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## Addendum to BSAL verification report

Warkworth Continuation 2014

Prepared for Warkworth Mining Limited | 5 June 2014

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## Addendum to BSAL verification report

Final

Report J14013RP2 | Prepared for Warkworth Mining Limited | 5 June 2014

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Prepared by	<b>Neil Cupples</b>	Approved by	<b>Dr Tim Rohde</b>
Position	Senior Soil Scientist	Position	Practice leader, rehabilitation, closure and soils
Signature		Signature	
Date	05 June 2014	Date	05 June 2014

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### Document Control

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# 1 Introduction

The Warkworth Continuation 2014 (the proposal) seeks to extend mining beyond the current limits of approval to ensure it remains economically viable and coal is extracted in the most economic manner as required under clause 15 of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007*.

The mining extension area is approximately 698ha (referred to herein as proposal area) and is located in a mining lease 20m below ground level, but will require a mining lease from the surface to 20m below surface level. This mining lease is yet to be approved.

Under the State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (the Mining SEPP), an application for a state significant mining or petroleum development must be accompanied by:

- a) a gateway certificate; or
- b) a site verification certificate (SVC) that certifies that the land on which the proposed development is to be carried out is not on biophysical strategic agricultural land.

The Mining SEPP sets out the requirements for supporting documentation which must accompany an SVC application and requires the supporting documentation to be prepared in accordance with the *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land* (the Interim protocol).

Warkworth Mining Limited made a SVC application to the NSW Department of Planning and Environment (DP&E) for the area requiring a mining lease from the surface to 20m below the ground. The SVC application was accompanied by a Biophysical Strategic Agricultural Land (BSAL) verification report (Appendix A) which was based on a desktop study using previous soil surveys of the area.

In accordance with the assessment procedures, the DPE requested the NSW Office of Environment and Heritage (OEH) to review the SVC application and provide a recommendation for their consideration. In their review, the OEH required additional information to complete their assessment of the SVC application against the Interim protocol.

Notwithstanding the additional information that was required by OEH, it was acknowledged that the data provided in the BSAL verification report was consistent with OEH knowledge and data of the area. That is, no BSAL has been mapped in the locality and soils units known to be in the area are of low fertility.

The purpose of this report is to provide additional information requested by OEH so that they can complete their assessment of the SVC application against the Interim protocol and the current publically available procedure.

This report includes:

- an introduction (this section);
- the methodology used in conducting this survey;
- a description of how this survey addressed the Interim protocol compliance issues;
- the results and discussion of this survey; and
- conclusions.

## 2 Method

This section describes the additional soil survey fieldwork and laboratory analysis that was done to address the additional matters raised by OEH.

### 2.1 Soil descriptions and sampling

The Interim protocol requires a minimum of three detailed soil description sites be surveyed for each soil type. A detailed test site is defined as soil profile inspection site that is described in sufficient detail to allow all major physical and chemical soil features of relevance to BSAL to be clearly identified. The description must include site data, ie the soil description, and samples for laboratory analysis, ie soil sample analysis.

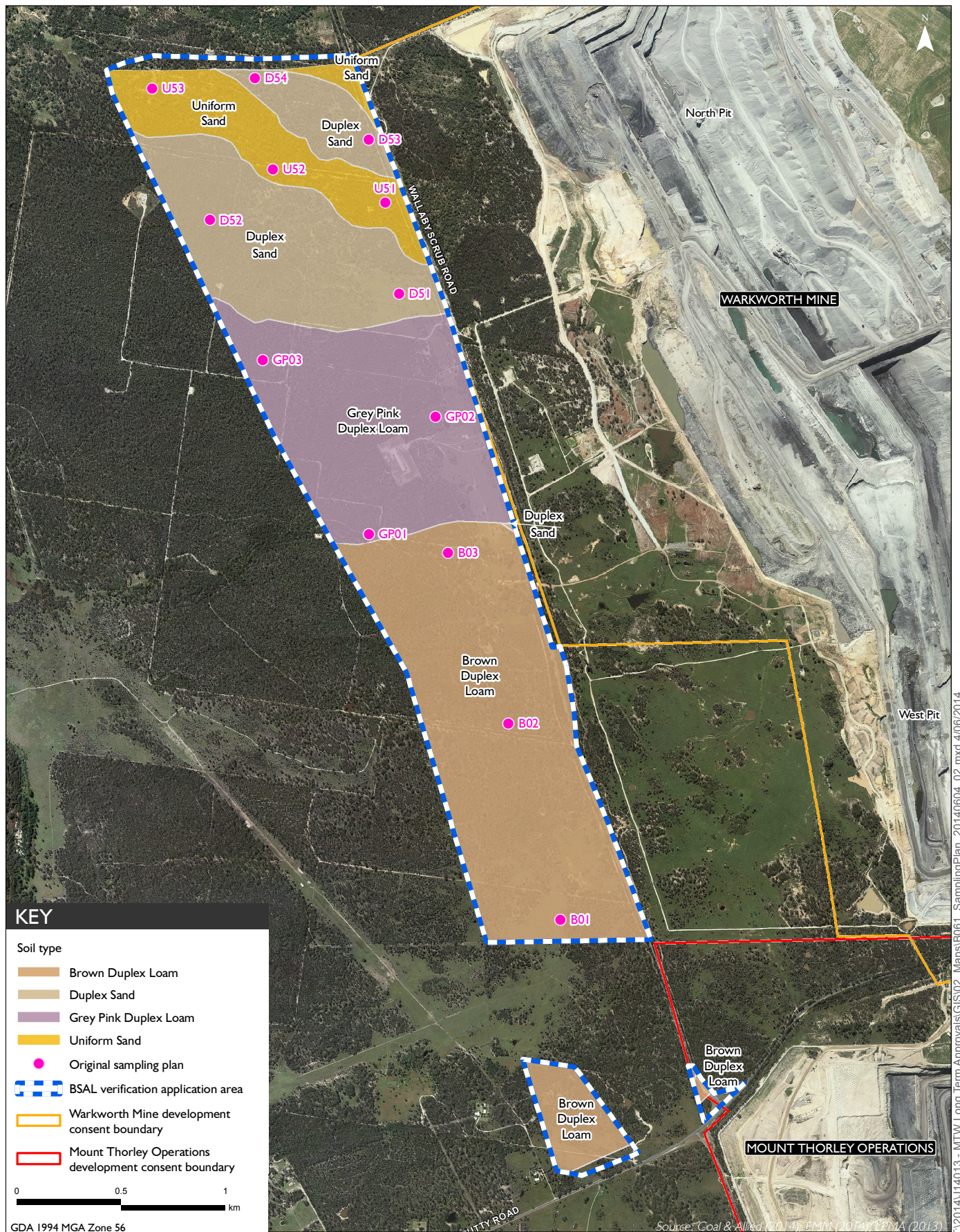
A survey plan for detailed soil descriptions was prepared based on existing mapping of soil units. The survey plan and existing mapping units are shown on Figure 2.1. As per the Interim protocol, the survey plan was based on three detailed sites for each soil type on the existing mapping. Tasks completed at each detailed soil description site were:

- prepare 1m deep trenches;
- record detailed soil descriptions using the Soil and Land Information System (SALIS) data card and BSAL data card; and
- collect soil samples at: 0, 0-50mm, 50-150mm, 150-300mm, 300-600mm and 600-1,000mm below ground level (bgl):
  - surface samples (0 mm bgl) were collected as a bulk sample from 12 sub-samples collected in a 10m radius around the trench; and
  - 250g soil samples were collected from each depth.

Check and exclusion sites were not included in the survey plan as it was considered that the existing soil mapping was satisfactory as it was previously accepted by DP&E. Where the existing mapping was in conflict with the field observations, additional check sites were undertaken which comprised holes dug to 0.5m and assessments that included brief soil profile descriptions, soil characteristic observations and vegetation observations. No laboratory analysis of samples was done on check sites.

The OEH requested BSAL mapping at 1:25,000 in its interim assessment. Under the Interim protocol this scale of mapping is required for developments which are considered to pose a high risk to agriculture, eg an open cut mine located on alluvial soils that are very likely to be BSAL. It is considered that the proposal poses a low risk to agriculture because the area being assessed is not on alluvial soils, is heavily wooded, not used for agriculture and has several physical and chemical criteria that would prevent it from being classified as BSAL. Therefore, the sampling density in the survey plan was for one sample per 50ha which is approximately 1:50,000 mapping. OEH confirmed via email that they agreed with the survey plan for 1:50,000 mapping.





Original sampling plan  
Warkworth Mine continuation  
BSAL verification  
Figure 2.1



## 2.2 Soil sample analysis

Soil samples from detailed test sites were packed into eskies with chain of custody certificates and sent to a NATA laboratory for analysis.

Soil samples were analysed using appropriate test procedures, eg National Test Code, for:

- soil pH (1:5 soil:water or 1:5 soil: CaCl<sub>2</sub>);
- salinity (EC 1:5 and ECe 1:5); and
- exchangeable cations and cation exchange capacity (for deriving exchangeable sodium percentage and the Ca:Mg ratio).

Laboratory analysis results were entered into the SALIS laboratory data template.





### 3 Interim protocol requirements

The OEH assessment of the SVC desktop based application required additional information to be provided to enable a thorough assessment against the Interim protocol. Table 3.1 summarises the additional information requested by OEH and how the supplementary soil survey has addressed the information request.

**Table 3.1 Resolution of information requests**

Information request	Resolution of information request
<b>Maps</b>	
Map of assessment area showing BSAL (at 1:25,000) and exclusion zones marked according to their BSAL limitation. Spatial dataset (boundary of BSAL areas) supplied in GIS format as per the Interim protocol.	BSAL was mapped at 1:50,000 in accordance with the Interim protocol. See section 3.1 for further details. A hard copy map has been provided in Figure 4.2 A spatial dataset of soil type polygons, BSAL polygons and soil sampling points have been provided.
Metadata for spatial datasets have been provided as per the Interim protocol	A spatial dataset of soil type polygons, BSAL polygons and soil sampling points have been provided.
<b>Lodgement of site and laboratory data</b>	
All site observations lodged on BSAL soil data cards and all required field attributes completed correctly for each observation type as per the Interim protocol, ie check, exclusion and detailed.	Soil data cards have been supplied in a physical form. Laboratory data has been supplied digitally in the specified SALIS format.
All laboratory data supplied in the SALIS lab data template, appropriate test procedures, eg National Test Code, identified and all relevant test results completed as per the <i>Interim protocol</i> .	Laboratory data has been supplied digitally in the specified SALIS format.
<b>Site assessment</b>	
Sampling density is as specified in the <i>Interim protocol</i> .	Sampling density within the project footprint was mapped at 1:50,000 in accordance with the Interim protocol. See section 3.1 for further details.
Observation sites (check, detailed and exclusion sites) are relatively evenly distributed across the study area	Within the approximately 698 ha proposal area 15 detailed sites and four check sites were investigated.
Each soil type identified has at least three detailed sites	Each soil unit has a minimum of three detailed sites recorded.
All relevant data has been collected and provided for detailed sites as per the <i>Interim protocol</i> .	Within the approximately 698 ha proposal area 15 detailed sites and four check sites were investigated. A hard copy map has been provided in Figure 4.2 A spatial dataset of soil type polygons, BSAL polygons and soil sampling points have been provided. BSAL was mapped at 1:50,000 in accordance with the Interim protocol. See section 3.1 for further details. Soil data cards have been supplied in a physical form. Laboratory data has been supplied digitally in the specified SALIS format.
Description of detailed sites is accompanied by a photograph of the site and of the soil profile being described.	Photographs of each site and soil profile have been provided in a digital format.
Adequate numbers of check sites used to: i) allocate a site to a soil type and soil map unit; and ii) confirm existing mapping	Detailed sites were used to verify the existing soil polygons. Check sites were only used where the detailed sites returned a soil type not in line with the existing mapping.

### 3.1 Map scale

A mapping scale of 1:50,000 was determined as addressing the appropriate level of risk of the proposal. The reasoning and acceptance of this mapping scale is detailed in Section 2.1.

The field survey of 15 detailed sites and four check sites covered the approximately 698ha proposal area at an intensity of one site per 36.74ha. According to the *Guidelines for surveying soil and land resources* (McKensie et al 2008), a 1:50,000 sampling intensity ranges between one site per 20ha to 100ha. The sampling intensity for this survey is at the more intense end of this range and is therefore deemed acceptable given the level of risk to agriculture associated with this proposal.

## 4 Results and discussion

A field survey of 15 detailed sites and four check sites was undertaken from 26 May 2014 to 28 May 2014 covering the four soil units identified in the existing mapping. The survey confirmed the presence of the four soil units identified in the proposal area. Soil units were renamed in line with the Australian soil classification (Isbell 1996) as described in Table 4.1. Figure 4.1 shows the survey locations and the resultant soil mapping from this recent survey.

**Table 4.1** Renamed soil units

Original soil units names	New soil units names
Uniform sand	Arenic rudosol
Duplex sand	Yellow sodosol
Grey pink duplex loam	Grey sodosol
Brown duplex loam	Brown kurosol

The type of observations made at each survey site are listed in Table 4.2.

**Table 4.2** Site units

Detailed sites	Check sites
US1	DSC1
US2	DSC2
US3	DSC3
DS1	DSC4
DS2	
DS3	
DS4	
DS5	
GP01	
GP02	
GP03	
B01	
B02	
B03	
B04	

### 4.1 Polygons

The survey confirmed the presence and spatial extent of six of the seven soil polygons identified in the original survey. The northern most Duplex sand (Yellow sodosol) polygon identified in Figure 2.1 was found to be incorrect and through the use of two detailed and four check sites, the polygon was found to be Arenic rudosol (Uniform sand). This soil unit is consistent with the soil units to its immediate north and south.

The correction was made in line with the Interim protocol which states that a soil polygon has to be greater than 70 per cent of a single soil type. Only a small area on the eastern side of the polygon, along

the access track, is composed of the Yellow sodosol (Duplex sand). The incorrect polygon was corrected and merged with the surrounding Arenic rudosol (Uniform sand) polygons as shown in Figure 4.1.

## 4.2 Soil units

The four soil units identified in existing soil mapping were found to be consistent with those identified during the survey.

The soil unit descriptions from the existing soil mapping, shown in Appendix C, were found to have a strong correlation with the field survey results. The field survey results are attached in Appendix D in the form of BSAL soil data cards.

## 4.3 Laboratory data

The laboratory analysis further confirms the existing descriptions of the four soil units identified by existing mapping. All four soil units consistently demonstrate low soil fertility with the Arenic rudosol demonstrating particularly low levels. The Yellow sodosol, Grey sodosol and Brown Kurosol demonstrated exchangeable sodium percentages that were sodic to strongly sodic. Strongly acidic surface soils that were below ideal plant growth levels (pH 5.5) were noted in all four soil units.

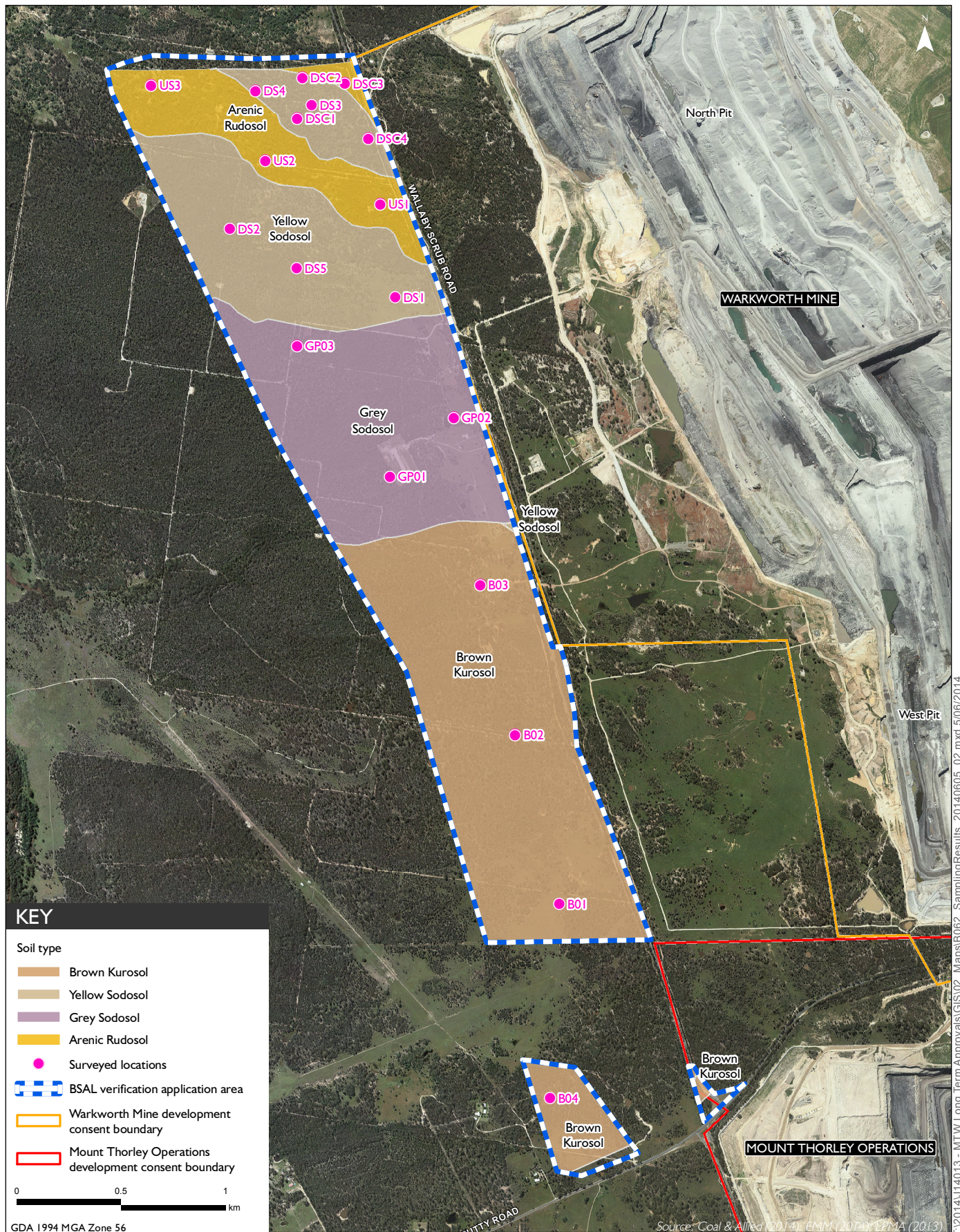
The BSAL assessment failed the four soil units on low fertility. This assessment is consistent with the low soil fertility apparent in the laboratory results.

## 4.4 BSAL determination

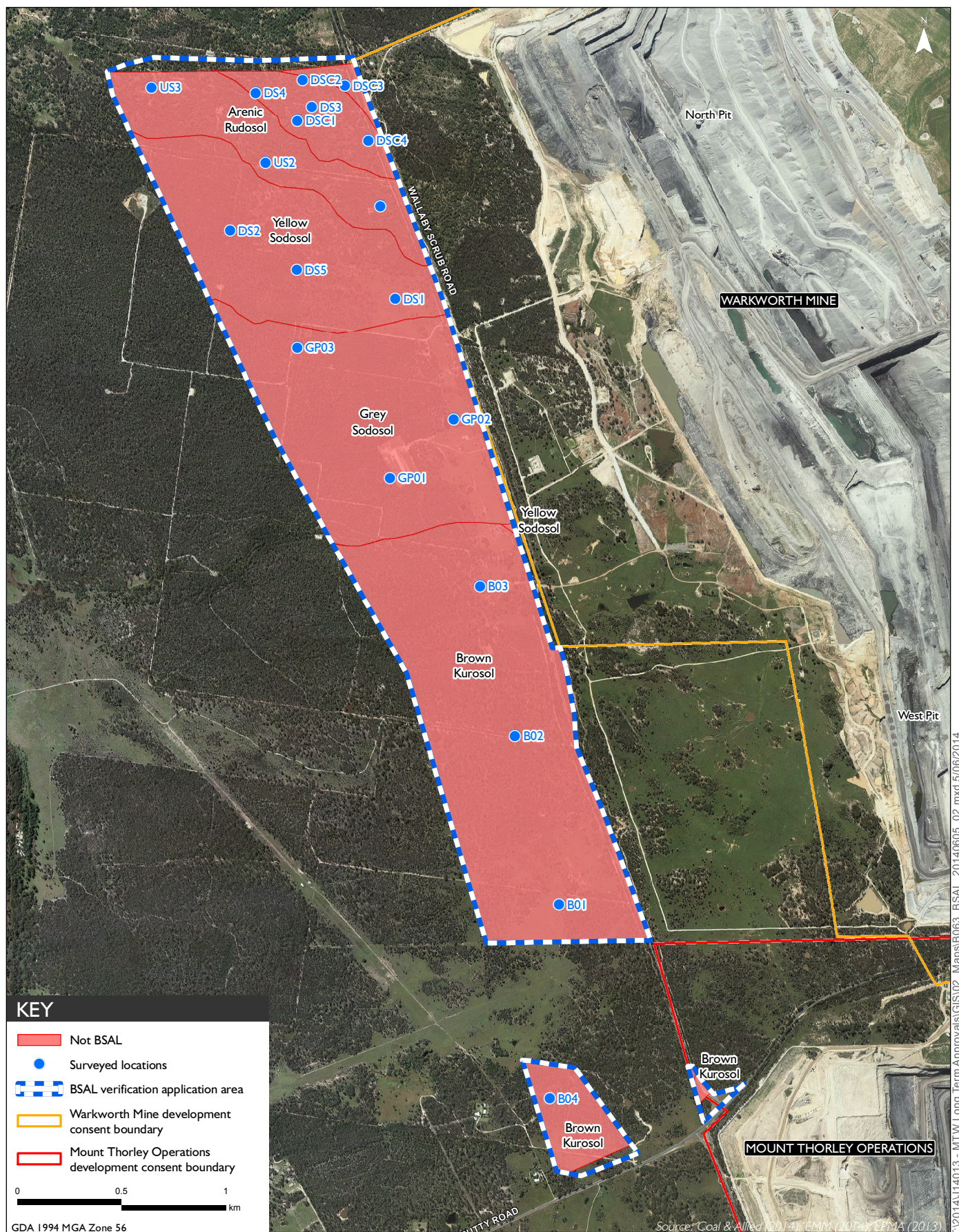
The BSAL verification report at Appendix A, found that there was no BSAL within the proposal area based on the four soil units in existing soil mapping.

