E3	
334 Ob	416951 7586437	Grazing	Gently undulating plain, mid slope 2%	Ironbark, Yellow Jack	Nil	Firm, no rock	-	Surface loamy sand	-	-	-	-	-	-	-	E3	
335 Ob	417079 7586414	Grazing	Gently undulating plain, mid slope 2%	Ironbark, Yellow Jack	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	
336 Ob	416787 7586206	Grazing	Gently undulating plain, mid slope 2%	Ironbark, Yellow Jack	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
337 Ob	416992 7586085	Grazing	Gently undulating plain, mid slope 2%	Ironbark, Yellow Jack	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E3	
338 De	416907 7585937	Grazing	Gently undulating plain, mid slope 2%	Ironbark, Yellow Jack	Nil	Firm, no rock	0-0.2 Abrupt 0.2-1	Sandy loam Silty Loam	Single grain Single grain	Nil Nil	2.5YR4/3 Reddish brown 2.5YR4/6 Red	Dry Dry	Rapid Rapid	-	-	E3	
339 De	416851 7585645	Grazing	Gently undulating plain, mid slope 2%	Ironbark, Yellow Jack	Nil	Firm, no rock	0-0.25 Abrupt 0.25-1	Sandy loam Silty Loam	Single grain Single grain	Nil Nil	2.5YR4/3 Reddish brown 2.5YR4/6 Red	Dry Dry	Rapid Rapid	-	-	E3	
340 Ob	416700 7585570	Grazing	Gently undulating plain, mid slope 2%	Ironbark	Nil	Firm, no rock	-	Surface loamy sand	-	-	-	-	-	-	-	E3	
341 Ob	416927 7585424	Grazing	Gently undulating plain, mid slope 2%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	-	Boundary of E3 and E4
342 Ob	416805 7585266	Grazing	Gently undulating plain, mid slope 2%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
343 Ob	416764 7584994	Grazing	Gently undulating plain, mid slope <1.5%	Ironbark	Nil	Firm, no rock	-	Surface silty loam	-	-	-	-	-	-	-	E4	
344 Ob	416722 7584723	Grazing	Gently undulating plain, mid slope <1.5%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
345 Ob	416682 7584340	Grazing	Gently undulating plain, flat plain 0%	Ironbark	Nil	Firm, no rock	-	Surface silty loam	-	-	-	-	-	-	-	E4	
346 Ob	416570 7584119	Grazing	Gently undulating plain, mid slope <1%	Ironbark	Nil	Firm, no rock	-	Surface silty loam	-	-	-	-	-	-	-	E4	
347	416738	Grazing	Gently	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
Ob	7584061		undulating plain, mid slope <2%														
348 Ob	416642 7583992	Grazing	Gently undulating plain, mid slope <1%	Ironbark	Nil	Soft, no rock	-	-	-	-	-	-	-	-	-	E2	
349 De	417978 7583698	Grazing	Washout, 1m deep, laterite at 1m depth	Ironbark	Overland erosion	Dry, hard setting, mixed gravels 10- 20mm <30%	0-0.15 Sharp 0.15-0.7	Silty loam Loamy Sand	Single grain / massive Single grain / massive	Nil Nil	10YR7/2 Light grey 10YR7/2 Light grey 10% mottle 10YR6/6 Brownish yellow	Dry Dry	Rapid Rapid	-	0-0.1 0.3-0.4	A1sv	
350 Ob	418012 7583753	Grazing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Boundary of A1sv and U2(a)
351 Ob	418049 7583846	Grazing	-	Lancewood	Nil	Laterite 90% cover	-	-	-	-	-	-	-	-	-	U2(a)	
352 Ob	418392 7583763	Grazing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Boundary of A1sv (west) and E2 (east)
353 Ob	417889 7583812	Grazing	Gently undulating plain, mid slope <2%	-	-	-	-	-	-	-	-	-	-	-	-	-	Boundary of A1sv (east) and E2 (west)
354 Ob	417731 7588806	Grazing	-	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
355 Ob	418090 7588719	Grazing	-	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
356 Ob	418427 7588643	Grazing	-	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
357 Ob	418753 7588594	Grazing	-	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
358 Ob	419018 7588519	Grazing	-	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
359 Ob	416840 7590791	Grazing	Gently undulating plain, mid slope <1%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
360	416702	Grazing	Gently	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	