This survey has not identified any significant changes in the presence or quality of soil units found within the proposal area. The change in extent of soil units will have no bearing on the BSAL verification assessment report findings (Appendix A). Figure 4.2 shows the resulting BSAL mapping for the proposal area based on the detailed soil description from the sampling locations shown on Figure 2.1.











## 5 Conclusions

The soil survey descriptions used for the BSAL verification report were found to accurately describe the soil units within the proposal area. An incorrectly identified polygon was recognised and corrected by this survey. There was no influence on the findings of the BSAL verification report by this error.

This survey therefore confirms and supports the original determination that there is no BSAL located within the proposal area.





## 6 References

EMM 2014, *BSAL Site verification certificate report*.

GSS Environmental 2010, *Warkworth mine extension: Soil survey and land resource assessment report*.

Isbell RF 1996, *The Australian soil classification*, CSIRO Publishing, Collingwood.

Office of Environment and Heritage 2013, *Interim Protocol for site verification and mapping of biophysical strategic agricultural land New South Wales*, New South Wales Government.

McKensie NJ, Grundy MJ, Webster R & Ringrose-Voase 2008, *Guidelines for surveying soil and land resources*, second edition, CSIRO Publishing, Collingwood.



## Appendix A

### BSAL verification report

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## BSAL Site Verification Certificate Report

Warkworth Continuation 2014

Prepared for Rio Tinto Coal Australia | 8 May 2014

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## BSAL Site Verification Certificate Report

Final

Report J14013RP1 | Prepared for Rio Tinto Coal Australia | 8 May 2014

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Prepared by **Ross Aitken-Smith**

Approved by **Dr Tim Rohde**

Position Environmental planner

Position Practice leader, rehabilitation,  
closure and soils

Signature



Signature



Date 8 May2014

Date 8 May2014

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# 1 Introduction

## 1.1 Legislative context

In 2012, the NSW government introduced the *Strategic Regional Land Use Policy* to balance land use outcomes between agriculture and mining projects. Under this policy, the NSW Strategic Regional Land Use Plans (SRLUPs) for the Upper Hunter were developed and identified strategic agricultural lands, which comprise biophysical strategic agricultural land (BSAL) and Critical Industry Clusters (CIC). Land identified as being highly suitable for agriculture is known as BSAL while CICs are regional concentrations of highly productive industries, namely equine and viticulture, which are related to each other, contribute to the identity of that region and provide significant employment opportunities.

Clause 50A of the *Environmental Planning and Assessment Regulation 2000* requires that a development application for mining development on certain identified land (including land shown on the Strategic Agricultural Land Map) must be accompanied by:

- a gateway certificate, or
- a site verification certificate that certifies that the land on which the proposed development is to be carried out is not biophysical strategic agricultural land.

Clause 17A of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (the Mining SEPP) defines mining development as:

1(a) development specified in clause 5 (Mining) of Schedule 1 to State Environmental Planning Policy (State and Regional Development) 2011, but only if:

(i) a mining lease under the *Mining Act 1992* is required to be issued to enable the development to be carried out because:

(A) the development is proposed to be carried out outside the mining area of an existing mining lease.

Further to this, under the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) Amendment 2013* (the 2013 Mining SEPP amendment), where a mining lease is required, State Significant Development (SSD) that is wholly or partially on either BSAL or an area mapped as CIC, must be considered through the Gateway process unless additional verification can prove otherwise. The assessment of the potential impacts of a proposal on agricultural land and water resources (including CICs) must be undertaken before a development application is lodged.

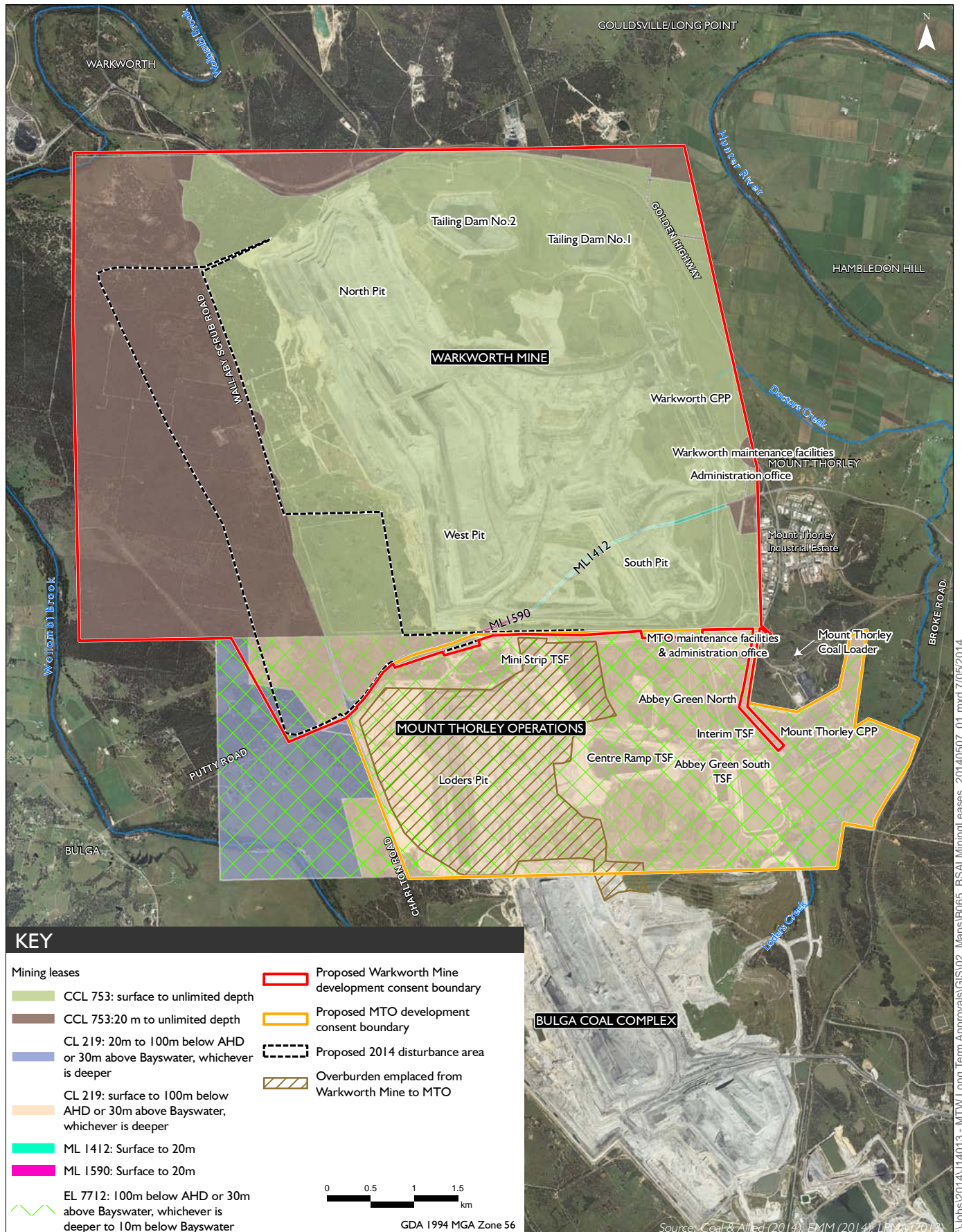
In light of the above, Warkworth Continuation 2014 constitutes a mining development, as defined in the Mining SEPP. The footprint of the proposal is located within a mining lease 20m below ground level (bgl), however requires a mining lease from the surface to 20m bgl. The majority of the footprint contains endangered ecological communities (EECs).

Although there are no lands mapped as BSAL within the footprint of disturbance, and the majority of the footprint contains EECs, the proponent still requires either a gateway certificate or a BSAL site verification certificate prior to lodging a development application because a surface mining lease is required.



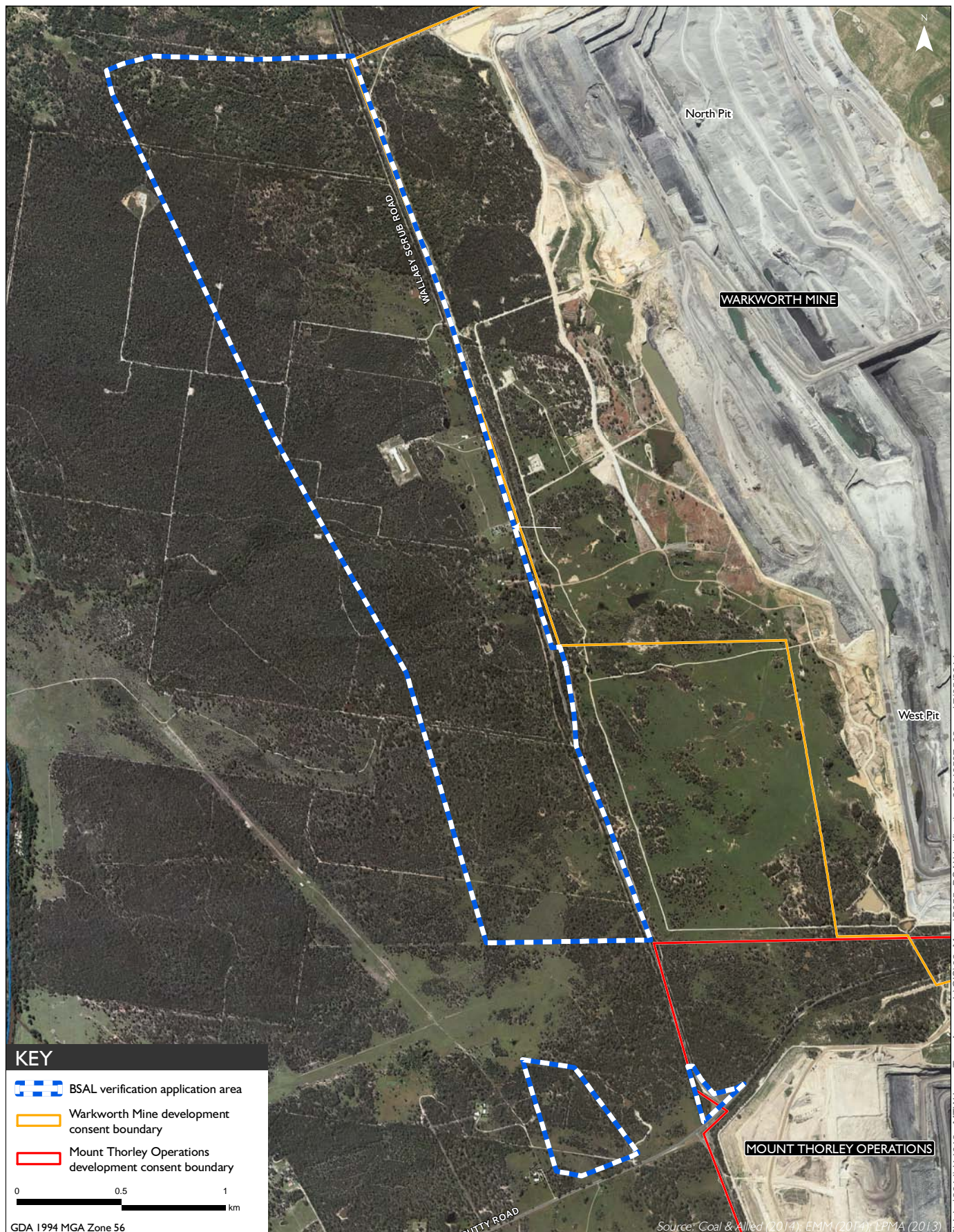
## 1.2 Project context

The majority of the Warkworth Continuation 2014 (the proposal) area is within CCL753, with the southern part within CL219 (which is a Mount Thorley Operations mining tenement) (Figure 1.1). Within the proposed mining area, CCL753 and the section of CL219 are subsurface mining leases granted in 1981. These mining leases do not include the surface to 20m depth. Mining Lease Applications 352 and 353 cover the surface to 20m depth required for the proposal, however these are yet to be approved. For the purposes of this report, these areas are known as the BSAL verification application area. The BSAL verification application area is approximately 667.5ha and shown in Figure 1.2.











## 1.3 Purpose

This report has been prepared in accordance with the *Interim protocol for site verification and mapping of biophysical strategic agricultural land* (OEH 2013) with the purpose of obtaining a site verification certificate for the BSAL verification application area to enable lodgement of a development application.

The BSAL verification application area is outside areas mapped as BSAL in the SRLRP. However, due to the regional scale of the mapping, where a proposal potentially triggers the Gateway process the proponent is required to undertake further evaluation to confirm that the proposal will not impact BSAL. Where BSAL is not identified, a site verification certificate is required that certifies that the land where the proposal is to be carried out is not BSAL.

The NSW Government has undertaken mapping for the 2013 Mining SEPP amendment to identify BSAL and the equine and viticulture CICs at a regional scale. The proposal is outside the 2km barrier nominated by the SRLUP Guidelines for CICs and hence further assessment is not required.

### 1.3.1 Statement of qualification

This report has been prepared with the oversight of Dr. Timothy Rohde a certified professional soil scientist. Dr. Rohde's qualifications and accreditations are presented in Appendix A.

## 1.4 Biophysical constraints to agriculture

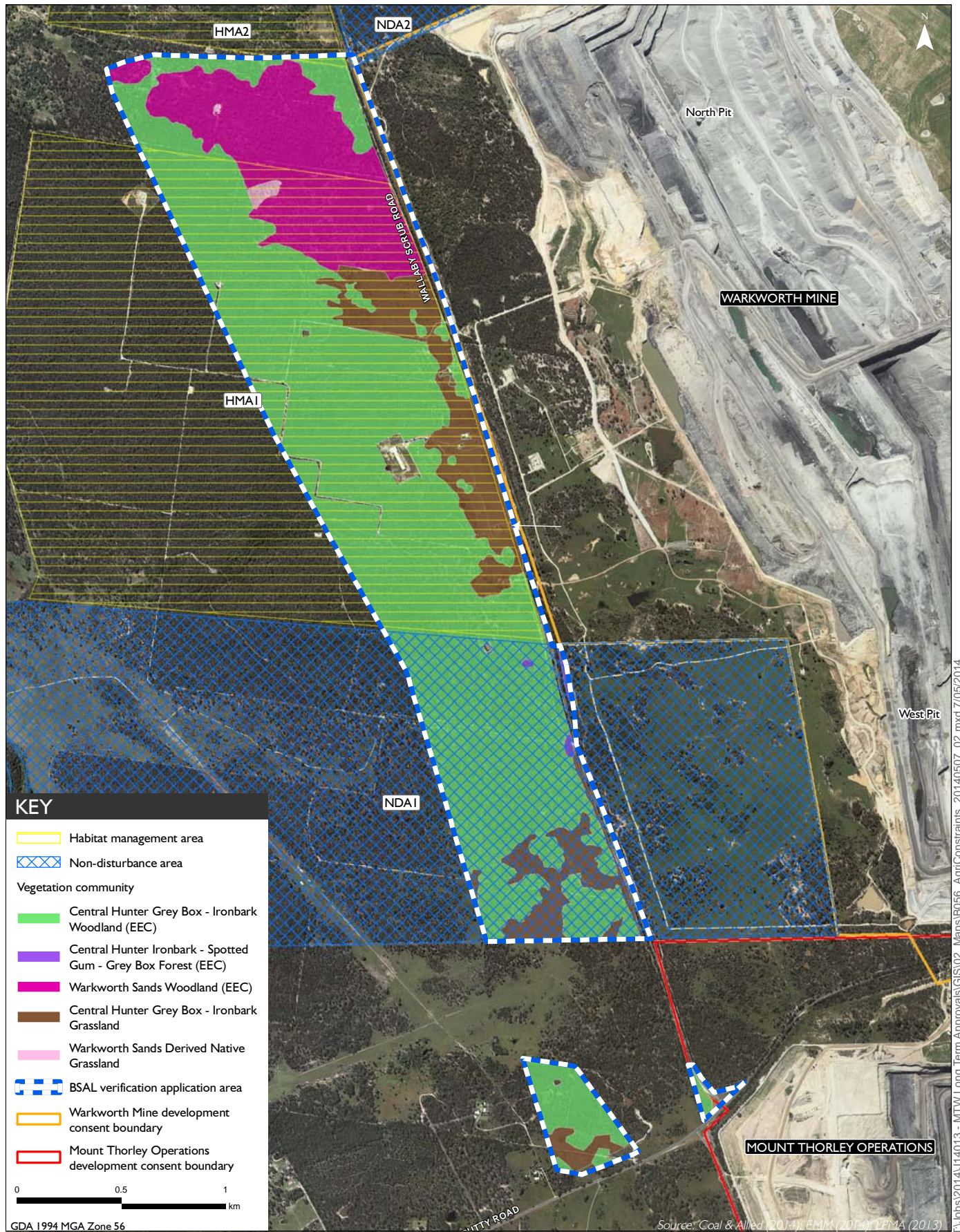
Several existing biophysical constraints are present at the BSAL verification application area, which prevent it from meeting the criteria for BSAL (Figure 1.3). The constraints include the predominant presence of EEC woodland with little to no grassland or pasture.

The existing land use is also constrained by the presence of the Green Offsets, protected under the existing development consent for Warkworth Mine (DA 300-9-2002i). The Green Offsets comprise a habitat management area (HMA) and a non-disturbance area (NDA). The woodland areas contain EECs listed under the NSW Threatened Species Conservation Act 1995.

Currently no agriculture occurs at the BSAL verification application area. It should be noted that the HMA and NDA will be relocated as part of Warkworth Continuation 2014.











#### 1.4.1 Habitat management areas

The existing HMA comprises the majority of the BSAL verification application area (Figure 1.3). The HMA limits all agricultural activity. The HMA was established upon granting of the current development consent in 2003. As part of the development consent and the prescribed management regime, no agricultural activity can currently occur within the HMA.

#### 1.4.2 Non disturbance area

Similarly, the NDA within the BSAL verification application area (Figure 1.3) was also established upon granting of the current development consent in 2003. As part of the development consent and the prescribed management regime, no agricultural activity can currently occur within the NDA.

#### 1.4.3 Endangered ecological communities

The majority of the BSAL verification application area has been identified as the Central Hunter Grey Box - Ironbark Woodland EEC (Figure 1.3). A smaller portion in the north of the site has been mapped as Warkworth Sands Woodland EEC. Within the BSAL verification application area, the Central Hunter Grey Box – Ironbark Woodland EEC is associated with Duplex Sand, Grey Pink Duplex Loam, Brown Duplex Loam and Uniform Sand soil units and the Warkworth Sands Woodland EEC is associated with the Uniform Sand soil unit. Both EECs have been excluded from agricultural activities for an extended period of time. The listing protects the EECs from everything except "routine agricultural management activity". Accordingly, there are no real prospects of the site ever being classified as BSAL.

### 1.5 Risk to agriculture

The potential impacts to agricultural resources are considered low given the presence of EEC woodland where no agricultural land use exists.

A risk assessment was undertaken in accordance with:

- the Guideline for Agricultural Impact Statements at the Exploration Stage (DTIRIS, 2012) which is based on the probability of occurrence and the consequence of the impact, as described in the Land Use Conflict Risk Assessment Guide (NSW DPI 2011)
- Appendix 3 of the Interim Protocol for site verification and mapping of biophysical strategic agricultural land.