Site No. / Type (De detailed, Ob – Observation)	Location E/N (GDA94 Zone 55)	Land Use	Landform, pattern, element, slope	Natural Vegetation	Microrelief, Disturbance, Erosion	Surface condition, surface rock	Horizon (m) / Boundary	Texture	Structure	Inclusions / Segregations	Colour / Mottle	Moisture	Drainage	Depth (cm) Field pH / Meter pH / Meter EC (dS/m)	Samples	Soil Type Ref/SMU	Observations
Ob	7590581		undulating plain, mid slope <1%														
361 Ob	416638 7590218	Grazing	Gently undulating plain, mid slope <1%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
362 Ob	416582 7590058	Grazing	Gently undulating plain, mid slope <2%	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	
363 Ob	416484 7589648	Grazing	-	Ironbark	Nil	Firm, no rock	-	-	-	-	-	-	-	-	-	E4	

ESSA

Agricultural Chemistry Pty Ltd /Yara (ASPAC certified)

**For Info Refer ESSA Pty Ltd
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Reference: **12/83:57269**

Sheet: 1 of 4

Date Received: 28/11/2012

Date Completed: 17/12/2012

FINAL REPORT

Project:

Project China STONE

All results in this report relate only to the items tested. Results are expressed on an "as received basis".

Client Name: GTES

Contact: Mr G Tuck

Sample Type: Soil

Number of samples: 33

Soil Analysis Report

Batch Number: 12/83:57269

Date Received: 28/11/2012

Date Completed:17/12/2012

Client: GTES Stone - Results Page 1 of 2

ESSA Ref	Sample ID	Field ref	Soil pH	Soil EC	Soil Cl	P(Olsen)	Exch.Ca	Exch. Mg	Exch.K	Exch. Na	CEC	Ca/Mg	ESP	Total N	Nitrate N	OrgMatter
		depth (cm)		dS/m	mg/kg	mg/kg	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g	Ratio	%Na/CEC	%	(%)	(%)
SAL0660/1009	2	0-4	6.2	0.02	28	5	2.39	0.76	0.17	<0.1	3.7	3.1	1	<0.01	<1	1.4
SAL0661/1010	2	30-40	6.3	0.02	29		1.59	0.87	0.13	<0.1	3.0	1.8	1			
SAL0662/1011	2	60-70	6.4	0.01	22		1.6	1.33	0.1	<0.1	3.4	1.2	1			
SAL0663/1012	6	0-10	6.3	0.04	23	14	5.29	1.3	0.46	<0.1	7.5	4.1	1	<0.01	8	1.9
SAL0664/1013	6	30-40	5.9	0.03	25		2.26	0.73	0.08	0.09	3.5	3.1	3			