Based on the risk matrix contained within the Guideline for Agricultural Impact Statements at the Exploration Stage, a risk ranking of A5 'low risk' of agricultural impact was determined.

The A5 risk ranking is based on a consequence of 'very minor damage and minor impact to agricultural resources or industries' with a likelihood of the consequence being an 'almost certain' probability. Due to the absence of agricultural activity and predominance of EEC woodland this risk ranking is appropriate as 'no measurable or identifiable impact on an agricultural resource or industry' can be identified.

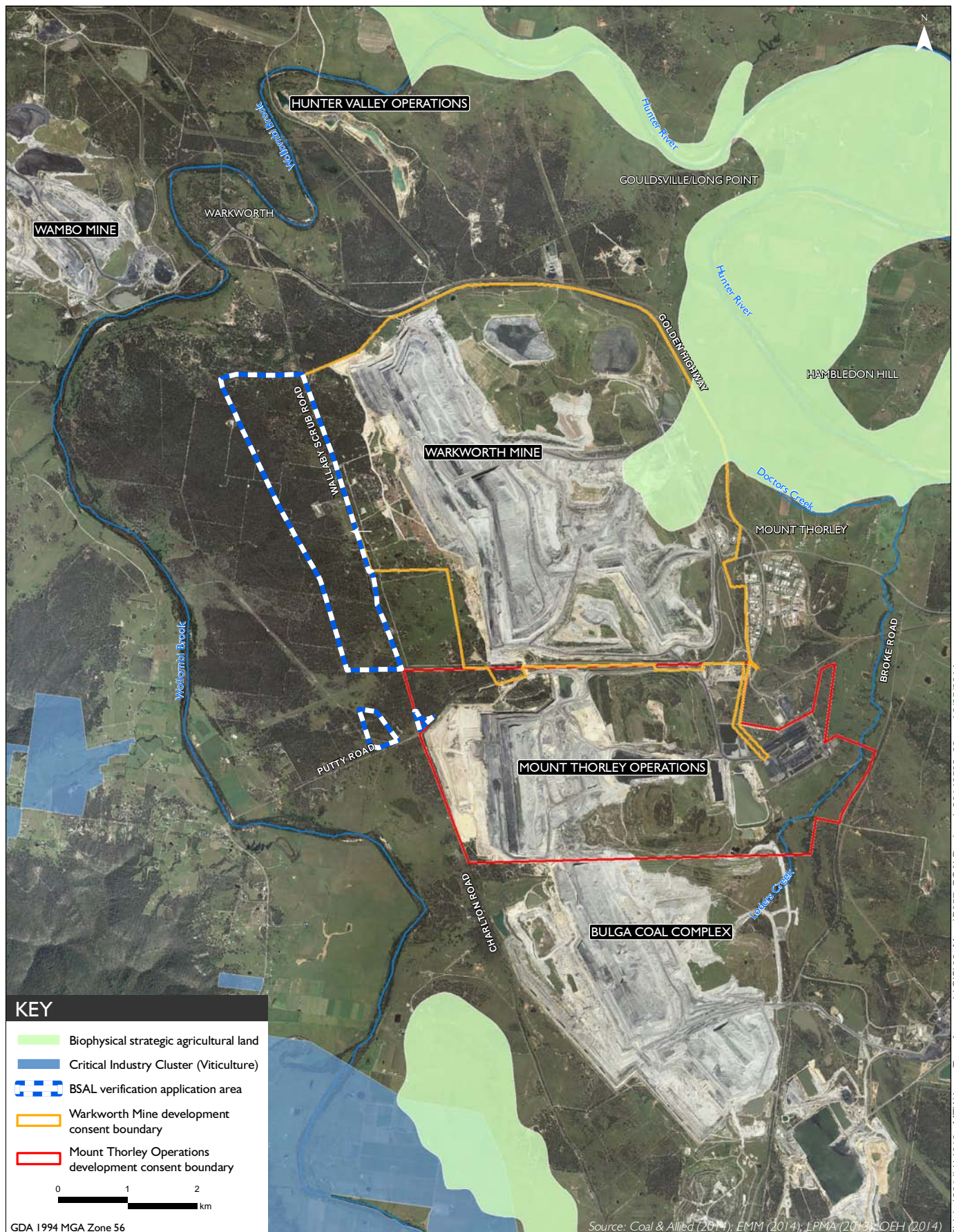


## 2 Regional verification of biophysical strategic agricultural land

The regional BSAL trigger map is presented in Figure 2.1 and indicates no BSAL in the vicinity of the proposal. The nearest BSAL is approximately 4 km to the east. Due to the regional scale of the SRLUP mapping, the proponent is required to undertake further evaluation to confirm that BSAL will not be impacted. Where BSAL is not identified, a site verification certificate is required that certifies that the land, where the proposal is to be carried out, is not BSAL.

The nearest CIC is approximately 5 km to the south, outside the 2 km barrier nominated by the SRLUP Guidelines for CICs and hence further CIC assessment is not required.





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## 3 Local verification of biophysical strategic agricultural land

### 3.1 Method

The BSAL verification has been completed by desktop assessment using the following studies:

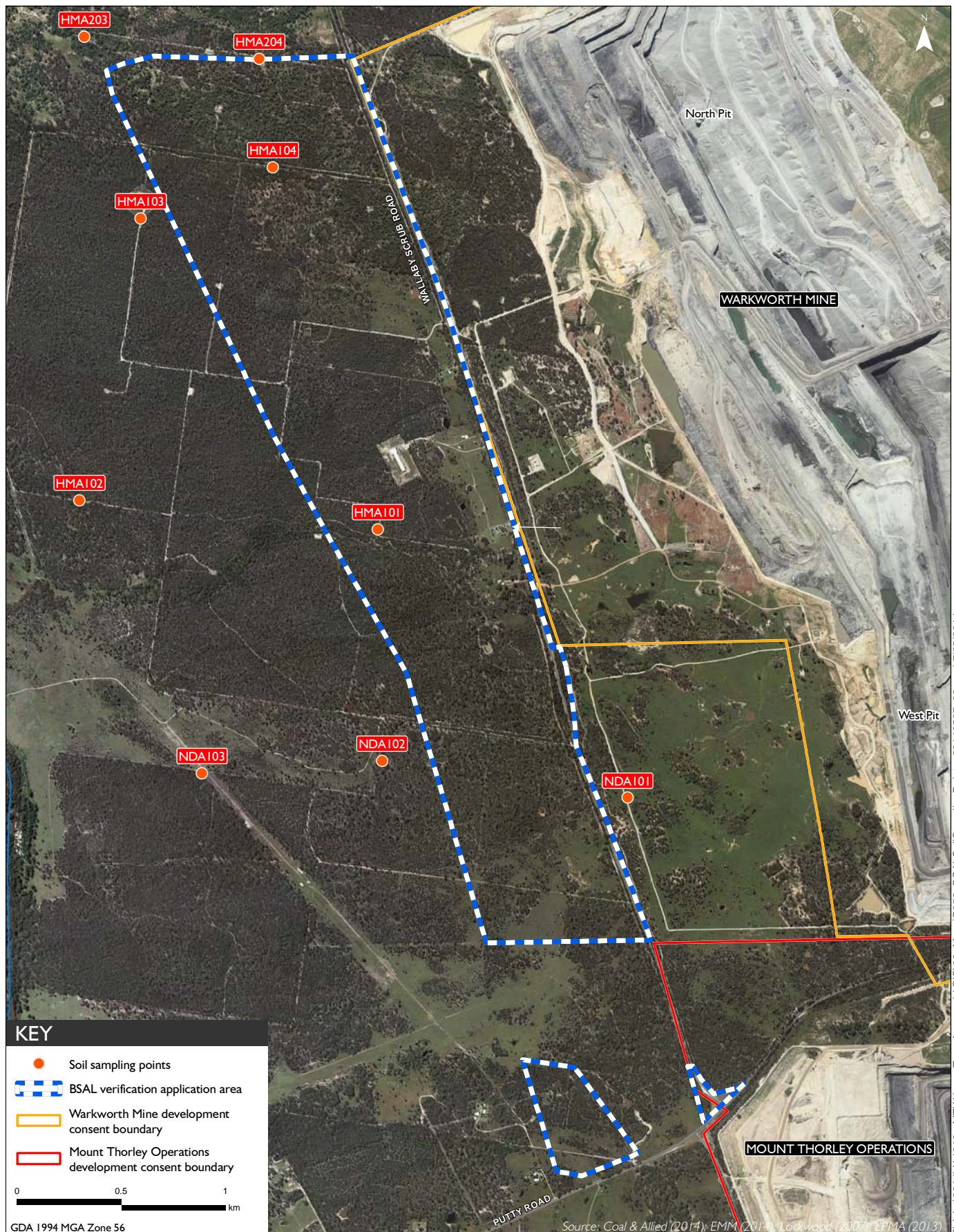
- Lockwood PV (2007) *Warkworth Sands soil survey: Soil sampling and analysis within the Green Offsets and Archerfield*; and
- GSS Environmental (2010) *Warkworth mine extension: Soil survey and land resource assessment*.

The GSS Environmental (GSSE) soil survey and resource assessment was a desktop study, with limited test-pitting done outside the BSAL verification application area. The soil survey and resource assessment drew upon a number of regional scale (1:250,000) and local scale (<1:100,000) soil surveys that incorporated part or all of the proposed activity area. GSSE produced a local scale map (<1:100,000) showing the spatial distribution of soil. Soils were described using an adaption of the Northcote (1971) key. The relevant aspect of the GSSE soil survey to the assessment area has been reproduced in Figure 3.1.

The BSAL verification assessment follows the key steps described in the *Interim Protocol for site verification and mapping of biophysical strategic agricultural land* (OEH 2013).







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### 3.1.1 Scale of biophysical strategic agricultural land verification assessment

The BSAL verification requires a soil survey scale of at least 1:100,000 correlating to a low level of risk. The risk ranking for the BSAL verification application area is described in Section 1.5 of this report.

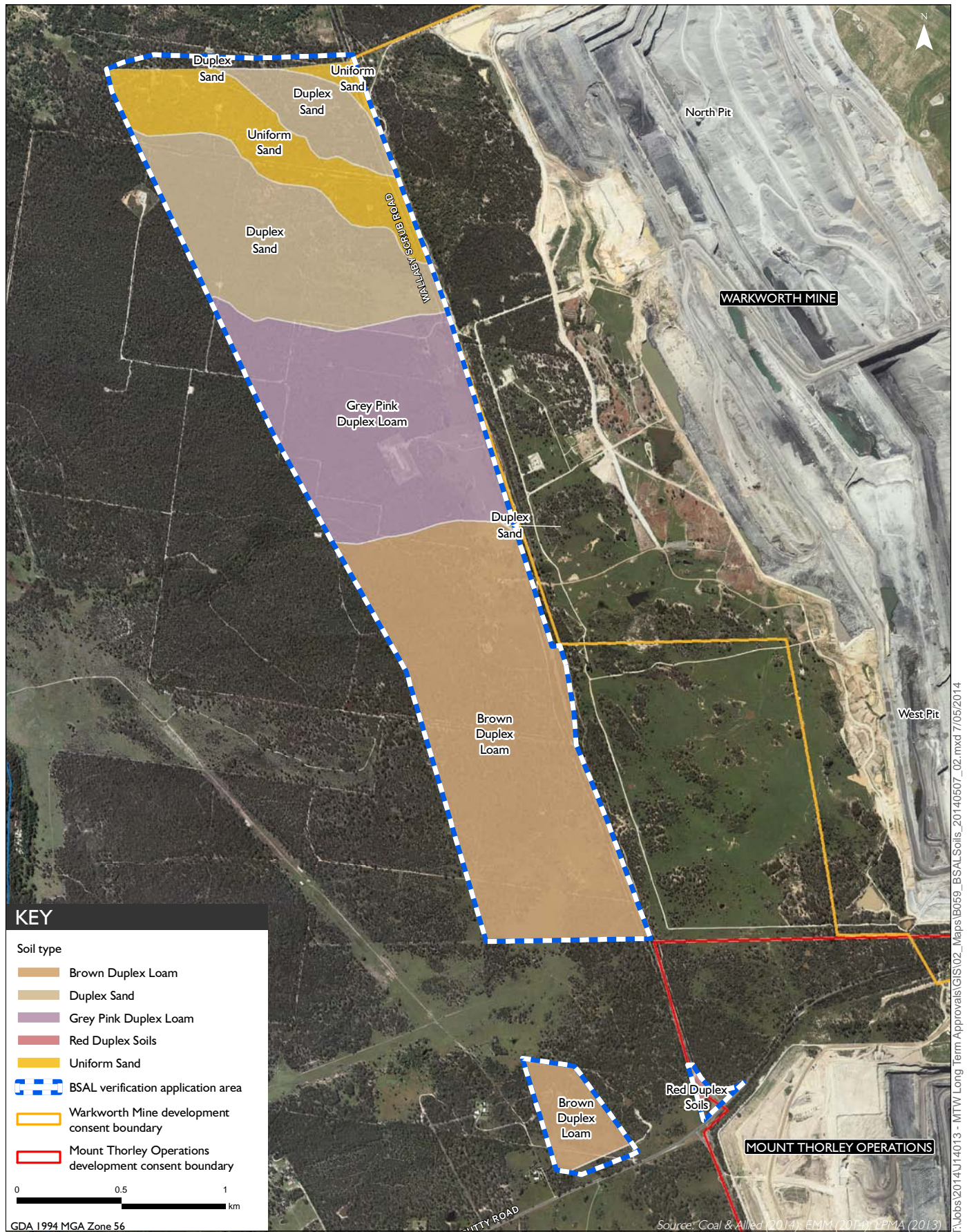
The *Interim Protocol for site verification and mapping of biophysical strategic agricultural land* (OEH 2013) in Appendix 3 describes a minimum sample density of one sample site per 25 to 400 hectares (ha) for BSAL assessment of low risk activities.

The BSAL verification of the BSAL verification application area has been done using soil descriptions and laboratory analysis reported in the Lockwood (2007) study. The relevant laboratory sample locations and soil descriptions from Lockwood (2007) are presented in Figure 3.1 and Figure 3.2 respectively. The soil descriptions and laboratory sample locations are relevant because they either fall inside or very close to the BSAL verification application area.

The BSAL verification application area is approximately 667.5 ha. The BSAL verification utilises six sample locations correlating to approximately one sample per 100 ha. The BSAL verification results described in Section 3.2 are therefore relevant for a low risk activity and satisfy guidance described in Appendix 3 of OEH (2013). It should also be noted that the site descriptions and laboratory sample locations used in this BSAL verification are evenly distributed across the BSAL verification application area, with at least one description and one set of laboratory data available for each soil unit described by GSSE (2010) and presented in Figure 3.2 .









### 3.1.2 Soil descriptions

Both GSSE (2010) and Lockwood (2007) have used different conventions for the naming of each soil unit. A comparison between the two naming conventions that shows how soil units align is provided in Table 3.1.

**Table 3.1 Soil unit classification comparison**

<b>GSSE (2010)</b>	<b>Lockwood (2007)</b>
Brown duplex loam	Sodosols (brown and yellow)
Red duplex loam	Sodosols (red)
Duplex sand	Shallow Warkworth sands (Sodosols)
Grey-pink duplex loam	Sodosols (grey)
Uniform sand	Deep Warkworth sands (Tenosols)

The Lockwood (2007) soil descriptions of the soil profile relevant to this BSAL verification assessment is provided as Appendix B.

### 3.1.3 Laboratory analysis

Laboratory analysis for the six soil units listed in Table 3.2 were completed by Lockwood (2007). The laboratory analysis is included as Appendix C.

**Table 3.2 Lockwood (2007) soil sample number and soil unit**

<b>Lockwood (2007) soil sample number<sup>1</sup></b>	<b>Soil unit<sup>2</sup></b>
HMA204	Duplex sand
HMA104	Uniform sand
HMA103	Grey-pink duplex loam
HMA101	Grey-pink duplex loam
NDA102	Brown duplex loam
NDA101	Brown duplex loam

Notes: 1. Refer to Figure 3.1.  
2. Refer to Figure 3.2 and Table 3.1

## 3.2 Results

Table 3.3 tabulates the results of the BSAL verification assessment. The BSAL verification assessment has been undertaken using the following resources:

- flow chart for site assessment of BSAL presented at Figure 2 in the *Interim Protocol for site verification and mapping of biophysical strategic agricultural land* (OEH 2013);
- soil profile descriptions;
- soil profile laboratory analysis;
- water availability from the NSW Office of Water (NOW); and



- relative fertility assessment from the Appendix 2 of the *Interim Protocol for site verification and mapping of biophysical strategic agricultural land* (OEH 2013).

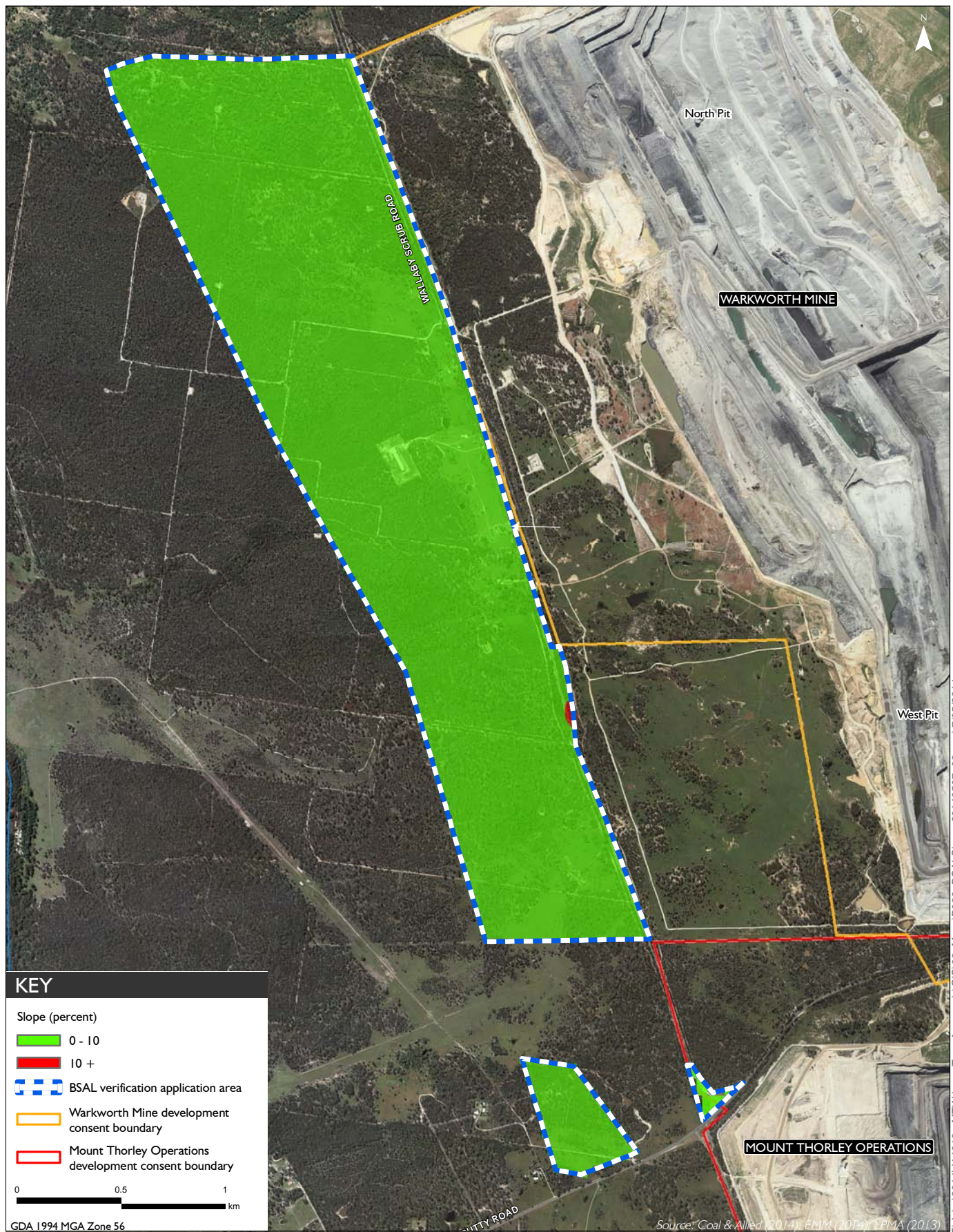
**Table 3.3**      **BSAL assessment for BSAL verification application area**

Criteria	Duplex sand (HMA204)	Uniform sand (HMA104)	Grey-pink duplex loam (HMA103)	Grey-pink duplex loam (HMA101)	Brown duplex loam (NDA102)	Brown duplex loam (NDA101)
Access to "reliable water supply" (only 1 "YES" is required to proceed)						
Within the area mapped using BOM data as having 350mm and above rainfall 9 out of 10 years?	Yes	Yes	Yes	Yes	Yes	Yes
Overlying a groundwater source declared by NOW as highly productive groundwater?	-	-	-	-	-	-
Within the area mapped by NOW as being within 150m of a highly reliable surface water supply?	-	-	-	-	-	-
Onsite verification can show access to a reliable water supply by localised groundwater conditions or alternate access to a highly reliable surface water supply via an easement	-	-	-	-	-	-
Soils and landscape verification (requires a "YES" to proceed to the next step)						
Is the slope ≤ 10% (refer to Figure 3.3)	Yes	Yes	Yes	Yes	Yes	Yes
Is there <30% rock outcrop?	Yes	Yes	Yes	Yes	Yes	Yes
Does ≤20% of area have unattached rock fragments >60mm diameter?	Yes	Yes	Yes	Yes	Yes	Yes
Does ≤50% of area have gilgais >500mm deep?	Yes	Yes	Yes	Yes	Yes	Yes
Soils and landscape verification (only 1 "YES" is required to proceed)						
Is slope between 5% and 10%? And does soil have moderately high or high fertility?	No	No	No	No	No	No
Is slope <5%? And are there some rock outcrops? And does soil have moderately high or high fertility?						
Is slope <5%? And Are there nil rock outcrops? And does soil have moderate fertility?						
Soils and landscape verification (requires a "YES" to proceed to the next step)						

**Table 3.3**      **BSAL assessment for BSAL verification application area**

Criteria	Duplex sand (HMA204)	Uniform sand (HMA104)	Grey-pink duplex loam (HMA103)	Grey-pink duplex loam (HMA101)	Brown duplex loam (NDA102)	Brown duplex loam (NDA101)
Is effective rooting depth to a physical barrier $\geq 750\text{mm}$ ?						
Is soil drainage better than poor?						
Is pH within the upper 600mm $\text{pH}_{\text{water}}$ 5–8.9 or $\text{pH}_{\text{CaCl}}$ 4.5–8.1?						
Is salinity within the upper 600mm (ECe) 4dS/m or chloride $< 800\text{mg/kg}$ when gypsum is present?						
Is effective rooting depth to a chemical barrier $\geq 75\text{mm}$ ?						
<b>Minimum area</b>						
Does the biophysical resource have a contiguous area of $\geq 20\text{ha}$ ?						
<b>BSAL</b>						
Is the Soil Management Unit (SMU) deemed to be BSAL						

Notes:    1. Source: Interim protocol for site verification and mapping of biophysical strategic agricultural land (OEH 2013).  
               2. YES\* indicates that the source information does not provide a clear no decision and therefore a yes is applied.





### 3.3 Assessment outcomes

The BSAL verification assessment is completed by exclusion. That is, once a soil has failed on one criterion it can no longer be categorised as BSAL.

The BSAL verification assessment has shown that all soil units have failed the BSAL verification assessment on the basis of having fertility less than 'moderately high'.

No soil units within the BSAL verification application area are classified as BSAL.

It should also be noted that:

- The Uniform sand/Tenosol (HMA104) would have also likely failed on the basis of rooting depth. That is the soil profile descriptions (Appendix D) indicate that the soil profile is less than 750mm.
- The Duplex soils/Sodosols (HMA204, HMA103, HMA101, NDA101 and NDA102) would have likely failed on the basis of poor drainage. That is the soil profile descriptions (from GSSE 2010) indicate the presences of gleying and mottling (refer to Table 2 of the *Interim Protocol for site verification and mapping of biophysical strategic agricultural land* (OEH 2013)).



## 4 Conclusion

The Warkworth Continuation 2014 constitutes a mining development, as defined in the Mining SEPP. The footprint of the proposal is located within a mining lease 20 m below ground level (bgl) and requires a mining lease from the surface to 20 m bgl. The majority of the footprint contains EECs.

Although there are no lands mapped as BSAL within the footprint of disturbance, and the majority of the footprint contains EECs, the proponent is still required to obtain either a gateway certificate or a BSAL site verification certificate, because a surface mining lease is required. These requirements precede lodgement of a development application.

BSAL verification has been undertaken in accordance with the Interim protocol for site verification and mapping of biophysical strategic agricultural land (OEH 2013).

The BSAL verification has found the proposal to have a low risk of agricultural impact due to the absence of agricultural resources within the footprint. The verification has found that all soil units have failed the BSAL verification assessment on the basis of having fertility less than moderately high. No soil units within the BSAL verification application area are classified as BSAL.

It should also be noted that:

- The Uniform sand/Tenosol (HMA104) would have also likely failed on the basis of rooting depth.
- The Duplex soils/Sodosols (HMA204, HMA103, HMA101, NDA101 and NDA102) would have likely failed on the basis of poor drainage.

This report has shown that the nearest CIC is approximately 5km to the south, outside the 2km barrier nominated by the SRLUP Guidelines for CICs and no further assessment is required.





## References

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GSS Environmental (2010) Warkworth mine extension: Soil survey and land resource assessment report

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Northcote KH (1971) A factual key for the recognition of Australian soils (3rd ed.) Glenside, South Australia: Rellim Technical Publications

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<http://www.resources.nsw.gov.au/environment/pgf/Glines/agricultural-impact-statements>



## Appendix A

### Statement of qualification

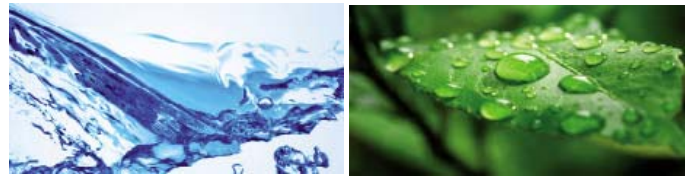
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# Curriculum vitae

## Timothy Rohde

Associate Environmental Scientist



Timothy is a Senior Environmental Scientist with 11 years environmental consulting experience in Australia and Indonesia. His work encompasses mining engineering, geotechnical engineering, unsaturated soil mechanics, soil science and geochemistry. Since 2004, he has specialised in mining waste characterisation including waste rock dumps, tailings storage facilities and heap leach piles. Timothy also specialises in closure and rehabilitation having managed projects related to closure cost estimation and technical aspects related to closure of waste rock dumps, tailings storage facilities and heap leach piles.

Timothy is uniquely placed not only understanding geochemistry of these structures but also design and closure to limit / mitigate environmental issues that these mine domains can produce.

### Education and Professional Qualifications

- PhD (Mining Engineering), University of Queensland, (UQ), 2009
- Post Graduate Diploma (Mined Land Rehabilitation), (UQ), 2004
- Bachelor of Environmental Science (Natural Resource Science), (UQ), 2002
- Chartered Professional Soil Scientist (CPSS), Stage 2

### Previous Positions and Appointments

- Senior Scientist – Mining, Sinclair Knight Merz, 2011-2012
- Senior Scientist – Mining, Environmental Earth Sciences, 2010-2011

- Senior Scientist – Mining, AECOM, 2008-2010
- Associate Lecturer / Research Fellow, The University of Queensland, 2007-2008
- Consultant to UniQuest, The University of Queensland, 2002-2007

### Professional Affiliations

- Australian Society of Soil Science
- International Union of Soil Science
- Central Queensland Mine Rehabilitation Group
- MAusIMM

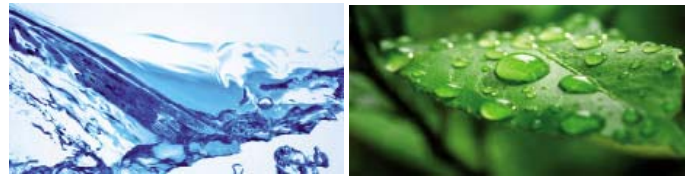
### Publications

- Chapman P.J., Willimas, D.J., and Rohde, T.K. (2009) *Unsaturated Behaviour of Tailings during Deposition and Desiccation Cycles with Reference to Closure Design*. Proceedings of the 4th Asia-Pacific Conference on Unsaturated Soils, Newcastle, Australia, 23-25 November 2009. Publisher Unknown.
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# Curriculum vitae

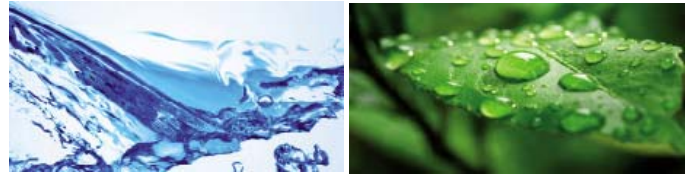
## Timothy Rohde



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- Rohde, T.K., and Williams D.J. (2011). *Waste Rock Dump Rainfall Infiltration and Base Seepage*. Proceedings of 7th Australian Workshop on Acid and Metalliferous Drainage, Darwin, Australia, 21-24 June 2011. Australian Centre for Minerals Extension Research. In Press.
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- Williams, D.J. & Rohde, T.K. (2007). *Reliability of Using Laboratory-Determined SWCC Data for Mine Waste Cover Design*. Proceedings of 4th International Conference on Mine Closure, Perth, Western Australia, 9-11 September 2009. Australian Centre for Minerals Extension Research. In Press.
- Williams, D.J. & Rohde, T.K. (2007). *Saturation required for continuum flow through different mine waste materials*. Proceedings of 10th Australia New Zealand Conference on Geomechanics, Brisbane, Australia, 21-24 October 2007, II, 280-285.
- Williams, D.J. & Rohde, T.K. (2007). *Strategies for reducing seepage from surface waste rock piles during operation and post-closure*. Proceedings of 2nd International Seminar on Mine Closure, Santiago, Chile, 16-19 October 2007, I, 521-532.
- Williams, D.J. & Rohde, T.K. (2008). *Rainfall infiltration into and seepage from waste rock piles – A review*. Proceedings of 1st International Seminar on Rock Dumps, Stockpiles and Heap Pads, Perth, Australia, 5-6 March 2008. Australian Geomechanics Centre.
- Williams, D.J. & Rohde, T.K. (2008). *Waste rock dump rainfall infiltration and base seepage at Cadia*. Proceedings of 6th Australian Workshop on Acid and Metalliferous Drainage, Burnie, Australia, 15-17 April 2008. Australian Centre for Minerals Extension Research.
- Williams, D.J., and Rohde, T.K. (2008). *Field Measurements of Mine Rock Dump Rainfall Infiltration and Base Seepage*. Geotechnical News, 26(1), 52-57.
- Williams, D.J., Rohde, T.K., Stolberg, D.J. & Pope, G. (2006). *Alternative design and instrumentation of covers over potentially acid forming mine wastes*. Proceedings of 5th International Congress on Environmental Geotechnics, Cardiff, UK, 26-30 June 2006, II, 1007-1014.

# Curriculum vitae

**Timothy Rohde**



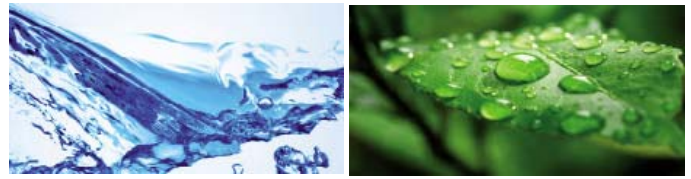
## Representative Experience

### Geochemistry Studies

- Mt Boppy, (NSW) 2011. Timothy completed a geochemistry baseline study of the Mt Boppy mine area to determine the potential for future acid mine drainage upon recommencing mining at the site. The study included a desktop review of site core logs and Total S assays to determine the likely geology units that may produce acid mine drainage. The desktop review was verified by limited sampling of the pit wall surface sulfides and the tailings storage facility. The project outcomes included a waste rock sulfur model and a waste rock management plan to limit future risk of acid mine drainage.
- Granny Deeps Project, (WA) 2010. Timothy has undertaken a geochemistry prefeasibility study for the proposed project. Project scope included development of a geochemistry block model for the proposed open pit accounting for environmental mitigation of acid rock drainage.
- Queen Bee Historical Mine, (NSW) 2010. Timothy completed a closure study for the site, satisfying the following general principles:
  - Geochemistry: This included understanding the geochemistry of waste rock and its ability to generate acid and metalliferous drainage;
  - Water Management: This included both surface water management of clean water entering clean water diversions and dirty water temporarily stored in evaporation ponds prior to removal by evaporation; and
  - Cover Design and Sediment Management: This included an understanding of the physical and chemical characteristics as well as an infiltration water balance to ensure that percolation into the underlying reactive waste rock was limited.
- Wetar Island, (Indonesia) 2008 – 2011. Timothy developed a waste rock dump design for environmental mitigation in escarped and difficult terrain. Timothy was also responsible for identifying environmental mitigation strategies and final closure and rehabilitation of the proposed heap leach pile to be constructed in sequential lifts over a 10 year period. The project is based in Indonesia, all environmental design has been approved under local laws and regulations.
- Mt Goldsworthy, (WA) 2009. Timothy undertook a review of all historical geochemistry data at the mine site to reassess potential acidity loads released to the environment (ARD). Based on the review and knowledge of local geology Timothy completed a conceptual design of a pit pump back system to return contaminated seepage to the open pit lake. Pit water quality was modelled over several years using PHREEQC.
- Stuart Oil Shale, (QLD) 2008 – 2010. Timothy has completed an assessment of the acid forming potential of waste rock and processed shale from an oil shale project near Gladstone. The assessment included kinetic column testing and leachate analysis. Timothy also designed the final covers trials for placed spent shale material (please refer to publication list).

# Curriculum vitae

## Timothy Rohde



- Olympic Dam, (SA) 2008. Timothy in collaboration with HLA completed static and kinetic testing program. Geochemical modelling (PHREEQC) was used to enhance prediction capability and assess natural attenuation mechanisms known to exist in the underlying limestone and calcareous clays.
- Telfer, (WA) 2009. Timothy identified opportunities and constraints on the use of saline mine water derived from the Telfer underground operations and addressed the key issues associated with its use on the surrounding landscape. Timothy completed a desktop review of the likely soil classification and boundaries across the mine area and undertook simple geochemical modelling (PHREEQC) to assess the likely mechanisms affecting fate and transport of surface salt resulting from evaporation of applied dust suppression water.

### Mine Site Compliance and Closure

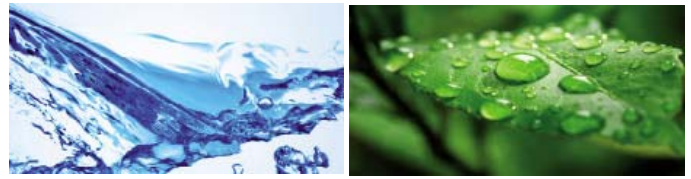
Timothy has experience in mine site compliance and closure having completed compliance and closure designs for waste rock dumps, tailings storage facilities and surface water management and release.

Recent projects include:

- Broken Head Quarry (NSW) 2012 in progress. Timothy is currently preparing a detailed closure strategy, landform model and  $\pm 30\%$  closure cost estimate investigating the option of returning the quarry area into a rural residential development.
- Channar (WA) 2012, in progress. Channar is scheduled to cease approximately in the mid 2020's. To satisfy the requirements of Channar Mining Joint Venture Agreement the site is required the development of a closure plan and Cost Estimate to a  $\pm 20\%$  level of accuracy. Timothy's role on the project was as Landform Design Manager. In this role Timothy lead a team of 6 people as well as completing technical works related to geochemistry and soil science. Timothy was also responsible for developing the work packet for Mining One Consulting and management of the sub-consultants and technically reviewing their work.
- Stanwell Power Assets (QLD) 2011. Timothy was part of a multi-disciplinary team working on a decommissioning plan, order-of-magnitude cost estimate and rehabilitation plan for a number of power generation assets owned and operated by Stanwell Power throughout Queensland. Timothy was responsible for delineating potential site contamination and closure and rehabilitation strategies. Strategies include developing bills of quantities as foundation assumptions towards the cost estimation study.
- QAL, (QLD) 2011. To comply with Rio Tinto's Closure Standard, QAL was updating an existing closure plan prepared in 2003. The closure plan included the refinery, associated red mud dam areas and the wharf and storage facility located on South Trees Island connected to the mainland by a causeway bridge. Timothy was the Project Manager on the project and coordinated a team of 12 people, including cost estimator, engineers and scientists. Timothy was also responsible for preparing the final deliverables (Knowledge base review, Closure strategy, Closure management plan and Closure cost estimate).
- Tanami Gold, (NT) 2011. Timothy authored the Notice of Intent (NOI) for the Central Tanami Project (former Groundrush, Newmont Asia Pacific). The purpose of the NOI is to provide the NT government with sufficient detail to determine whether the project will be reviewed by either the EIS / PER process.

# Curriculum vitae

## Timothy Rohde



- Crocodile Gold, (NT) 2009. Timothy has undertaken Mine Management Plans and Water Management Plans for five operations prior to start-up to gain regulatory approval. Compliance reporting included developing a site water balance and a conceptual land irrigation area.
- Ranger Uranium Mine, (NT) 2008. Investigated compliance issues for RUM arising from deluge and cyclone events that resulted in pit inundation and lost production.
- Wetar Mine, Wetar (Indonesia) 2008 and 2010. Timothy has investigated the unsaturated soil mechanics behind the operational water balance for a copper heap leach pad and completed engineered closure designs. The 2010 study included conceptual design of a waste rock dump built within a coastal valley. Design considered potential environmental impacts and strategies to mitigate these potential effects.
- Newcrest Mine, (NSW) 2005 to 2008. Timothy has successfully designed an alternative closure plan resulting in management of acid rock drainage, reduced earthworks and increased visual amenity by designing the final closure plan in sympathy to the surrounding landscape.
- Century-Zinifex Mine, (QLD) 2007. Contribution to waste rock dump closure planning.
- Cosmos Nickel Mine, (WA) 2006 to 2008. Contributed to the ongoing compliant closure plan for a potentially contaminating tailings storage facility.

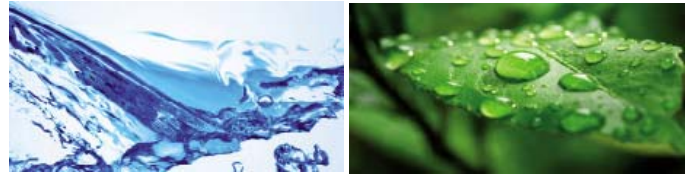
Timothy has prepared Mine Closure and Rehabilitation Plans including probabilistic closure cost estimation.

Recent experience includes:

- Mt Keith Nickel Operation, (WA) 2010
- Leinster Nickel Operation, (WA) 2010
- Kambalda Nickel Concentrator, (WA) 2010
- Kalgoorlie Nickel Smelter, (WA) 2010
- Kwinana Nickel Refinery, (WA) 2010
- Muja South, (WA) 2010
- Dawson Coal Mine (QLD) 2010
- Wetar Mine, Wetar (Indonesia) 2009

# Curriculum vitae

## Timothy Rohde



### Material Management

Timothy has undertaken compaction trials (and testing of hydraulic conductivity) for a number of clients to assess the compaction performance of overburden, including rocky spoil, clayey overburden and Vertosols. These studies have involved private enterprise projects, some being highly sensitive from a political or environmental perspective.

Recent projects include:

- Century-Zinifex Mine, (QLD) 2007
- Ensham Coal Mine, (QLD) 2007
- Newcrest Mine, (NSW) 2005 to 2006

The main objective of these studies has been to assess the relative efficiency of haul truck and scrapper compaction of trafficked waste rock surfaces to assess the viability of non-inclusion of compacted clay restrictive seals as part of final closure design.

### Landform and Closure Design

- Blair Athol, (QLD) 2012. Timothy was engaged by Rio Tinto Coal Australia to undertake a literature review of all relevant documentation related to landform design and closure for the Blair Athol mine. Based on the review of soil chemistry and spoil geochemistry Tim developed a field validation program to assess stockpile suitability for closure and to assess the performance of existing rehabilitated areas against a hybrid set of closure criteria that Tim developed from the Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland. Based on the available literature and site validation program Tim assessed simple slopes and all of catchments for erosion potential and rates using MINerosion 3.1 and 4.1. Based on the study Blair Athol mine was able to refine their landform scheduling model and adjust their closure cost estimation accordingly.

Timothy has developed and constructed world-class demonstrations of instrumented waste rock dumps and tailings storage facilities. Instrumentation has included:

- Full weather stations to record rainfall, temperature, humidity, wind speed and direction, actual evaporation, and solar radiation;
- Lysimeters to measure base seepage and trafficked surface infiltration; and
- Temperature sensors and gas sampling tubes to assess oxygen levels and oxidation.