SAL0665/1014	6	60-70	6.9	0.02	25		1.44	0.89	0.05	0.26	3.0	1.6	9			
SAL0666/1015	6	80-90	7.2	0.02	27		1.36	0.91	0.09	0.23	3.0	1.5	8			
SAL0667/1016	18	0-5	6.4	0.03	22	8	2.08	0.61	0.2	<0.1	3.3	3.4	1	<0.01	<1	1.1
SAL0668/1017	18	10-20	6.2	0.02	21		1.69	0.43	0.14	<0.1	2.6	3.9	1			
SAL0669/1018	18	50-60	6.1	0.01	20		0.65	0.49	0.03	<0.1	1.7	1.3	2			
SAL0670/1019	18	100-110	6.2	0.01	21		0.73	1.18	0.03	<0.1	2.5	0.6	3			
SAL0671/1020	36	0-10	6.2	0.06	32	15	5.01	1.6	0.36	<0.1	7.4	3.1	1	0.04	<1	2.2
SAL0672/1021	36	50-60	6.2	0.03	26		4.77	2.23	0.45	0.12	8.0	2.1	2			
SAL0673/1022	36	90-100	6.7	0.02	24		1.16	0.76	0.11	<0.1	2.5	1.5	3			
SAL0674/1023	38	0-10	6.1	0.02	22	7	1.59	0.62	0.19	<0.1	2.8	2.6	1	<0.01	<1	0.9
SAL0675/1024	38	30-40	5.9	0.03	35		1.22	0.94	0.24	<0.1	3.0	1.3	1			
SAL0676/1025	38	60-70	6	0.02	16		1.58	1.35	0.24	<0.1	3.8	1.2	1			
SAL0677/1026	47	0-10	6.2	0.09	35	10	5.54	4.84	0.64	0.1	11.5	1.1	1	0.09	<1	4
SAL0678/1027	47	30-40	6.1	0.04	27		3.31	3.53	0.43	<0.1	7.7	0.9	1			
SAL0679/1028	47	70-80	6	0.02	24		1.59	3.89	0.28	<0.1	6.2	0.4	1			
SAL0680/1029	60	0-10	4.7	0.03	23	9	0.26	0.56	0.05	<0.1	1.7	0.5	4	0.01	<1	1.1
SAL0681/1030	69	0-5	5.5	0.02	19	12	0.72	0.21	0.1	<0.1	1.5	3.4	1	<0.01	1	1.2
SAL0682/1031	69	20-30	5.3	0.01	21		0.52	0.35	0.12	<0.1	1.6	1.5	3			
SAL0683/1032	69	80-90	5.5	0.02	19		0.19	0.3	0.25	<0.1	1.6	0.6	3			
SAL0684/1033	79	0-10	6.1	0.08	39	12	6.3	6.87	0.61	0.65	14.9	0.9	4	0.01	2	2.3
SAL0685/1034	79	30-40	6.9	0.06	219		7.2	6.97	0.48	1.42	16.6	1.0	9			
SAL0686/1035	79	90-100	5.1	0.49	360		5.92	6.64	0.44	2.68	16.3	0.9	17			
SAL0687/1036	142	0-10	5.6	0.05	35	12	2.75	5.21	0.25	0.21	8.8	0.5	2	0.03	2	2.8
SAL0688/1037	142	30-40	6.2	0.04	30		0.26	9.61	0.21	0.43	10.9	0.0	4			
SAL0689/1038	142	70-80	7.2	0.05	28		0.4	11.43	0.22	0.44	12.8	0.0	3			
SAL0690/1039	148	0-7	5.6	0.11	25	10	2.89	1.25	0.36	0.13	5.0	2.3	3	0.08	<1	4.2
SAL0691/1040	148	30-40	5.8	0.03	26		0.18	0.86	0.06	0.27	1.8	0.2	15			
SAL0692/1041	148	70-80	7.4	0.12	226		0.31	3.13	0.07	1.33	5.3	0.1	25			