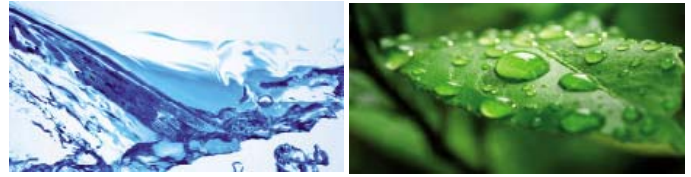
Recent projects include:

- Mt Keith Nickel Operation, (Conceptual Only) (WA), 2010
- Leinster Nickel Operation, (Conceptual Only) (WA), 2010



# Curriculum vitae

## Timothy Rohde



- Kambalda Nickel Concentrator, (Conceptual Only) (WA), 2010
- Kalgoorlie Nickel Smelter, (Conceptual Only) (WA) 2010
- Kwinana Nickel Refinery, (WA) 2010
- Toms Gully, (Conceptual Only) (NT) 2009
- Millennium Coal Mine, (QLD) 2009 to 2010
- North Point and Princess Louise, (Conceptual Only) (NT) 2009
- Cosmos Mine, (WA) 2006 to 2008
- Newcrest Mine, (NSW) 2003 to 2008
- Olympic Dam, (Conceptual Only) (SA) 2008

### Cover Design

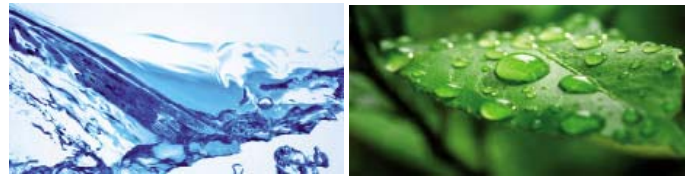
Timothy has developed and constructed world-class demonstrations of cover design trials at a number of mine sites throughout Australia. He has evaluated the “store/release” cover system as the preferred approach in semi-arid conditions, such as those that exist over much of Australia. Timothy has developed as an alternative, a thick mono-layer of overburden design. He has designed and installed real-time monitoring systems using time domain reflectometry to measure volumetric water content, thermocouple sensors to measure soil suction, and lysimeters to measure percolation rates at the cover/waste interface and the waste/foundation interface. Timothy is an experienced modeller and routinely uses HYDRUS-2D and Vadose/w.

Recent projects include:

- Century Mine (QLD) 2012
- Iluka Mineral Sands (Vadose/w) (SA) 2012
- Brukunga Legacy Site (Vadose/w) (SA) 2012
- Mt Keith Nickel Operation, (Conceptual Only) (WA) 2010
- Leinster Nickel Operation, (Conceptual Only) (WA) 2010
- Kambalda Nickel Concentrator, (Conceptual Only) (WA) 2010
- Kalgoorlie Nickel Smelter, (Conceptual Only), (WA) 2010
- Francis Creek, (NT) 2009

# Curriculum vitae

## Timothy Rohde



- Toms Gully, (Conceptual Only) (NT) 2009
- Millennium Coal Mine, (QLD) 2009 to 2010
- North Point and Princess Louise, (Conceptual Only) (NT) 2009
- Newcrest Mine, (NSW) 2003 to 2008
- Stuart Shale Oil, (QLD) 2005
- Kidston Mine, (QLD) 2003

### Mining Co-disposal

Timothy has been involved in the development of co-disposal techniques. He developed co-disposal to allow better use of available storage volume, better grading and limit oxygen ingress. Key findings from Timothy's work have included improved grading by co-disposal limits oxygen ingress via the base rubble zone and coarse-grained angle of repose layers. In addition, co-disposal results in an increased water holding capacity. This means that the mixture will remain saturated to a greater degree than relatively free-drained coarse waste rock, reducing the availability of oxygen and potential oxidation of any sulfides present, thus further reducing the potential for Acid Mine Drainage.

Recent projects include:

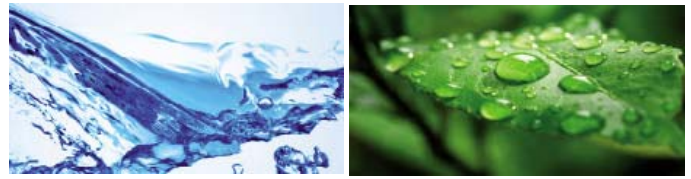
- Kestrel Coal Mine, (QLD) 2009
- Fortescue, (WA) 2008

### Soil Assessment and Land Suitability

- Moolarben Coal (NSW) 2012. Preparation of s Strategic Agricultural Assessment including the assessment of biophysical strategic agricultural land (BSAL). The assessment was completed by desktop by analysis of a previously completed soil survey of the mine lease.
- Saraji East (QLD) 2012. Preparation of a Protection Order for submission to the DERM for confirmed strategic cropping. The soil survey and protection order were used to reconfigure the mine operation, allowing mining to proceed, while protecting some of the states prime agricultural land.
- Collingwood and Taroom (QLD) 2012. The project involved a soil survey to describe and map soils using the Australian Soil Classification and Northcote Key to a depth of 1 m. The project is heavily centred on strategic cropping land due to its proximity to the central protection area. Timothy's involvement in the project is project direction and management and mentoring of junior staff members that have been progressively trained throughout 2011.
- Peak Downs Expansion (QLD) 2011. The study included a desktop assessment and field survey. The field survey includes describing soil using the Australian Soils Classification and Northcote Key to a depth of 1 m. Reporting

# Curriculum vitae

## Timothy Rohde

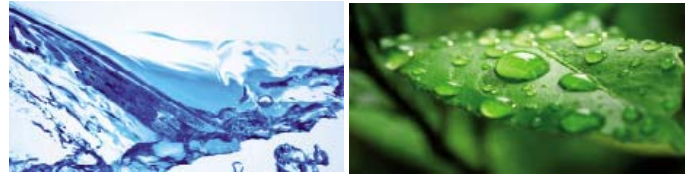


includes management of soil units and preservation for rehabilitation of the mine site post closure. Project also includes project management and development and training of junior staff.

- New Acland (QLD) 2011. Development of a Topsoil Stripping and Management Plan. The Topsoil Stripping and Management Plan objectives includes: Devise and maintain a topsoil balance that achieves rehabilitation objectives during the life of the mine; Ensure effective topsoil removal techniques are employed to maximise volumes of suitable topsoil and minimise wastage; and Maintain topsoil viability during stripping, spreading and stockpiling, through best practice techniques and effective stockpile design and treatment. Project also includes project management and development and training of junior staff.
- Wards Well (QLD) 2011. The study included a desktop assessment and field survey. The field survey includes describing soil using the Australian Soils Classification and Northcote Key to a depth of 1 m. Reporting includes management of soil units and preservation for rehabilitation of the mine site post closure. Project also includes project management and development and training of junior staff.
- Arrow Energy (QLD) 2011. The study included a desktop assessment and field survey. The field survey included describing soil using the Australian Soils Classification and Northcote Key to a depth of 1 m. Reporting includes management of soil units during construction of the pipeline.
- Xstrata (QLD) (2010). Timothy completed baseline studies for geology, soil and landscape and closure and rehabilitation for the Rolleston West Expansion EIS. Studies included gap analysis of existing data from the operational Rolleston Mine, advice to site geology staff on chip sampling from the exploration program and reporting of geochemistry, soil characteristics and landform design for the proposed expansion. Studies accounted for future possible expansion, without sterilising future resources.
- Ipswich City Council (QLD) 2010. This Soils of Ipswich Field Guide was developed to assist in identifying soils at risk of erosion, so appropriate erosion and sediment control measures could be implemented. Activities to which this applies included:
  - Building and maintaining roads and services;
  - Infrastructure (e.g. stormwater, potable water, sewers etc.);
  - Construction works (e.g. building, installation of minor infrastructure in parks etc) and landscaping;
  - Designing, approving and monitoring development activities; and
  - Any other activities that require the excavation and/or trenching of soils.
- The ultimate aim was to assist in preventing the erosion and transport of sediment to infrastructure (e.g. roadways, stormwater systems etc)
- Linc Energy (QLD) 2008. The study included a desktop assessment and field survey. Field soil survey locations were selected to include sites representative of the main soil types occurring within the study area. The Queensland Universal Soil Loss Equation (USLE) K-factor data was used to identify soils that are susceptible to erosion.

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## **Acid Sulfate Soil Management**

Timothy has developed environmental management plans for control and management of acid sulfate soils, water quality, and sediment and erosion control for coastal land developments.

Recent projects include:

- Gloucester to Hexham Pipeline, (NSW) 2010
- Black Swamp, (QLD) 2009 and 2010
- Curtis Island LNG, (QLD) 2010
- Brisbane Eastern Busway, (QLD) 2009
- Darling Walk, (NSW) 2008

## **Mine Water Management**

Timothy has been involved in the development of site water balances using GoldSim at the following mine site:

- Burton Coal Mine, (QLD) 2010

In addition Timothy has developed Final Void Management Plans for:

- Werris Creek Coal Mine, (NSW) 2010

## Appendix B

### Lockwood (2007) soil profile descriptions

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## Sodosols and related soils (depth to clay <0.5 m)

**Profile:** NDA101 (core)

**Location:** 56H 316758E 6388536N

**ASC:** Brown Sodosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
A1	0 - 50	Dark yellowish brown (10YR 4/4)	—	Silty loam	Weak polyhedral (10 mm)	—	Firm	Clear
A2	50 – 150	Dark yellowish brown (10YR 4/5)	—	Silty loam	Massive	—	Firm	Abrupt
B21	150 – 400	Yellowish brown (7.5YR 5/8)	—	Medium heavy clay	Strong prismatic	—	Strong	Gradual
B22	400 - 900	Yellowish brown (10YR 5/6)	—	Medium heavy clay	Strong angular blocky	—	Strong	Gradual
B3	900 – 1000+	Yellow (10YR 7/6)	—	Silty clay	Moderate angular blocky	Weathered sandstone	Strong	

**Profile no:** NDA102 (core)

**Location:** 56H 315584E 6388715N

**ASC:** Brown Sodosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
A1	0 – 20	Dark yellowish brown (10YR 4/4)	—	Silty loam	Massive	—	Firm	Abrupt
A2	20 – 120	Yellowish brown (10YR 5/4)	—	Silty loam	Massive	—	Firm	Sharp
B21	120 – 450	Strong brown (7.5YR 4/6)	Few fine distinct dark	Heavy clay	Strong polyhedral	—	Strong	Gradual
B22	450 – 700	Yellowish brown (10YR 5/6)	—	Heavy clay	Moderate polyhedral	—	Strong	Gradual
B3	700 – 900+	Brownish yellow (10YR 6/6)	—	Medium clay	Moderate polyhedral	Weathered sandstone	Strong	

**Profile no:** NDA103 (core)

**Location:** 56H 314715E 6388649N

**ASC:** Yellow Dermosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
A1	0 – 30	Dark yellowish brown (10YR 4/4)	—	Sandy clay loam	Massive	—	Very firm	Abrupt
A2	30 – 100	Brown (10YR 4/3)	—	Sandy clay loam	Massive	—	Very firm	Sharp
B2	100 – 400	Brownish yellow (10YR 6/6)	Many medium distinct pale	Light clay	Strong prismatic	—	Strong	Gradual
B3	400 – 500+	Yellowish brown (10YR 5/6)	Many medium distinct brown	Light clay	Moderate blocky	—	Strong	

**Profile no:** HMA101 (core)

**Location:** 56H 315562E 6389819N

**ASC:** Grey Sodosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
A1	0 – 50	Brown (10YR 4/3)	—	Light sandy loam	Massive	—	Weak	Clear
A2	50 – 300	Light grey (10YR 7/2)	—	Light sandy loam	Massive	Common subangular quartz (10 – 20 mm)	Weak	Sharp
B2	300 – 500+	Light brownish grey (10YR 6/2)	—	Medium clay	Moderate blocky	—	Strong	

**Profile no:** HMA103 (core)

**Location:** 56H 314429E 6391309N

**ASC:** Brown Sodosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
A1	0 – 75	Dark yellowish brown (10YR 4/4)	—	Loamy sand	Weak subangular blocky (10 – 20 mm)	—	Very weak	Clear
A2	75 – 300	Yellowish brown (10YR 5/4)	—	Clayey sand	Massive	—	Very weak	Sharp
B2	300 – 1000+	Yellowish brown (10YR 5/8)	Common medium distinct pale	Medium clay	Strong angular blocky	—	Very firm	

**Profile no:** HMA202 (core)

**Location:** 56H,314236,6392647

**ASC:** Brown Sodosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
A1	0 – 50	Dark yellowish brown (10YR 3/4)	—	Sandy clay loam	Weak subangular blocky (10 – 20 mm)	—	Firm	Clear
A2	50 – 150	Brown (10YR 4/3)	—	Sandy clay loam	Massive	—	Firm	Sharp
B21	150 – 1100	Dark yellowish brown (10YR 4/6)	Common medium distinct yellowish brown	Heavy clay	Strong angular blocky	—	Strong	Diffuse
B22	1100 – 1400+	Yellowish brown (10YR 5/4)	Common medium distinct yellowish brown and dark	Medium clay	Strong angular blocky	—	Strong	

**Profile no:** HMA206 (pit)

**Location:** 56H 314229E 6392661N

**ASC:** Brown Sodosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
A1	0 – 150	10YR 3/3 (dark brown)	—	Clay loam	Weak subangular blocky (20 – 30 mm)	—	Very firm	Clear
A2	150 - 300	10YR 5/3 (brown)	—	Clay loam	Massive	—	Strong	Sharp
B2	300 – 1200	10YR 5/3 (brown)	—	Heavy clay	Strong prismatic (25 – 50 mm) breaking to strong polyhedral (10 mm)	—	Very strong	Gradual
B3	1200 – 1400+	10YR 5/4 (yellowish brown)	Common coarse prominent brownish yellow (10YR 6/8) and few medium prominent light grey (10YR 7/1)	Medium clay	Strong prismatic (30 – 40 mm)	—	Strong	

**Profile no:** NDA201 (core)

**Location:** 56H 315407E 6392711N

**ASC:** Brown Chromosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
A1	0 – 150	Brown (7.5YR 4/4)	—	Clay loam	Moderate granular (5-10 mm)	—	Strong	Abrupt
B2	150 – 700	Strong brown (7.5YR 4/6)	Few medium prominent pale and dark	Medium clay	Strong angular blocky	—	Strong	Gradual
C	700 – 1000+	—	—	—	—	Weathered sandstone	Strong	



**Profile no:** NDA202 (core)

**Location:** 56H 316047E 6393025N

**ASC:** Brown Sodosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
A1	0 - 120	Dark yellowish brown (10YR 4/4)	Common fine distinct brown	Clay loam	Weak subangular blocky (10 – 20 mm)	—	Firm	Sharp
B21	120 - 600	Yellowish brown (10YR 5/4)	Common medium distinct pale and few fine prominent red	Medium heavy clay	Strong angular blocky	—	Strong	Diffuse
B22	600 – 1400+	Light grey (2.5Y 7/2)	Common fine prominent yellow-brown	Medium heavy clay	Strong angular blocky	—	Strong	

**Profile no:** HMA301 (core)

**Location:** 56H 317636E 6393737N

**ASC:** Grey Sodosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
A1	0 - 25	Dark yellowish brown (10YR 4/4)	—	Sandy clay loam	Weak subangular blocky (20 mm)	—	Firm	Clear
A2	25 - 100	Yellowish brown (10YR 5/4)	—	Sandy clay loam	Massive	Common subrounded quartz (10 – 15 mm)	Firm	Sharp
B21	100 - 1100	Pale brown (10YR 6/3)	Common very coarse distinct dark and few fine distinct yellow	Medium heavy clay	Strong prismatic	—	Strong	Diffuse
B22	1100 – 1300+	Ligt grey (10YR 7/2)	Many medium prominent yellow	Medium heavy clay	Strong prismatic	—	Strong	

**Note:** sand in cracks in B2 horizons.

**Profile no:** HMA302 (core)

**Location:** 56H 315929E 6394554N

**ASC:** Yellow Sodosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
A1	0 – 40	Dark brown (10YR 3/3)	—	Sandy loam	Weak subangular blocky (20 – 30 mm)	—	Firm	Clear
A2	40 – 200	Yellowish brown (10YR 5/4)	—	Clayey sand	Massive	—	Weak	Sharp
B2	200 – 900+	Light yellowish brown (10YR 6/4)	Many coarse distinct strong brown and few fine distinct dark reddish brown	Medium clay	Strong prismatic	—	Strong	

**Profile no:** ARCH02 (core)

**Location:** 56H 317137E 6400647N

**ASC:** Brown Sodosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
A1	0 -50	Dark yellowish brown (10YR 3/4)	—	Loam	Moderate subangular blocky (10 - 20 mm)	—	Firm	Clear
A2	50 – 120	Dark yellowish brown (10YR 4/6)	—	Sandy clay loam	Weak subangular blocky	—	Firm	Sharp
B2	120 – 1500+	Yellowish brown (10YR 5/6)	Common medium distinct dark and pale brown	Medium clay	Strong prismatic	—	Strong	

**Profile no:** ARCH09 (pit)

**Location:** 56H 316418E 6402391N

**ASC:** Grey Sodosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
A1	0 - 100	Dark brown (7.5YR 3/2)	—	Clayey sand	Weak subangular blocky (10-20 mm)	—	Moderate	Clear
A2	100 - 200	Pinkish grey (7.5YR 6/2)	—	Loamy sand	Massive	—	Weak	Sharp
B2	200 - 1300	Light brown (7.5YR 6/3)	Many very coarse prominent strong brown (7.5YR 5/8)	Medium clay	Strong columnar (120 – 200 mm)	—	Strong	Diffuse
C	1300 – 1500+	Light grey (7.5YR 7/1)	Many very coarse prominent strong brown (7.5YR 5/6)	Sandy clay loam	Massive	—	Strong	

**Profile no:** ARCH11 (pit)

**Location:** 56H 316939E 6402995N

**ASC:** Grey Sodosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
A1	0 - 200	7.5YR 4/4 (brown)	—	Loamy sand	Weak subangular blocky (10 – 20 mm)	—	Weak	Gradual
C	200 - 550	7.5YR 6/4 (light brown)	—	Loamy sand	Massive	—	Weak	Sharp
2B2	550 - 1000	7.5YR 6/3 (light brown)	Many very coarse distinct reddish yellow (7.5YR 6/8)	Medium heavy clay	Strong columnar (150 – 250 mm)	—	Strong	Diffuse
2C	1000 – 1600+	7.5YR 5/6 (strong brown)	Many very coarse distinct light brown (7.5YR 6/3)	Sandy clay loam	Massive	—	Strong	

## Arenic Rudosols overlying buried soils (depth to clay 0.5 – 2 m)

**Profile no:** HMA102 (core)

**Location:** 56H 314135E 6389965N

**ASC:** Arenic Rudosol/Brown Sodosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
A1	0 -50	Dark brown (7.5YR 3/3)	—	Sand	Single grain	—	Loose	Abrupt
C1	50 -300	Yellowish red (5YR 5/6)	—	Sand	Single grain	—	Loose	Gradual
C2	300 – 700	Pink (5YR 7/3)	—	Sand	Single grain	—	Loose	Sharp
2B2b	700 – 1300+	Brown (10YR 5/3)	—	Medium clay	Strong blocky	—	Strong	

**Profile no:** HMA104 (core)

**Location:** 56H 315056E 6391557N

**ASC:** Arenic Rudosol/Grey Sodosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
A1	0 – 100	Dark yellowish brown (10YR 4/4)	—	Loamy sand	Weak subangular blocky (10 – 20 mm)	—	Very weak	Gradual
C1	100 – 250	Very pale brown (10YR 7/3)	—	Sand	Single grain	—	Loose	Gradual
C2	250 – 500	Light grey (10YR 7/2)	—	Sand	Single grain	—	Loose	Sharp
2B2b	500 – 900+	Light brownish grey (10YR 6/2)	Common medium prominent orange	Medium heavy clay	Strong angular blocky	—	Strong	

**Profile no:** HMA203 (core)

**Location:** 56H 314159E 6392184N

**ASC:** Arenic Rudosol/Grey Sodosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
A1	0 - 150	Dark yellowish brown (10YR 4/4)	—	Loamy sand	Massive to weak subangular blocky (10 - 20 mm)	—	Very weak	Diffuse
C	150 – 800	Very pale brown (10YR 7/3)	—	Sand	Single grain	—	Loose	Clear
2B2	800+	Very pale brown (10YR 7/3)	Few fine prominent strong brown	Medium clay		—		

**Profile no:** HMA303 (core)

**Location:** 56H 316544E 6393408N

**ASC:** Arenic Rudosol/Brown Kurosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
A1	0 - 15	Brown (7.5YR 4/4)	—	Loamy sand	Weak platy (15 mm)	—	Weak	Clear
C	15 - 600	Light brown (7.5YR 6/4)	—	Sand	Single grain	—	Very weak	Sharp
2B2b	600 - 850	Strong brown (7.5YR 5/8)	Many medium prominent pale and light grey	Medium clay	Strong prismatic	—	Very firm	Gradual
2C	850+					Weathered sandstone		