Client: GTES Stone - Results Page 2 of 2

Lab No	Sample ID	Field ref	PSA-CS	PSA-FS	PSA-Silt	PSA-Clay	Disp Ratio	ADMC	Emerson	Sulfate-S	Mn	Boron	Copper	Iron	Zinc	Al	Al/CEC(%)
		Depth (cm)	%	%	%	%	R1	%	Number	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	meq/100g	%
SAL0660/1009	2	0-4	49	36	6	9	0.60	0.4	5	2	23.8	0.2	0.3	13	0.2	0.34	9
SAL0661/1010	2	30-40	46	31	6	18	0.73	0.4	5							0.39	13
SAL0662/1011	2	60-70	40	29	4	27	0.58	0.7	3							0.38	11
SAL0663/1012	6	0-10	42	30	16	14	0.69	1.0	5	3	30.4	0.3	0.6	25	<0.1	0.35	5
SAL0664/1013	6	30-40	50	29	11	11	0.99	0.5	5							0.32	9
SAL0665/1014	6	60-70	52	26	8	15	0.86	0.8	5							0.33	11
SAL0666/1015	6	80-90	48	35	6	11	0.89	0.5	5							0.37	13
SAL0667/1016	18	0-5	55	35	3	6	0.99	0.3	5	2	30.9	0.2	0.3	18	0.1	0.38	12
SAL0668/1017	18	10-20	47	40	5	9	0.90	0.3	5							0.36	14
SAL0669/1018	18	50-60	43	42	3	13	0.99	0.3	5							0.45	27
SAL0670/1019	18	100-110	43	35	4	18	0.95	0.6	5							0.47	19
SAL0671/1020	36	0-10	27	45	15	14	0.74	1.0	5	4	15.3	0.3	0.4	60	0.5	0.36	5
SAL0672/1021	36	50-60	19	35	19	26	0.76	1.1	5							0.44	6
SAL0673/1022	36	90-100	46	35	7	15	0.81	0.4	5							0.43	17
SAL0674/1023	38	0-10	26	54	18	4	0.87	0.5	5	2	5.5	-0.1	0.4	15	0.3	0.39	14
SAL0675/1024	38	30-40	27	38	9	27	0.60	0.7	5							0.55	19
SAL0676/1025	38	60-70	21	28	7	45	0.35	1.1	5							0.55	15
SAL0677/1026	47	0-10	20	32	25	24	0.71	2.1	5	5	62.9	0.4	1	61	2.1	0.34	3
SAL0678/1027	47	30-40	27	38	17	20	0.83	1.3	5							0.35	5
SAL0679/1028	47	70-80	41	35	7	18	0.89	1.1	5							0.37	6
SAL0680/1029	60	0-10	38	35	6	22	0.66	0.3	5	7	9	<0.1	0.2	32	<0.1	0.79	46
SAL0681/1030	69	0-5	34	56	2	9	0.70	0.4	5	3	3.1	<0.1	0.2	23	<0.1	0.46	31
SAL0682/1031	69	20-30	40	50	3	8	0.79	0.3	5							0.56	35
SAL0683/1032	69	80-90	31	50	6	13	0.55	1.1	5							0.85	52
SAL0684/1033	79	0-10	10	20	13	55	0.57	4.3	5	4	30.8	0.6	0.7	74	0.2	0.5	3
SAL0685/1034	79	30-40	9	17	14	58	0.57	4.3	5							0.52	3
SAL0686/1035	79	90-100	8	15	15	62	0.53	4.6	2							0.61	4
SAL0687/1036	142	0-10	40	37	5	18	0.73	1.7	5	5	0.6	0.1	0.5	48	<0.1	0.39	4
SAL0688/1037	142	30-40	36	34	5	25	0.68	2.2	5							0.36	3
SAL0689/1038	142	70-80	29	42	7	22	0.64	2.4	5							0.35	3
SAL0690/1039	148	0-7	40	35	13	12	0.75	1.0	5	7	27.7	0.4	0.2	51	0.3	0.38	8
SAL0691/1040	148	30-40	42	39	9	12	0.79	0.4	2							0.39	22
SAL0692/1041	148	70-80	30	32	9	30	0.95	1.4	2							0.43	8

All results for particle size analysis and R1 are reported on oven-dried basis (no pre-treatment applied to test samples)

METHOD DESCRIPTIONS

Soil

Reference: 12/83:57269

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Methods used to Analyse Samples

Analyte	ALHS*	Uncertainty %	LOQ	Unit	Name	Method Description
pH	4A1	1.1	0.1	pH	pH	1:5 water extr, pH meter
EC	3A1	5.4	0.01	dS/m	Electrical conductivity	1:5 water extr, EC meter
Cl	5A2	10.0	10.0	mg/kg	Chloride	1:5 water extr, (AA) colorimetric
NO3-N	7C2	6.7	1.0	mg/kg	Nitrate-nitrogen	1:5 water extr, (AA) colorimetric
NH4-N	7C2	7.8	0.6	mg/kg	Ammonium-nitrogen	1M KCl extr, (AA) colorimetric
Bicarb.P	9B2	16.8	1.0	mg/kg	Bicarb.ext.phosphorus	0.5M NaHCO3 @ pH 8.5, (AA) colorimetric
Exch.Ca	15C1	7.2	0.18	meq/100g	Exchangeable calcium	1M NH4OAc @ pH 7.0 leach, AAS
Exch.Mg	15C1	4.7	0.31	meq/100g	Exchangeable magnesium	1M NH4OAc @ pH 7.0 leach, AAS
Exch.Na	15C1	9.6	0.09	meq/100g	Exchangeable calcium	1M NH4OAc @ pH 7.0 leach, AAS
Exch.K	15C1	4.8	0.02	meq/100g	Exchangeable calcium	1M NH4OAc @ pH 7.0 leach, AAS
CEC	15I3	5.7	1.0	meq/100g	Cation Exchange Capacity	KNO3 + Ca(NO3)2 extr, (AA) colorimetric
DTPA-Cu	12A1	17.1	0.26	mg/kg	DTPA ext. copper	DTPA extraction, AAS
DTPA-Zn	12A1	16.4	0.10	mg/kg	DTPA ext. zinc	DTPA extraction, AAS
DTPA-Mn	12A1	9.0	0.32	mg/kg	DTPA ext. manganese	DTPA extraction, AAS
DTPA-Fe	12A1	13.0	0.23	mg/kg	DTPA ext. iron	DTPA extraction, AAS
ADMC	2A1	11.9	0.4	%	Air Dried Moisture Content	Gravimetric oven dry @ 105C
R1	NA	20.2	NA		Dispersion Ratio	Ratio [Aqueous dispersible (Silt + Clay):Total (Silt + Clay)]
SO4-S	10B3	11.5	0.6	mg/kg	Sulfate sulfur	Ca(H2PO4)2 @ pH 4.0 extractable sulfate-sulfur, ICPOES
Sand	no ref	22.1	1.0	%	Particle size, sand	Hydrometer, gravimetric & Sieve
Silt	no ref	16.6	1.0	%	Particle size, silt	Hydrometer, gravimetric
Clay	no ref	12.7	1.0	%	Particle size, clay	Hydrometer, gravimetric
TN	7A2	12.9	0.01	%	Total Kjeldahl Nitrogen	Sulphuric acid digest, (AA) colorimetric

* Australian Laboratory Handbook of Soil and Water Chemical Methods (1992)

For Manager
Analytical Services:

D E Baker BSc MASSSI

Agricultural Chemistry Pty Ltd(ASPAC Approved)

QUALITY CONTROL DATA

Soil

Reference: 12/83:57269

Page: 4 of 4

* Australian Laboratory Handbook of Soil and Water Chemical Methods (1992)

Test Method	Units		Acceptance Criteria	
			Actual Value	[Range]
pH	pH	B		5.0 - 5.3
EC	dS/m	B		0.27 - 0.32
Cl	mg/kg	B		10 - 35
NO3-N	mg/kg	B		10 - 16
NH4-N	mg/kg	NA		NA
Bicarb.P	mg/kg	B		51 -75
Total Kjeldahl N	%	ASPAC 34	0.110	.100 - .120
Total P	%	ASPAC 34	0.02	.019 - .021
Organic Carbon	%	B		1.82 - 2.3
Ca (Exch. cations)pH7	meq/100g	B		6.96 - 8.04
Mg (Exch. cations)pH7	meq/100g	B		1.88 - 2.22
Na (Exch. cations)pH7	meq/100g	B		.057 - .182
K (Exch. cations)pH7	meq/100g	B		1.209 - 1.411
Exch. Acidity	meq/100g			NA
ECEC	meq/100g	A		NA
CEC	meq/100g	S12		58 - 73
ESP	%	A		NA
Coarse sand	%	B	17.0	17.3 - 22.4
Fine Sand	%	B	22.0	20.0 - 25.7
Silt	%	B	16.0	10.5 - 19.8
Clay	%	B	44.0	37.9 - 48.9
R1		B		0.23 - 0.38

Test Method	Units	Test Soil	Acceptance Criteria	
			Actual Value	[Range]
DTPA-Cu	mg/kg	SB		2.37 - 3.25
DTPA-Zn	mg/kg	SB		3.15 - 3.81
DTPA-Mn	mg/kg	SB		97.7 - 149.0
DTPA-Fe	mg/kg	SB		24.3 - 32.6
0.33 Bar	%	G		32 - 51
15 Bar	%	G		23 - 30
Ca (Exch. cations)pH8.5	meq/100g	S12		27.7 - 35.4
Mg (Exch. cations)pH8.5	meq/100g	S12		22.88 - 24.5
Na (Exch. cations)pH8.5	meq/100g	S12		2.0 - 2.28
K (Exch. cations)pH8.5	meq/100g	S12		1.64 - 2.09