**Profile no:** ARCH01 (core)

**Location:** 56H 317071E 6401148N

**ASC:** Arenic Rudosol/Grey Sodosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
A1	0 - 120	Dark brown (10YR 3/3)	—	Loamy sand	Weak subangular blocky (10 – 30 mm)	—	Weak	Gradual
C	120 - 550	Yellowish brown (10YR 5/4)	—	Sand	Single grain	—	Weak	Abrupt
2B2b	550 – 1050+	Light brownish grey (10YR 6/2)	Many coarse prominent strong brown	Light medium clay (with some coarse sand)	Strong angular blocky	—	Very firm	

**Profile no:** ARCH05 (core)

**Location:** 56H 316569E 6402275N

**ASC:** Arenic Rudoaol/Brown Sodosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
A1	0 - 200	Dark reddish brown (5YR 3/4)	—	Loamy sand	Weak subangular blocky (10 – 20 mm)	—	Very weak	Diffuse
C	200 - 600	Reddish brown (5YR 5/3)	—	Sand	Single grain	—	Loose	Abrupt
2B2b	600 – 650+	Yellowish brown (10YR 5/6)	Many medium distinct pale	Medium clay	Strong prismatic	—	Strong	

**Profile no:** ARCH07

**Location:** 56H 316933E 6403003N

**ASC:** Arenic Rudosol/Grey Sodosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
A1	0 - 50	Dark brown (7.5YR 3/4)	—	Loamy sand	Single grain to massive	—	Very weak	Clear
C1	50 - 350	Brown (7.5YR 4/4)	—	Loamy sand	Single grain to massive	—	Very weak	Clear
C2	350 - 650	Brown (7.5YR 5/4)	—	Loamy sand	Single grain to massive	Few subangular quartz (10 – 15 mm)	Very weak	Abrupt
2B2b	650 – 1000+	Light grey (10YR 7/2)	Many medium prominent yellowish brown	Medium clay	Strong prismatic	—	Strong	

**Profile no:** ARCH10 (pit)

**Location:** 56H 317448E 6402100N

**ASC:** Arenic Rudosol/Grey Dermosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
A1	0 - 200	7.5YR 3/3 (dark brown)	—	Sand	Massive to weak subangular blocky	—	Very weak	Diffuse
C	200 - 1300	7.5YR 6/2 (pinkish grey)	Very few medium prominent strong brown	Sand	Single grain	—	Loose	Clear
2Ab	1300 - 1600	7.5YR 7/2 (pinkish grey)	Many very coarse prominent yellowish red (5YR 5/6)	Sandy clay loam	Massive	—	Strong	Gradual
2B2b	1600 – 1700+	7.5YR 7/2 (pinkish grey)	Many very coarse prominent reddish yellow (5YR 6/8)	Clay loam, sandy	Moderate angular blocky (20 – 40 mm)	—	Strong	

## Arenic Rudosols and Orthic Tenosols (depth to clay >2 m)

**Profile no:** HMA201 (core)

**Location:** 56H 314809E 6392453N

**ASC:** Arenic Rudosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
A11	0 - 50	Dark yellowish brown (10YR 4/4)	—	Loamy sand	Weak subangular blocky (10 – 20 mm)	—	Very weak	Clear
A12	50 - 300	Yellowish brown (10YR 5/4)	—	Sand	Single grain	—	Loose	Diffuse
C	300 – 1300+	Very pale brown (10YR 7/3)	—	Sand	Single grain	—	Loose	

**Profile no:** HMA204 (core)

**Location:** 56H 314993E 6392074N

**ASC:** Arenic Rudosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
A1	0 – 25	Yellowish brown (10YR 5/6)	—	Sand	Single grain	—	Loose	Clear
C	25 – 1500+	Brownish yellow (10YR 6/6)	—	Sand	Single grain	—	Loose	

**Profile no:** HMA205 (pit + sand auger)

**Location:** 56H 314800E 6392456N

**ASC:** Bleached-Orthic Tenosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
A1	0 – 100	7.5YR 4/3 (brown)	—	Sand	Single grain	—	Loose	Gradual
A2e	100 – 2500	7.5YR 7/4 (pink)	—	Sand	Single grain	Very few subrounded ferromanganiferous concretions (10 – 20 mm)	Loose	Gradual
B21	2500 – 5500	7.5YR 5/8 (strong brown)	Many coarse prominent light grey (10YR 7/1)	Clayey sand	Massive	—	Very weak	Diffuse
B22	5500 – 6000+	2.5YR 4/8 (red brown)	—	Clayey sand	Massive	—	Very weak	

**Profile no:** HMA304 (core)

**Location:** 56H 316987E 6393415N

**ASC:** Arenic Rudosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
A1	0 – 60	Dark yellowish brown (10YR 4/4)	—	Loamy sand	Single grain	—	Loose	Clear
C	60 – 1300+	Pale brown (10YR 6/3)	—	Loamy sand	Single grain	—	Loose	

**Profile no:** ARCH04 (core)

**Location:** 56H 317462E 6402102N

**ASC:** Brown-Orthic Tenosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
A1	0 - 400	Dark yellowish brown (10YR 3/4)	—	Sand	Single grain	—	Loose	Diffuse
A2	400 - 900	Brown (10YR 5/3)	—	Sand	Single grain	—	Loose	Clear
B2w	900 – 1400+	Yellowish brown (10YR 5/6)	Common fine prominent strong brown	Sand	Single grain	—	Loose	

**Profile no:** ARCH06

**Location:** 56H 316857E 6402778N

**ASC:** Arenic Rudosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
A11	0 - 30	Brown (7.5YR 4/3)	—	Loamy sand	Weak platy (15 mm)	—	Very weak	Clear
A12	30 - 500	Brown (7.5YR 4/3)	—	Sand	Single grain	—	Loose	Diffuse
C?	500 – 1500+	Strong brown (7.5YR 4/6)	—	Sand	Single grain	—	Loose	

## Black Dermosols

**Profile no:** ARCH03 (core)

**Location:** 56H 317698E 6400659N

**ASC:** Black Dermosol (?)

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
Ap	0 - 100	Very dark brown (10YR 2/2)	—	Light clay	Disturbed fragments (recently cultivated)	—	Very firm	Clear
B2?	100 – 1400+	Very dark brown (10YR 2/2)	—	Light clay	Strong angular blocky	—	Strong	

**Profile no:** ARCH08 (core)

**Location:** 56H 317045E 6403575N

**ASC:** Black Dermosol

Horizon	Depth (mm)	Colour (moist)	Mottles	Field texture	Structure	Coarse fragments, segregations	Consistence (dry)	Boundary
Ap	0 - 100	Very dark brown (7.5YR 2/3)	—	Light clay	Weak blocky (30 – 50 mm)	—	Very firm	Clear
B21	100 - 700	Very dark brown (7.5YR 2/2)	—	Light clay	Strong polyhedral (10 – 20 mm)	—	Very firm	Gradual
B22	700 – 1500+	Dark brown (7.5YR 3/3)	—	Light clay	Strong polyhedral (20 – 30 mm)	—	Very firm	





## Appendix C

Lockwood (2007) laboratory analysis

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**Sodosols and related soils: soil chemical and physical analyses.**

Site	Depth m	pHw	Bray P mg/kg	Carbon %	Ex Al cmol <sub>c</sub> /kg	Ex Ca cmol <sub>c</sub> /kg	Ex Mg cmol <sub>c</sub> /kg	Ex Na cmol <sub>c</sub> /kg	Ex K cmol <sub>c</sub> /kg	ECEC cmol <sub>c</sub> /kg	ECe dS/m	ESP %	Emerson class	Loveday & Pyle
NDA101	0 - 0.1	5.5	4.9	2.15	0.0	8.0	4.8	0.7	1.2	14.7	0.87	5.0	5	2.0
NDA101	0.1 - 0.2	6.3	1.1	0.80	0.0	5.0	5.0	1.0	0.5	11.5	0.46	8.7	3b	6.0
NDA101	0.2 - 0.5	5.9	1.3		0.0	9.5	12.9	3.8	0.6	26.7	1.32	14.3	1	14.0
NDA101	0.5 - 1.0	6.4	1.0		0.0	8.5	14.3	7.1	0.5	30.3	2.47	23.5	2	13.5
NDA102	0 - 0.1	5.9	2.7	2.00	0.0	3.2	6.3	1.0	1.0	11.4	1.03	8.4	3b	5.5
NDA102	0.1 - 0.2	6.0	0.6	0.77	0.0	1.0	7.0	1.9	0.3	10.2	0.83	18.6	3b	8.0
NDA102	0.2 - 0.5	6.0	0.5		0.0	2.4	30.5	9.2	0.6	42.7	3.61	21.5	1	15.0
NDA102	0.5 - 1.0	6.8	1.9		0.0	1.9	26.0	8.9	0.6	37.3	3.71	23.8	1	15.0
NDA103	0 - 0.1	5.8	1.3	1.17	0.0	3.0	7.8	1.2	0.7	12.8	0.80	9.5	3b	6.5
NDA103	0.1 - 0.2	6.0	0.8	1.09	0.0	2.8	9.4	2.0	0.5	14.6	0.99	13.4	2	11.0
NDA103	0.2 - 0.5	6.1	0.6		0.0	1.4	14.9	5.6	0.3	22.2	2.62	25.2	2	13.0
NDA103	0.5 - 1.0	6.6	0.4		0.0	1.1	17.8	8.9	0.4	28.2	1.17	31.5	2	14.0
NDA201	0 - 0.1	6.0	1.9	2.40	0.0	16.3	3.8	0.2	2.5	22.8	0.87	0.9	3b	5.5
NDA201	0.1 - 0.2	6.3	1.1	1.93	0.0	17.7	3.5	0.1	2.0	23.3	0.65	0.5	3a	6.5
NDA201	0.2 - 0.5	7.2	2.5		0.0	29.8	4.5	0.2	1.6	36.1	1.12	0.5	6	0.0
NDA201	0.5 - 1.0	8.3	0.8		0.0	28.6	5.8	0.1	0.9	35.4	0.67	0.4	5	0.0
NDA202	0 - 0.1	6.0	1.1	1.72	0.0	5.9	6.3	0.7	1.0	13.9	0.55	5.0	3b	2.5
NDA202	0.1 - 0.2	7.2	0.6	1.01	0.0	8.5	12.3	2.4	0.9	24.1	0.79	10.0	2	13.0
NDA202	0.2 - 0.5	7.5	1.2		0.0	8.6	13.6	4.3	0.8	27.3	1.63	15.9	2	10.5
NDA202	0.5 - 1.0	8.9	0.7		0.0	9.8	18.6	9.8	0.9	39.1	1.42	25.1	3b	6.0
NDA202	1.0 - 1.4	8.2	0.4		0.0	5.6	20.3	12.2	0.9	39.1	1.45	31.3	1	15.0
HMA101	0 - 0.1	5.8	1.9	1.49	0.0	1.9	1.2	0.1	0.4	3.7	0.24	3.9	5	2.5
HMA101	0.1 - 0.2	6.2	1.8	1.86	0.0	0.9	1.2	0.2	0.2	2.6	0.25	6.7	5	2.5
HMA101	0.2 - 0.5	6.7	4.1		0.0	0.2	10.4	4.9	0.6	16.0	2.43	30.4	2	12.5

**Sodosols and related soils: soil chemical and physical analyses (continued)**

Site	Depth m	pHw	Bray P mg/kg	Carbon %	Ex Al cmol <sub>c</sub> /kg	Ex Ca cmol <sub>c</sub> /kg	Ex Mg cmol <sub>c</sub> /kg	Ex Na cmol <sub>c</sub> /kg	Ex K cmol <sub>c</sub> /kg	ECEC cmol <sub>c</sub> /kg	ECe dS/m	ESP %	Emerson class	Loveday & Pyle
HMA103	0 - 0.1	5.8	1.7	2.22	0.0	4.2	2.3	0.4	0.4	7.3	2.05	6.1	5	2.0
HMA103	0.1 - 0.2	5.8	1.3	0.66	0.0	0.9	0.8	0.2	0.1	2.1	0.77	9.1	5	1.0
HMA103	0.2 - 0.5	6.2	2.8		0.0	0.2	6.6	3.3	0.2	10.1	1.89	32.1	1	15.5
HMA103	0.5 - 0.9	6.9	0.2		0.0	0.0	13.1	7.9	0.3	21.4	1.44	37.0	1	15.5
HMA202	0 - 0.1	5.4	1.3	3.14	0.0	5.4	3.9	0.8	1.1	11.2	1.19	7.4	5	0.0
HMA202	0.1 - 0.2	5.9	0.8	0.84	0.0	2.5	2.9	1.0	0.6	7.0	0.85	14.7	3b	4.0
HMA202	0.2 - 0.5	6.0	0.4		0.0	8.1	16.8	9.8	1.8	36.5	2.38	26.8	2	13.0
HMA202	0.5 - 1.0	5.9	0.3		0.0	6.1	16.4	12.9	1.5	37.0	3.35	34.9	1	15.5
HMA202	1.0 - 1.4	6.1	0.2		0.0	3.3	9.7	8.7	0.9	22.6	3.93	38.6	1	15.5
HMA301	0 - 0.1	5.3	1.7	2.90	0.0	2.9	5.9	0.7	0.8	10.4	0.56	6.9	3b	4.0
HMA301	0.1 - 0.2	5.8	0.6	0.61	0.0	1.2	15.0	2.2	0.7	19.1	1.06	11.3	3b	7.0
HMA301	0.2 - 0.5	6.8	1.4		0.0	0.9	20.1	5.6	0.5	27.1	2.51	20.6	2	10.5
HMA301	0.5 - 1.0	8.0	2.0		0.0	0.4	19.6	7.3	0.5	28.0	3.58	26.3	1	14.5
HMA301	1.0 - 1.3	8.6	1.5		0.0	0.1	20.1	8.4	0.8	29.5	4.44	28.6	1	15.5
HMA302	0 - 0.1	6.0	11.3	0.67	0.0	3.6	1.9	0.1	1.0	6.5	0.32	1.1	7	5.0
HMA302	0.1 - 0.2	6.0	7.7	2.07	0.0	1.9	1.2	0.1	0.7	3.9	0.42	1.8	5	3.5
HMA302	0.2 - 0.5	6.3	7.2		0.0	1.1	13.9	4.4	1.0	20.5	1.77	21.7	1	13.5
HMA302	0.5 - 0.8	5.7	1.0		0.0	0.3	12.5	6.7	0.3	19.8	3.80	34.0	1	15.0
ARCH02	0 - 0.1	5.8	2.6	0.55	0.0	3.9	4.1	0.7	1.6	10.2	0.81	6.8	3b	5.5
ARCH02	0.1 - 0.2	6.1	1.1	1.75	0.0	3.4	6.4	1.2	1.0	12.0	0.72	9.7	3b	8.0
ARCH02	0.2 - 0.5	7.2	0.5		0.0	4.5	21.3	7.2	0.8	33.8	3.55	21.4	3b	7.0
ARCH02	0.5 - 1.0	8.9	0.4		0.0	3.5	20.8	12.5	0.9	37.7	7.38	33.1	1	14.5
ARCH02	1.0 - 1.4	9.1	0.5		0.0	13.5	22.5	11.9	0.6	48.5	8.26	24.6	1	15.0

**Shallow Warkworth Sands (Arenic Rudosols/Sodosols): soil chemical and physical analyses.**

Site	Depth m	pHw	Bray P mg/kg	Carbon %	Ex Al cmol <sub>c</sub> /kg	Ex Ca cmol <sub>c</sub> /kg	Ex Mg cmol <sub>c</sub> /kg	Ex Na cmol <sub>c</sub> /kg	Ex K cmol <sub>c</sub> /kg	ECEC cmol <sub>c</sub> /kg	ECe dS/m	ESP %	Emerson class	Loveday & Pyle
HMA102	0 - 0.1	7.5	4.8	0.23	0.0	1.6	0.2	0.0	0.1	2.0	0.17	1.4		
HMA102	0.1 - 0.2	6.9	1.2	0.10	0.0	0.6	0.1	0.0	0.1	0.8	0.12	2.6		
HMA102	0.2 - 0.5	6.7	25.9		0.0	0.6	0.2	0.1	0.1	0.9	0.32	10.9		
HMA102	0.5 - 0.8	6.3	13.5		0.0	0.5	0.7	0.2	0.1	1.5	0.86	14.9		
HMA104	0 - 0.1	5.1	2.6	3.66	0.0	1.7	1.6	0.2	0.7	4.2	1.65	4.8		
HMA104	0.1 - 0.2	5.2	1.4	0.90	0.0	0.3	0.7	0.1	0.4	1.5	0.64	9.1	5	0.0
HMA104	0.2 - 0.5	5.9	11.1		0.0	0.1	0.5	0.0	0.2	0.8	0.20	5.4		
HMA104	0.5 - 1.0	5.5	2.9		1.6	0.0	11.7	1.6	1.3	16.2	0.43	9.9	3a	6.0
HMA203	0 - 0.1	5.8	1.4	0.42	0.0	0.8	0.4	0.1	0.2	1.4	0.36	4.7	5	1.5
HMA203	0.1 - 0.2	5.6	0.8	0.12	0.0	0.1	0.2	0.1	0.2	0.6	0.30	12.3	5	1.5
HMA203	0.2 - 0.5	6.0	18.3		0.0	0.3	0.2	0.0	0.2	0.8	0.25	6.4		
HMA203	0.5 - 0.7	6.1	13.0		0.0	0.5	0.2	0.0	0.1	0.8	0.21	6.2		
HMA303	0 - 0.1	5.9	1.4	0.61	0.0	1.3	0.6	0.1	0.2	2.2	0.22	2.7	5	1.5
HMA303	0.1 - 0.2	5.4	1.3	0.51	0.0	0.1	0.4	0.1	0.1	0.8	0.32	11.0	3a	4.5
HMA303	0.2 - 0.5	5.9	3.0		0.0	0.2	0.4	0.0	0.1	0.8	0.12	6.0	3b	5.0
HMA303	0.5 - 0.8	5.2	0.8		0.8	0.3	7.0	1.7	0.7	10.5	0.65	16.6	5	1.5
ARCH01	0 - 0.1	5.2	3.9	0.18	0.0	1.9	1.1	0.4	0.3	3.7	1.59	11.2		
ARCH01	0.1 - 0.2	5.5	1.1	1.04	0.0	0.5	0.6	0.2	0.2	1.6	0.61	14.6	3b	3.5
ARCH01	0.2 - 0.5	6.0	1.7		0.0	0.4	0.5	0.1	0.1	1.2	0.23	8.8	3b	4.0
ARCH01	0.5 - 1.0	5.6	0.9		0.0	0.5	13.1	5.5	0.3	19.4	2.94	28.5	1	15.0
ARCH05	0 - 0.1	4.9	2.8	0.40	0.0	0.9	0.5	0.1	0.2	1.7	0.83	6.7	5	1.0
ARCH05	0.1 - 0.2	5.1	1.3	0.79	0.0	0.3	0.4	0.1	0.1	0.9	0.50	11.7	3a	4.5
ARCH05	0.2 - 0.5	5.9	1.2		0.0	0.2	0.3	0.1	0.1	0.8	0.19	11.4	3a	5.0
ARCH07	0 - 0.1	5.2	2.2	0.37	0.0	1.6	0.5	0.0	0.4	2.5	0.41	1.8	3a	4.5
ARCH07	0.1 - 0.2	5.6	0.7	0.33	0.0	1.3	0.6	0.0	0.3	2.2	0.32	0.7	3a	4.5
ARCH07	0.2 - 0.5	5.9	2.3		0.0	1.9	0.7	0.0	0.3	2.9	0.47	1.3	1	5.0
ARCH07	0.5 - 1.0	7.3	1.2		0.0	1.7	8.6	3.4	0.3	13.9	1.25	24.2	1	15.5