Data 12/83 ACL , 57269 Phosyn

ESSA Pty Ltd /Phosyn Ag Chem (ASPAC certified)

**For Info Refer ESSA Pty Ltd
PO Box 442 Sunnybank Q 4109**

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Reference: **13/14:64470**

Sheet: 1 of 4

Date Received: 19/04/2013
Date Completed: 24/04/2013

FINAL REPORT

Project:

Project China STONE

All results in this report relate only to the items tested. Results are expressed on an "as received basis".

Client Name: GTES

Contact: Mr G Tuck

Sample Type: Soil

Number of samples: 3

Soil Analysis Report

Batch Number: 12/83:57269

Date Received: 19/04/2013

Date Completed:24/04/2013

Client: GTES Stone - Results Page 1 of 2

ESSA Ref	Sample ID	field ref	Soil pH	Soil EC	Soil Cl	P(Olsen)	Exch.Ca	Exch. Mg	Exch.K	Exch. Na	CEC	Ca/Mg	ESP	Total N	Nitrate N	OrgMatter
		depth (m)		dS/m	mg/kg	mg/kg	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g	Ratio	%Na/CEC	%	(%)	(%)
SAM1751	302	0.00-0.10	5.0	0.01	<1	15	0.34	0.31	0.03	<0.1	1.0	1.1	3	0.012	<1	0.7
SAM1752	302	0.30-0.40	5.8	1.34	2268	7	0.88	1.26	0.21	3.9	6.5	0.7	60	0.012	24	0.7
SAM1753	302	0.60-0.70	5.6	3.02	2698	6	0.08	2.7	0.05	4.5	7.6	<0.1	60	0.012	69	0.7

ESSA Ref	Sample ID	field ref	PSA-CS	PSA-FS	PSA-Silt	PSA-Clay	ADMC	Emerson	Sulfate-S	Mn	Boron	Copper	Iron	Zinc	Al	Al/CEC(%)
		depth (m)	%	%	%	%	%	Number	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	meq/100g	%
SAM1751	302	0.00-0.10	32.0	44.0	9.0	17.0	0.4	2.0	4.0	0.3	0.1	0.2	18.0	<0.1	0.3	32.0
SAM1752	302	0.30-0.40	32.0	40.0	5.0	24.0	0.4	5*	27.0	2.8	0.7	0.3	20.0	0.2	0.3	4.0
SAM1753	302	0.60-0.70	21.0	28.0	7.0	45.0	0.7	1.0	119.0	<0.2	1.7	0.2	12.0	<0.1	0.3	3.0

All results for particle size analysis are reported on oven-dried basis (no pre-treatment applied to test samples) Affected by high salts*

METHOD DESCRIPTIONS

Soil

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Methods used to Analyse Samples

Analyte	ALHS*	Uncertainty %	LOQ	Unit	Name	Method Description
pH	4A1	1.1	0.1	pH	pH	1:5 water extr, pH meter
EC	3A1	5.4	0.01	dS/m	Electrical conductivity	1:5 water extr, EC meter
Cl	5A2	10.0	10.0	mg/kg	Chloride	1:5 water extr, (AA) colorimetric
NO3-N	7C2	6.7	1.0	mg/kg	Nitrate-nitrogen	1:5 water extr, (AA) colorimetric
NH4-N	7C2	7.8	0.6	mg/kg	Ammonium-nitrogen	1M KCl extr, (AA) colorimetric
Bicarb.P	9B2	16.8	1.0	mg/kg	Bicarb.ext.phosphorus	0.5M NaHCO3 @ pH 8.5, (AA) colorimetric
Exch.Ca	15C1	7.2	0.18	meq/100g	Exchangeable calcium	1M NH4OAc @ pH 7.0 leach, AAS
Exch.Mg	15C1	4.7	0.31	meq/100g	Exchangeable magnesium	1M NH4OAc @ pH 7.0 leach, AAS
Exch.Na	15C1	9.6	0.09	meq/100g	Exchangeable calcium	1M NH4OAc @ pH 7.0 leach, AAS
Exch.K	15C1	4.8	0.02	meq/100g	Exchangeable calcium	1M NH4OAc @ pH 7.0 leach, AAS
CEC	15I3	5.7	1.0	meq/100g	Cation Exchange Capacity	KNO3 + Ca(NO3)2 extr, (AA) colorimetric
DTPA-Cu	12A1	17.1	0.26	mg/kg	DTPA ext. copper	DTPA extraction, AAS
DTPA-Zn	12A1	16.4	0.10	mg/kg	DTPA ext. zinc	DTPA extraction, AAS
DTPA-Mn	12A1	9.0	0.32	mg/kg	DTPA ext. manganese	DTPA extraction, AAS
DTPA-Fe	12A1	13.0	0.23	mg/kg	DTPA ext. iron	DTPA extraction, AAS
ADMC	2A1	11.9	0.4	%	Air Dried Moisture Content	Gravimetric oven dry @ 105C
R1	NA	20.2	NA		Dispersion Ratio	Ratio [Aqueous dispersible (Silt + Clay):Total (Silt + Clay)]
SO4-S	10B3	11.5	0.6	mg/kg	Sulfate sulfur	Ca(H2PO4)2 @ pH 4.0 extractable sulfate-sulfur, ICPOES
Sand	no ref	22.1	1.0	%	Particle size, sand	Hydrometer, gravimetric & Sieve
Silt	no ref	16.6	1.0	%	Particle size, silt	Hydrometer, gravimetric
Clay	no ref	12.7	1.0	%	Particle size, clay	Hydrometer, gravimetric
TN	7A2	12.9	0.01	%	Total Kjeldahl Nitrogen	Sulphuric acid digest, (AA) colorimetric

* Australian Laboratory Handbook of Soil and Water Chemical Methods (1992)

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Analytical Services:

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QUALITY CONTROL DATA

Soil

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* Australian Laboratory Handbook of Soil and Water Chemical Methods (1992)

Test Method	Units		Acceptance Criteria	
			Actual Value	[Range]
pH	pH	B		5.0 - 5.3
EC	dS/m	B		0.27 - 0.32
Cl	mg/kg	B		10 - 35
NO3-N	mg/kg	B		10 - 16
NH4-N	mg/kg	NA		NA
Bicarb.P	mg/kg	B		51 -75
Total Kjeldahl N	%	ASPAC 34	0.110	.100 - .120
Total P	%	ASPAC 34	0.02	.019 - .021
Organic Carbon	%	B		1.82 - 2.3
Ca (Exch. cations)pH7	meq/100g	B		6.96 - 8.04
Mg (Exch. cations)pH7	meq/100g	B		1.88 - 2.22
Na (Exch. cations)pH7	meq/100g	B		.057 - .182
K (Exch. cations)pH7	meq/100g	B		1.209 - 1.411
Exch. Acidity	meq/100g			NA
ECEC	meq/100g	A		NA
CEC	meq/100g	S12		58 - 73
ESP	%	A		NA
Coarse sand	%	B	17.0	17.3 - 22.4
Fine Sand	%	B	22.0	20.0 - 25.7
Silt	%	B	16.0	10.5 - 19.8
Clay	%	B	44.0	37.9 - 48.9
R1		B		0.23 - 0.38

Test Method	Units	Test Soil	Acceptance Criteria	
			Actual Value	[Range]
DTPA-Cu	mg/kg	SB		2.37 - 3.25
DTPA-Zn	mg/kg	SB		3.15 - 3.81
DTPA-Mn	mg/kg	SB		97.7 - 149.0
DTPA-Fe	mg/kg	SB		24.3 - 32.6
0.33 Bar	%	G		32 - 51
15 Bar	%	G		23 - 30
Ca (Exch. cations)pH8.5	meq/100g	S12		27.7 - 35.4
Mg (Exch. cations)pH8.5	meq/100g	S12		22.88 - 24.5
Na (Exch. cations)pH8.5	meq/100g	S12		2.0 - 2.28
K (Exch. cations)pH8.5	meq/100g	S12		1.64 - 2.09