**Deep Warkworth Sands (Arenic Rudosols and Orthic Tenosols): soil chemical and physical analyses.**

Site	Depth m	pHw	Bray P mg/kg	Carbon %	Ex Al cmol <sub>c</sub> /kg	Ex Ca cmol <sub>c</sub> /kg	Ex Mg cmol <sub>c</sub> /kg	Ex Na cmol <sub>c</sub> /kg	Ex K cmol <sub>c</sub> /kg	ECEC cmol <sub>c</sub> /kg	ECe dS/m	ESP %	Emerson class	Loveday & Pyle
HMA201	0 – 0.1	4.7	3.3	0.70	0.0	1.3	0.5	0.1	0.2	2.1	1.33	4.4		
HMA201	0.1 – 0.2	4.8	3.5	0.32	0.0	0.7	0.2	0.0	0.2	1.2	0.78	1.8		
HMA201	0.2 – 0.5	5.4	7.3		0.0	0.2	0.1	0.0	0.1	0.5	0.21	3.3		
HMA201	0.5 – 1.0	5.7	1.6		0.0	0.3	0.2	0.0	0.1	0.6	0.13	0.0		
HMA204	0 – 0.1	5.5	1.7	0.18	0.0	0.6	0.2	0.0	0.1	1.0	0.18	3.8		
HMA204	0.1 – 0.2	5.3	1.2	0.18	0.0	0.3	0.2	0.0	0.1	0.7	0.23	1.9		
HMA204	0.2 – 0.5	5.5	4.8		0.0	0.3	0.3	0.0	0.1	0.7	0.31	6.8		
HMA304	0 – 0.1	5.2	1.8	0.20	0.0	0.6	0.4	0.1	0.1	1.2	0.31	4.3		
HMA304	0.1 – 0.2	5.0	1.1	0.64	0.0	0.1	0.1	0.0	0.1	0.3	0.27	12.6		
HMA304	0.2 – 0.5	5.4	4.9		0.0	0.0	0.0	0.0	0.1	0.2	0.17	16.3		
HMA304	0.5 – 0.8	5.8	4.7		0.0	0.2	0.1	0.0	0.1	0.4	0.13	3.0		
ARCH04	0 – 0.1	6.4	1.9	1.84	0.0	2.8	1.2	0.1	0.6	4.7	0.86	1.9		
ARCH04	0.1 – 0.2	6.5	1.6	0.95	0.0	1.6	0.6	0.0	0.4	2.6	0.36	1.0		
ARCH04	0.2 – 0.5	6.4	2.4		0.0	1.3	0.5	0.0	0.4	2.3	0.50	1.8		
ARCH04	0.5 – 1.0	6.2	2.6		0.0	0.5	0.3	0.0	0.3	1.1	0.38	2.6		
ARCH04	1.0 – 1.4	6.0	3.5		0.0	0.3	0.4	0.1	0.1	0.9	0.39	10.2		
ARCH06	0 – 0.1	6.1	1.2	0.34	0.0	1.8	0.6	0.0	0.3	2.8	0.25	1.4		
ARCH06	0.1 – 0.2	6.0	3.1	0.57	0.0	0.9	0.5	0.1	0.2	1.6	0.21	4.6		
ARCH06	0.2 – 0.5	5.9	2.1		0.0	0.6	0.3	0.0	0.2	1.1	0.25	2.5		
ARCH06	0.5 – 1.0	6.2	2.3		0.0	0.4	0.4	0.0	0.2	1.0	0.21	4.1		
ARCH06	1.0 – 1.5	6.4	2.5		0.0	0.4	0.3	0.0	0.2	1.0	0.13	3.9		

**Black Dermosols: soil chemical and physical analyses.**

Site	Depth m	pHw	Bray P mg/kg	Carbon %	Ex Al cmol <sub>c</sub> /kg	Ex Ca cmol <sub>c</sub> /kg	Ex Mg cmol <sub>c</sub> /kg	Ex Na cmol <sub>c</sub> /kg	Ex K cmol <sub>c</sub> /kg	ECEC cmol <sub>c</sub> /kg	ECe dS/m	ESP %	Emerson class	Loveday & Pyle
ARCH03	0 - 0.1	6.2	85.1	1.07	0.0	18.7	11.0	0.4	3.2	33.4	2.12	1.3	3b	4.0
ARCH03	0.1 - 0.2	6.3	70.5	1.89	0.0	20.6	12.1	0.5	1.9	35.2	1.91	1.5	3b	5.0
ARCH03	0.2 - 0.5	7.5	23.9		0.0	29.4	15.6	1.2	0.6	46.8	0.77	2.7	3b	5.5
ARCH03	0.5 - 1.0	7.7	30.9		0.0	28.3	15.9	2.2	0.5	46.8	2.01	4.6	3b	5.5
ARCH03	1.0 - 1.3	8.1	27.6		0.0	30.1	16.8	1.8	0.6	49.3	0.82	3.7	3b	5.0
ARCH08	0 - 0.1	6.7	83.6	2.32	0.0	20.2	10.4	0.6	4.9	36.2	1.28	1.6	3b	4.5
ARCH08	0.1 - 0.2	7.0	58.6	1.71	0.0	20.8	10.3	0.6	3.3	35.1	0.63	1.8	3b	5.5
ARCH08	0.2 - 0.5	7.6	23.7		0.0	27.5	13.0	0.7	3.1	44.3	0.70	1.6	3b	4.0
ARCH08	0.5 - 1.0	7.9	30.4		0.0	22.8	11.9	0.6	0.9	36.2	0.72	1.6	3b	4.0
ARCH08	1.0 - 1.5	8.1	30.3		0.0	22.4	12.1	0.7	0.6	35.9	0.82	1.8	3b	5.0

## Appendix 5 Soil particle size distribution

Site	Depth m	Coarse sand %	Fine sand %	Silt %	Clay %	Total %
<b>Sodosols and related soils</b>						
NDA103	0 - 0.1	26.0	44.7	9.0	20.3	100.0
NDA103	0.1 - 0.2	24.7	41.6	8.8	24.2	99.2
NDA103	0.2 - 0.5	19.7	38.2	8.3	33.4	99.6
NDA103	0.5 - 1.0	13.2	39.7	8.8	37.5	99.2
NDA202	0 - 0.1	26.5	36.7	16.0	22.0	101.3
NDA202	0.1 - 0.2	16.3	26.1	15.9	40.4	98.7
NDA202	0.2 - 0.5	19.7	26.9	14.1	38.1	98.8
NDA202	0.5 - 1.0	11.6	18.8	17.1	50.8	98.4
NDA202	1.0 - 1.4	6.7	10.8	20.6	60.1	98.1
HMA202	0 - 0.1	20.1	28.8	26.4	27.0	102.4
HMA202	0.1 - 0.2	25.4	33.3	25.0	16.4	100.1
HMA202	0.2 - 0.5	2.1	21.0	16.5	59.4	99.0
HMA202	0.5 - 1.0	2.7	26.7	17.0	52.8	99.2
HMA202	1.0 - 1.4	4.9	42.5	15.3	37.0	99.7
<b>Arenic Rudosols/Sodosols</b>						
HMA104	0 - 0.1	56.1	27.7	7.7	8.3	99.8
HMA104	0.1 - 0.2	61.5	28.1	5.5	4.6	99.7
HMA104	0.2 - 0.5	61.3	32.8	3.3	3.2	100.5
HMA104	0.5 - 1.0	28.7	11.8	1.6	56.3	98.4
HMA303	0 - 0.1	51.3	38.7	5.5	5.5	101.0
HMA303	0.1 - 0.2	51.3	39.8	4.7	4.1	99.9
HMA303	0.2 - 0.5	45.8	42.9	6.4	4.2	99.2
HMA303	0.5 - 0.8	27.1	23.8	4.8	42.9	98.5
ARCH05	0 - 0.1	71.5	17.8	6.6	5.2	101.0
ARCH05	0.1 - 0.2	75.5	15.4	5.9	3.2	100.0
ARCH05	0.2 - 0.5	72.3	17.6	7.0	3.4	100.3
ARCH07	0 - 0.1	58.7	26.7	8.3	7.5	101.2
ARCH07	0.1 - 0.2	65.6	24.2	6.6	4.0	100.5
ARCH07	0.2 - 0.5	62.3	24.9	7.2	5.2	99.6
ARCH07	0.5 - 1.0	51.5	16.7	5.1	25.5	98.8
<b>Arenic Rudosols and Orthic Tenosols</b>						
HMA201	0 - 0.1	59.3	31.3	5.6	3.9	100.1
HMA201	0.1 - 0.2	62.5	30.2	4.5	2.3	99.6
HMA201	0.2 - 0.5	58.9	32.5	6.0	2.6	99.9
HMA201	0.5 - 1.0	52.5	35.7	9.3	2.1	99.7
ARCH04	0 - 0.1	82.1	11.0	3.7	3.6	100.3
ARCH04	0.1 - 0.2	76.6	14.9	4.9	3.3	99.8
ARCH04	0.2 - 0.5	69.2	17.3	9.8	3.5	99.8
ARCH04	0.5 - 1.0	74.6	16.3	6.6	1.9	99.4
ARCH04	1.0 - 1.4	69.4	16.2	11.2	2.6	99.5

## Appendix D

### Soil descriptions

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### Brown Duplex Loam

**Description:** This soil unit is characterised by an abrupt texture change between the dark brown silty/loam surface soil and the clayey brown sandy clay loam and yellowish brown medium heavy clay subsurface layers (duplex soil) (Table 5). This soil unit is identified in the Australian Soil Classification as a Sodosol and has also in the past been referred to in Great Soil Group terminology as Solonetz, Solodised-Solonetz and Solodic soils.

**Location:** This soil unit is the dominant soil in the Warkworth Mine study area (40.8 per cent cover) and is associated with undulating hillslopes, particularly mid-low sloping land and creek flats. This common soil unit was profiled during the Wollombi Brook investigation, refer Appendix 4, Plate 1 and Plate 2.

**Management:** The surface 0.10m of topsoil is suitable for stripping and reuse as a topdressing material in rehabilitation works. Some topsoil profiles exhibited high sodicity values, however, soil aggregate stability was reasonable due to significant soil organic carbon content. In addition this topsoil's loamy soil texture is desirable for rehabilitation works.

The subsoil is unsuitable for rehabilitation works as it is highly sodic and dispersive.

The topsoil requires standard erosion and sediment control measures if disturbed. Given the soil's sodicity range, additional measures for stockpiling the soil and its reuse during rehabilitation works is recommended. These measures include stockpiling the soil where it is not exposed to wet conditions after stripping as this will limit dispersion and erosion, and the use of soil ameliorants such as gypsum and biosolids to improve aggregate cohesion (refer Section 4).

Table 5 – Brown Duplex Loam Profile

Layer #	Depth (m)	Description	
		Field	Laboratory
1	0.00 - 0.02	Dark (yellowish) brown (10 YR 4/4) silty loam to loam exhibiting weak peds of 10 millimetres (mm) or massive pedality. Boundary abrupt.	Moderately acidic with an average pH of 6.0 (range 5.4 - 6.3, n = 5) and non-saline with low Electrical Conductivity (ECe) of less than 1dS/m 9 (range 0.46 – 1.19dS/m, n = 5).
2	0.02 - 0.12	Dark yellowish brown (10 YR 5/4) silty loam with massive pedality. Boundary sharp.	Moderately sodic with an average Exchangeable Sodium Percentage (ESP) of 12%, (range 5 - 18.9, n = 5) with generally stable soil aggregates as indicated by Emerson Aggregate Test (EAT) classifications of 3-5.
3	0.12 - 0.45	Brown (7.5 YR 5/8 - 7.5 YR 4/6) heavy clay with a strong structure (polyhedral to prismatic). Boundary gradual.	Moderately acidic with an average pH of 6.0 (range 5.8 - 6.7, n = 12) and non-saline with average low ECe of less than 2dS/m (range 0.34 - 4.24, n = 12; note >4dS/m was an exception).  Highly sodic with an average ESP of 27% (range 14.3 - 37.1; n = 5) and low aggregate stability with EAT classes of 1 and 2 (n = 10).
4	0.45 - 0.70	Yellowish brown (10 YR 5/6) heavy clay with strong structure (polyhedral to angular blocky peds). Boundary gradual.	
5	0.70 - 2.00	Yellowish (10 YR 6/6) medium clay to silty clay with moderate structure (polyhedral to angular blocky peds).	

n = number of replicate soil profile sites, actual data replicates often larger as vertical sampling per layer varied (e.g. layer 2 may have been sampled at 0.05 and 0.10m at some soil profile sites).

### Duplex Sand

**Description:** This soil unit is characterised by an abrupt texture change between the sandy surface soil and the medium-heavy clayey subsurface soil (duplex soil). Subsurface soils may be greyish, brownish or yellowish in colour (Table 7).

**Location:** This soil unit is the third most dominant soil in the Warkworth Mine study area (16.5 per cent cover) and is associated with the Uniform Sands in the northern part of the study area.

**Management:** The top 0.30m of topsoil is suitable to marginally suitable for stripping and reuse as topdressing in rehabilitation works. The top 0.05m of this soil is of suitable nature and the subsequent 0.25m is of marginal nature due to its single grain structure. It is recommended that the full 0.30m of topsoil be utilised, however, additional measures to treat the 0.05-0.30m fraction are recommended. These measures are discussed below.

The subsoil is not recommended for reuse in rehabilitation activities due to the limiting factors of texture, high sodicity and dispersion. Sodicinity in the topsoil was observed to increase in a minority of soil profiles which contained clayey sand textures. As sodicity is related to exchangeable cations and soil clay content, these few outliers with small clay contents do not impact overall stripping depth recommendations.

The topsoil requires standard erosion and sediment control measures if disturbed and given its textural structure additional measures are recommended. Suitable measures include storing the soil where it is not exposed to wet conditions after stripping as this will limit dispersion and erosion, and the use of soil ameliorants (e.g. gypsum and biosolids) to improve aggregate cohesion (refer Section 4).

This soil unit is closely related to the uniform soil unit (Table 9) which supports the endangered Warkworth Sands vegetation community. This soil may contain a viable seed-bank for this community and utilisation of all sandy topsoil to aid restoration efforts in alternative Green Offset zones is feasible. Stripping depth may be in places as deep as 1m for this purpose.

Table 7 – Duplex Sand Profile

Layer	Depth	Description	
#	(m)	Field	Laboratory
1	0.00 - 0.05	Dark yellowish brown (105 YR 4/4) loamy sand with weak subangular structure and very weak consistence. Boundary gradual.	Moderately acidic with an average pH of 6.0 (range 5.8 - 7.5, n = 5) and non-saline with low ECe of less than 1dS/m (range 0.17 - 2.05dS/m, n = 5).
2	0.05 - 0.30	Pale brown (10 YR 7/3) sand with single grain structure and loose consistence. Boundary abrupt.	Sodicinity was low with average ESP of 6.15% (range 2.3 - 12.3, n = 5) and moderate to high aggregate stability with EAT class measurements of 5. The higher ESP was a class 3b.
3	0.30 - 0.50+	Light brownish grey to brown (10 YR 6/2 - 10 YR 5/3) medium heavy clay with strong blocky structure and strong consistence.	Slightly acidic with an average pH of 6.3 (range 5.5 - 7.6, n = 13) and non-saline with low ECe of less than 1dS/m (range 0.16 - 1.86dS/m, n = 12).  Highly sodic however with an ESP range of 10-50% (n = 3) and low-moderate aggregate stability with EAT classifications of 1 and 2 (n = 12).
n = number of replicate soil profile sites, actual data replicates often larger as vertical sampling per layer varied (e.g. layer 2 may have been sampled at 0.05 and 0.10m at some soil profile sites).			



### Grey-Pink Duplex Loam

**Description:** This soil unit is characterised by an abrupt texture change between the grey-brown sandy-loam surface soil and the underlying grey-pinkish clayey subsurface soil (Table 8). This soil unit is also identified in the Australian Soil Classification as a Sodosol. A distinguishing feature of this duplex unit is the grey clayey subsurface horizon. Grey colours occur in the landscape as seasonal saturation of the soil profile mobilises insitu-pigment bearing minerals (iron oxides) which are subsequently lost to free draining waters.

**Location:** This soil unit occurs mainly in and around Wallaby Scrub Road sloping towards Wollombi Brook. This soil unit generally occurs in the landscape on the lower-slopes and is a minor soil unit covering 10.2 per cent of the study area. Grey layers also occur higher up the hill-slope (termed gley) where impermeable or poorly draining horizons result in a localised saturated environment which favours mobilisation and loss of pigment bearing minerals.

This soil unit was profiled during the Wollombi Brook investigation, refer **Appendix 4**, Plate 3 and Plate 4.

**Management:** The surface 0.30m of this soil is suitable for stripping and reuse as topdressing in rehabilitation. The subsoil is not recommended for reuse in rehabilitation due to the limiting factors of textural structure and likely high sodicity and dispersion issues.

The topsoil soil requires standard erosion and sediment control measures if disturbed. Caution during stripping is advised as mixing of the quality topsoil with the subsoil will negatively impact on rehabilitation works.

Table 8 – Grey-Pink Duplex Loam Profile

Layer	Depth	Description	
#	(m)	Field	Laboratory
1	0.0 - 0.05	Brown (10 YR 4/3) sandy loam with massive structure and weak consistence. Boundary clear.	Moderately acidic with a pH of 6.0 and non-saline with low ECe of less than 0.5dS/m (n = 1).
2	0.05 - 0.30	Light grey to pinkish-grey (10 YR 7/2 - 7.5YR 6/2) sandy loam with weak (20 - 30mm block peds) to massive pedality and weak consistence. Boundary abrupt.	Non sodic with ESP of 5% and high aggregate stability with an EAT classification of 5 (n = 1).
3	0.30 - 0.50+	Light brownish - grey to pinkish-grey (10 YR 6/2 - 7.5YR 6/2) medium clay with moderate structure (blocky, angular peds) and strong consistence.	Slightly acidic with an average pH of 6.3 (range 5.9 - 6.7, n = 2) and non-saline with low ECe of less than 2dS/m (range 1.11 - 2.43dS/m, n = 2).  A high sodic value was recorded (ESP of 30%) combined with a low-moderate aggregate stability with EAT classifications of 1 and 2 (n = 2).
n = number of replicate soil profile sites, actual data replicates often larger as vertical sampling per layer varied (e.g. layer 2 may have been sampled at 0.05 and 0.10m at some soil profile sites).			

### Uniform Sand

**Description:** This soil unit is characterised by predominately yellowish-brown sand throughout the soil profile for a minimum of two metres (Table 9).

**Location:** This minor soil unit (6.9 per cent of the study area) occurs in the northern part of the study area, predominately to the north-western boundary. This deep sand is associated with the Warkworth Sands vegetation community. It has developed from aeolian deposition of sand particles and its location reflects recent and past wind direction (McKensie et al., 2008). It is termed a continental dune. This soil unit is identified in the Australian Soil Classification as a Tenosol as it exhibits weak pedological development.

This soil unit was profiled during the Wollombi Brook investigation, refer Appendix 4, Plate 5 and Plate 6.

**Management:** This soil is not suitable for stripping and reuse as topdressing in mine rehabilitation works due to its single grain sandy structure.

This soil supports the endangered Warkworth Sands vegetation community and as such the stripping and reuse of this soil to support restoration/recreation works in alternative Green Offset zones is feasible. Recommended stripping depth is 1-2m. This soil does not present any sodic, erodibility or acidity issues that would prevent its re-use in this context, either in its removal, transport or storage. Due to its single grain texture, preventing wind erosion during storage is recommended. This soil is strongly acidic which is appropriate for this specific vegetation community. Generally strong soil acidity is not considered optimal for mine rehabilitation works.

Table 9 – Uniform Sand Profile

Layer	Depth	Description	
#	(m)	Field	Laboratory
1	0.00 - 0.05	Grey or Brown sand (7.5 YR 5/1 - 7.5 YR 4/2) sand. Single grained with loose consistence. Boundary diffuse to gradual.	Strongly acidic with a pH of 4.7 - 5.3 throughout the profile (n = 2) and non-saline with low average ECe of less than 1.5dS/m (range 0.13 - 10.23, n = 2).
2	0.05 - 2.00	Pink-greyish or light brown (7.5 YR 6/2 - 7.5 YR 6/4) sand. Single grained with loose consistence.	Non sodic with ESP of <3% (range 1.8 - 6.8, n = 2).
n = number of replicate soil profile sites, actual data replicates often larger as vertical sampling per layer varied (e.g. layer 2 may have been sampled at 0.05 and 0.10m at some soil profile sites).			

## Appendix B

### Laboratory data

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## CERTIFICATE OF ANALYSIS

Work Order	: <b>ES1411884</b>	Page	: 1 of 18
Client	: <b>EMGA MITCHELL MCLENNAN</b>	Laboratory	: Environmental Division Sydney
Contact	: MR TIMOTHY ROHDE	Contact	: Client Services
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Facsimile	: 07 3839 1866	Facsimile	: +61-2-8784 8500
Project	: WARKWORTH	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 29-MAY-2014
Sampler	: NC	Issue Date	: 03-JUN-2014
Site	: ----		
Quote number	: BN/482/14	No. of samples received	: 78
		No. of samples analysed	: 78

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results



NATA Accredited Laboratory 825

Accredited for compliance with  
ISO/IEC 17025.

### Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Ashesh Patel	Inorganic Chemist	Sydney Inorganics
Di-An Dao		Sydney Inorganics
Wisam Marassa	Inorganics Coordinator	Sydney Inorganics



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### **General Comments**

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.  
LOR = Limit of reporting  
^ = This result is computed from individual analyte detections at or above the level of reporting



## Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Client sample ID

Client sampling date / time

				B02, 0-30MM	B02, 30-100MM	B02, 150-300MM	B02, 300-500MM	B02, 500-800MM
				28-MAY-2014 15:00	28-MAY-2014 15:00	28-MAY-2014 15:00	28-MAY-2014 15:00	28-MAY-2014 15:00
Compound	CAS Number	LOR	Unit	ES1411884-001	ES1411884-002	ES1411884-003	ES1411884-004	ES1411884-005
<b>EA002 : pH (Soils)</b>								
pH Value	----	0.1	pH Unit	5.6	5.2	4.6	4.5	4.6
<b>EA010: Conductivity</b>								
Electrical Conductivity @ 25°C	----	1	µS/cm	91	31	194	278	364
<b>EA055: Moisture Content</b>								
Moisture Content (dried @ 103°C)	----	1.0	%	9.0	7.0	13.2	14.0	10.7
<b>ED008: Exchangeable Cations</b>								
Exchangeable Calcium	----	0.1	meq/100g	10.8	2.1	2.0	1.8	1.2
Exchangeable Magnesium	----	0.1	meq/100g	7.1	3.2	7.6	8.2	5.8
Exchangeable Potassium	----	0.1	meq/100g	1.0	0.4	0.4	0.3	0.2
Exchangeable Sodium	----	0.1	meq/100g	0.2	0.3	1.3	1.7	1.3
Exchangeable Aluminium	----	0.1	meq/100g	<0.1	<0.1	<0.1	<0.1	0.1
Cation Exchange Capacity	----	0.1	meq/100g	19.1	6.0	11.3	12.1	8.5
Exchangeable Sodium Percent	----	0.1	%	1.3	4.6	9.0	10.4	11.1
Calcium/Magnesium Ratio	----	0.1	-	1.5	0.6	0.3	0.2	0.2



## Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Client sample ID

Client sampling date / time

				B02, 800-1000MM	B01, 10-50MM	B01, 50-100MM	B01, 150-260MM	B01, 300-550MM
				28-MAY-2014 15:00	28-MAY-2014 15:00	28-MAY-2014 15:00	28-MAY-2014 15:00	28-MAY-2014 15:00
Compound	CAS Number	LOR	Unit	ES1411884-006	ES1411884-007	ES1411884-008	ES1411884-009	ES1411884-010
<b>EA002 : pH (Soils)</b>								
pH Value	----	0.1	pH Unit	4.8	5.6	5.2	4.7	5.2
<b>EA010: Conductivity</b>								
Electrical Conductivity @ 25°C	----	1	µS/cm	310	16	15	119	345
<b>EA055: Moisture Content</b>								
Moisture Content (dried @ 103°C)	----	1.0	%	11.6	13.0	15.2	22.1	15.7
<b>ED008: Exchangeable Cations</b>								
Exchangeable Calcium	----	0.1	meq/100g	0.5	2.2	1.9	2.3	1.4
Exchangeable Magnesium	----	0.1	meq/100g	3.1	5.1	5.2	12.2	9.2
Exchangeable Potassium	----	0.1	meq/100g	0.2	0.5	0.6	0.4	0.3
Exchangeable Sodium	----	0.1	meq/100g	0.9	0.8	0.5	2.5	2.5
Exchangeable Aluminium	----	0.1	meq/100g	0.1	<0.1	<0.1	<0.1	<0.1
Cation Exchange Capacity	----	0.1	meq/100g	4.7	8.7	8.2	17.4	13.4
Exchangeable Sodium Percent	----	0.1	%	12.7	7.4	5.3	10.6	12.6
Calcium/Magnesium Ratio	----	0.1	-	0.2	0.4	0.4	0.2	0.2





## Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Client sample ID

Client sampling date / time

				B01, 550-800MM	B04, 0-50MM	B04, 50-110MM	B04, 150-260MM	B04, 260-470MM
				28-MAY-2014 15:00	28-MAY-2014 15:00	28-MAY-2014 15:00	28-MAY-2014 15:00	28-MAY-2014 15:00
Compound	CAS Number	LOR	Unit	ES1411884-011	ES1411884-012	ES1411884-013	ES1411884-014	ES1411884-015
<b>EA002 : pH (Soils)</b>								
pH Value	----	0.1	pH Unit	5.5	5.5	6.0	6.0	4.8
<b>EA010: Conductivity</b>								
Electrical Conductivity @ 25°C	----	1	µS/cm	490	36	40	94	427
<b>EA055: Moisture Content</b>								
Moisture Content (dried @ 103°C)	----	1.0	%	15.2	4.5	5.6	4.3	17.4
<b>ED008: Exchangeable Cations</b>								
Exchangeable Calcium	----	0.1	meq/100g	1.1	4.8	4.4	2.4	1.5
Exchangeable Magnesium	----	0.1	meq/100g	7.6	1.6	1.7	1.4	4.8
Exchangeable Potassium	----	0.1	meq/100g	0.2	0.7	0.6	0.5	1.3
Exchangeable Sodium	----	0.1	meq/100g	2.5	<0.1	<0.1	<0.1	1.5
Exchangeable Aluminium	----	0.1	meq/100g	<0.1	<0.1	<0.1	<0.1	<0.1
Cation Exchange Capacity	----	0.1	meq/100g	11.4	7.2	6.8	4.5	9.2
Exchangeable Sodium Percent	----	0.1	%	14.0	1.1	1.2	2.0	11.6
Calcium/Magnesium Ratio	----	0.1	-	0.1	3.0	2.6	1.7	0.3



## Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Client sample ID

Client sampling date / time

				B04, 470-700MM	B04, 700-1000MM	B03, 0-50MM	B03, 50-150MM	B03, 150-240MM
				28-MAY-2014 15:00	28-MAY-2014 15:00	28-MAY-2014 15:00	28-MAY-2014 15:00	28-MAY-2014 15:00
Compound	CAS Number	LOR	Unit	ES1411884-016	ES1411884-017	ES1411884-018	ES1411884-019	ES1411884-020
<b>EA002 : pH (Soils)</b>								
pH Value	----	0.1	pH Unit	4.9	5.0	5.3	5.0	5.6
<b>EA010: Conductivity</b>								
Electrical Conductivity @ 25°C	----	1	µS/cm	587	30	64	67	87
<b>EA055: Moisture Content</b>								
Moisture Content (dried @ 103°C)	----	1.0	%	14.6	10.9	12.2	10.3	10.9
<b>ED008: Exchangeable Cations</b>								
Exchangeable Calcium	----	0.1	meq/100g	1.0	0.5	2.0	2.2	2.1
Exchangeable Magnesium	----	0.1	meq/100g	3.8	1.8	2.0	3.0	3.0
Exchangeable Potassium	----	0.1	meq/100g	0.8	0.2	0.5	0.3	0.2
Exchangeable Sodium	----	0.1	meq/100g	1.6	0.8	0.2	0.7	0.7
Exchangeable Aluminium	----	0.1	meq/100g	<0.1	<0.1	<0.1	<0.1	<0.1
Cation Exchange Capacity	----	0.1	meq/100g	7.2	3.3	4.8	6.3	6.0
Exchangeable Sodium Percent	----	0.1	%	14.4	15.5	4.2	8.4	9.3
Calcium/Magnesium Ratio	----	0.1	-	0.3	0.3	1.0	0.7	0.7



## Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Client sample ID

Client sampling date / time

				B03, 300-470MM	B03, 600-730MM	B03, 730-1000MM	DS5, 0-50MM	DS5, 100-200MM
				28-MAY-2014 15:00	28-MAY-2014 15:00	28-MAY-2014 15:00	28-MAY-2014 15:00	28-MAY-2014 15:00
Compound	CAS Number	LOR	Unit	ES1411884-021	ES1411884-022	ES1411884-023	ES1411884-024	ES1411884-025
<b>EA002 : pH (Soils)</b>								
pH Value	----	0.1	pH Unit	5.0	5.2	5.2	5.3	5.3
<b>EA010: Conductivity</b>								
Electrical Conductivity @ 25°C	----	1	µS/cm	335	662	700	9	16
<b>EA055: Moisture Content</b>								
Moisture Content (dried @ 103°C)	----	1.0	%	17.5	12.6	13.7	4.4	3.0
<b>ED008: Exchangeable Cations</b>								
Exchangeable Calcium	----	0.1	meq/100g	0.3	0.3	0.3	0.8	0.9
Exchangeable Magnesium	----	0.1	meq/100g	1.2	1.5	1.6	1.1	0.7
Exchangeable Potassium	----	0.1	meq/100g	<0.1	<0.1	<0.1	0.2	<0.1
Exchangeable Sodium	----	0.1	meq/100g	0.8	1.1	0.8	0.2	0.2
Exchangeable Aluminium	----	0.1	meq/100g	<0.1	<0.1	<0.1	<0.1	<0.1
Cation Exchange Capacity	----	0.1	meq/100g	2.4	2.9	2.8	2.2	1.8
Exchangeable Sodium Percent	----	0.1	%	18.2	19.2	17.2	6.0	7.9
Calcium/Magnesium Ratio	----	0.1	-	0.2	0.2	0.2	0.7	1.3



## Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Client sample ID

Client sampling date / time

				DS5, 200-300MM	DS5, 300-550MM	DS5, 600-900MM	DS3, 0-50MM	DS3, 50-150MM
				28-MAY-2014 15:00	28-MAY-2014 15:00	28-MAY-2014 15:00	28-MAY-2014 15:00	28-MAY-2014 15:00
Compound	CAS Number	LOR	Unit	ES1411884-026	ES1411884-027	ES1411884-028	ES1411884-029	ES1411884-030
<b>EA002 : pH (Soils)</b>								
pH Value	----	0.1	pH Unit	5.9	7.0	7.5	4.2	3.9
<b>EA010: Conductivity</b>								
Electrical Conductivity @ 25°C	----	1	µS/cm	73	229	476	12	5
<b>EA055: Moisture Content</b>								
Moisture Content (dried @ 103°C)	----	1.0	%	13.4	14.1	10.0	3.4	4.4
<b>ED008: Exchangeable Cations</b>								
Exchangeable Calcium	----	0.1	meq/100g	2.3	1.0	0.5	0.4	0.2
Exchangeable Magnesium	----	0.1	meq/100g	7.3	3.7	3.0	0.2	<0.1
Exchangeable Potassium	----	0.1	meq/100g	0.2	0.1	0.2	<0.1	<0.1
Exchangeable Sodium	----	0.1	meq/100g	1.7	1.3	1.2	<0.1	<0.1
Exchangeable Aluminium	----	0.1	meq/100g	<0.1	<0.1	<0.1	<0.1	<0.1
Cation Exchange Capacity	----	0.1	meq/100g	11.6	6.2	4.9	0.7	0.3
Exchangeable Sodium Percent	----	0.1	%	10.7	13.9	15.3	2.1	4.5
Calcium/Magnesium Ratio	----	0.1	-	0.3	0.3	0.2	2.0	2.0



## Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Client sample ID

Client sampling date / time

				DS3, 180-300MM	DS3, 300-600MM	DS3, 600-1000MM	DS4, 0-50MM	DS4, 50-150MM
				28-MAY-2014 15:00	28-MAY-2014 15:00	28-MAY-2014 15:00	26-MAY-2014 15:00	26-MAY-2014 15:00
Compound	CAS Number	LOR	Unit	ES1411884-031	ES1411884-032	ES1411884-033	ES1411884-034	ES1411884-035
<b>EA002 : pH (Soils)</b>								
pH Value	----	0.1	pH Unit	3.8	4.0	4.6	3.8	4.2
<b>EA010: Conductivity</b>								
Electrical Conductivity @ 25°C	----	1	µS/cm	3	3	2	10	8
<b>EA055: Moisture Content</b>								
Moisture Content (dried @ 103°C)	----	1.0	%	3.6	3.5	3.9	1.8	3.8
<b>ED008: Exchangeable Cations</b>								
Exchangeable Calcium	----	0.1	meq/100g	<0.1	<0.1	0.2	0.8	0.2
Exchangeable Magnesium	----	0.1	meq/100g	<0.1	<0.1	<0.1	0.1	<0.1
Exchangeable Potassium	----	0.1	meq/100g	<0.1	<0.1	<0.1	<0.1	<0.1
Exchangeable Sodium	----	0.1	meq/100g	<0.1	<0.1	<0.1	<0.1	<0.1
Exchangeable Aluminium	----	0.1	meq/100g	<0.1	<0.1	<0.1	<0.1	<0.1
Cation Exchange Capacity	----	0.1	meq/100g	<0.1	<0.1	0.3	1.0	0.3
Exchangeable Sodium Percent	----	0.1	%	12.1	15.3	4.2	1.1	2.5
Calcium/Magnesium Ratio	----	0.1	-	1.0	1.0	2.0	8.0	2.0



## Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Client sample ID

Client sampling date / time

				DS4, 150-300MM	DS4, 600-1000MM	DS4, 350-600MM	US1, 0-50MM	US1, 50-110MM
				26-MAY-2014 15:00	26-MAY-2014 15:00	26-MAY-2014 15:00	26-MAY-2014 15:00	26-MAY-2014 15:00
Compound	CAS Number	LOR	Unit	ES1411884-036	ES1411884-037	ES1411884-038	ES1411884-039	ES1411884-040
<b>EA002 : pH (Soils)</b>								
pH Value	----	0.1	pH Unit	3.9	4.1	3.9	4.0	4.1
<b>EA010: Conductivity</b>								
Electrical Conductivity @ 25°C	----	1	µS/cm	11	4	5	6	8
<b>EA055: Moisture Content</b>								
Moisture Content (dried @ 103°C)	----	1.0	%	3.9	3.6	3.8	2.6	2.6
<b>ED008: Exchangeable Cations</b>								
Exchangeable Calcium	----	0.1	meq/100g	<0.1	<0.1	<0.1	0.1	0.2
Exchangeable Magnesium	----	0.1	meq/100g	<0.1	<0.1	<0.1	<0.1	<0.1
Exchangeable Potassium	----	0.1	meq/100g	<0.1	<0.1	<0.1	<0.1	<0.1
Exchangeable Sodium	----	0.1	meq/100g	<0.1	<0.1	<0.1	<0.1	<0.1
Exchangeable Aluminium	----	0.1	meq/100g	<0.1	<0.1	<0.1	<0.1	<0.1
Cation Exchange Capacity	----	0.1	meq/100g	0.2	<0.1	0.1	0.2	0.3
Exchangeable Sodium Percent	----	0.1	%	4.9	10.5	9.8	5.9	10.1
Calcium/Magnesium Ratio	----	0.1	-	1.0	1.0	1.0	----	2.0
Calcium/Magnesium Ratio	----	0.1	-	----	----	----	2.5	----



## Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Client sample ID

Client sampling date / time

				US1, 150-300MM	US1, 300-600MM	US1, 600-1000MM	DS1, 0-50MM	DS1, 50-130MM
				26-MAY-2014 15:00	26-MAY-2014 15:00	26-MAY-2014 15:00	27-MAY-2014 15:00	27-MAY-2014 15:00
Compound	CAS Number	LOR	Unit	ES1411884-041	ES1411884-042	ES1411884-043	ES1411884-044	ES1411884-045
<b>EA002 : pH (Soils)</b>								
pH Value	----	0.1	pH Unit	4.0	4.1	4.5	5.3	5.7
<b>EA010: Conductivity</b>								
Electrical Conductivity @ 25°C	----	1	µS/cm	5	4	2	28	21
<b>EA055: Moisture Content</b>								
Moisture Content (dried @ 103°C)	----	1.0	%	2.6	2.9	3.5	18.4	14.8
<b>ED008: Exchangeable Cations</b>								
Exchangeable Calcium	----	0.1	meq/100g	<0.1	<0.1	2.2	1.4	0.6
Exchangeable Magnesium	----	0.1	meq/100g	<0.1	<0.1	2.4	1.5	1.2
Exchangeable Potassium	----	0.1	meq/100g	<0.1	<0.1	0.4	0.2	0.1
Exchangeable Sodium	----	0.1	meq/100g	<0.1	<0.1	0.2	0.3	0.3
Exchangeable Aluminium	----	0.1	meq/100g	<0.1	<0.1	<0.1	<0.1	<0.1
Cation Exchange Capacity	----	0.1	meq/100g	<0.1	0.2	5.2	3.4	2.3
Exchangeable Sodium Percent	----	0.1	%	8.5	<0.1	4.1	6.8	10.1
Calcium/Magnesium Ratio	----	0.1	-	1.0	1.0	0.9	0.9	0.5





## Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Client sample ID

Client sampling date / time

				DS1, 150-300MM	DS1, 300-460MM	DS1, 600-1000MM	US3, 0-50MM	US3, 50-130MM
				27-MAY-2014 15:00	27-MAY-2014 15:00	27-MAY-2014 15:00	26-MAY-2014 15:00	26-MAY-2014 15:00
Compound	CAS Number	LOR	Unit	ES1411884-046	ES1411884-047	ES1411884-048	ES1411884-049	ES1411884-050
<b>EA002 : pH (Soils)</b>								
pH Value	----	0.1	pH Unit	5.2	5.9	7.0	4.4	4.2
<b>EA010: Conductivity</b>								
Electrical Conductivity @ 25°C	----	1	µS/cm	30	277	618	6	4
<b>EA055: Moisture Content</b>								
Moisture Content (dried @ 103°C)	----	1.0	%	12.4	12.8	12.2	3.5	3.2
<b>ED008: Exchangeable Cations</b>								
Exchangeable Calcium	----	0.1	meq/100g	0.4	0.2	<0.1	0.2	0.1
Exchangeable Magnesium	----	0.1	meq/100g	1.3	1.4	1.6	0.1	<0.1
Exchangeable Potassium	----	0.1	meq/100g	<0.1	<0.1	<0.1	<0.1	<0.1
Exchangeable Sodium	----	0.1	meq/100g	0.4	0.7	1.0	<0.1	<0.1
Exchangeable Aluminium	----	0.1	meq/100g	<0.1	<0.1	<0.1	<0.1	<0.1
Cation Exchange Capacity	----	0.1	meq/100g	2.2	2.3	2.8	0.4	0.2
Exchangeable Sodium Percent	----	0.1	%	11.7	16.7	18.7	2.6	5.2
Calcium/Magnesium Ratio	----	0.1	-	0.3	0.1	<0.1	2.0	1.0



## Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Client sample ID

Client sampling date / time

				US3, 150-300MM	US3, 300-600MM	US3, 600-1000MM	GP1, 0-50MM	GP1, 50-150MM
				26-MAY-2014 15:00	26-MAY-2014 15:00	26-MAY-2014 15:00	27-MAY-2014 15:00	27-MAY-2014 15:00
Compound	CAS Number	LOR	Unit	ES1411884-051	ES1411884-052	ES1411884-053	ES1411884-054	ES1411884-055
<b>EA002 : pH (Soils)</b>								
pH Value	----	0.1	pH Unit	5.0	4.4	4.4	4.1	4.6
<b>EA010: Conductivity</b>								
Electrical Conductivity @ 25°C	----	1	µS/cm	3	2	3	16	24
<b>EA055: Moisture Content</b>								
Moisture Content (dried @ 103°C)	----	1.0	%	4.3	4.8	5.3	4.2	5.6
<b>ED008: Exchangeable Cations</b>								
Exchangeable Calcium	----	0.1	meq/100g	0.3	0.4	0.2	0.2	<0.1
Exchangeable Magnesium	----	0.1	meq/100g	<0.1	<0.1	<0.1	0.5	0.5
Exchangeable Potassium	----	0.1	meq/100g	<0.1	<0.1	<0.1	0.2	<0.1
Exchangeable Sodium	----	0.1	meq/100g	<0.1	<0.1	<0.1	<0.1	<0.1
Exchangeable Aluminium	----	0.1	meq/100g	<0.1	<0.1	<0.1	<0.1	<0.1
Cation Exchange Capacity	----	0.1	meq/100g	0.5	0.5	0.2	0.9	0.7
Exchangeable Sodium Percent	----	0.1	%	2.5	2.7	5.0	6.3	9.6
Calcium/Magnesium Ratio	----	0.1	-	3.0	4.0	2.0	0.4	0.2



## Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Client sample ID

Client sampling date / time

				GP1, 190-300MM	GP1, 300-600MM	GP1, 750-1000MM	GP03, 0-50MM	GP03, 50-150MM
				27-MAY-2014 15:00	27-MAY-2014 15:00	27-MAY-2014 15:00	27-MAY-2014 15:00	27-MAY-2014 15:00
Compound	CAS Number	LOR	Unit	ES1411884-056	ES1411884-057	ES1411884-058	ES1411884-059	ES1411884-060
<b>EA002 : pH (Soils)</b>								
pH Value	----	0.1	pH Unit	5.5	6.3	6.7	4.0	4.3
<b>EA010: Conductivity</b>								
Electrical Conductivity @ 25°C	----	1	µS/cm	187	639	485	18	12
<b>EA055: Moisture Content</b>								
Moisture Content (dried @ 103°C)	----	1.0	%	15.0	14.7	8.2	5.0	5.3
<b>ED008: Exchangeable Cations</b>								
Exchangeable Calcium	----	0.1	meq/100g	<0.1	<0.1	<0.1	0.3	<0.1
Exchangeable Magnesium	----	0.1	meq/100g	1.7	1.2	2.2	1.2	1.2
Exchangeable Potassium	----	0.1	meq/100g	<0.1	<0.1	<0.1	0.2	0.2
Exchangeable Sodium	----	0.1	meq/100g	0.4	0.6	0.8	0.1	<0.1
Exchangeable Aluminium	----	0.1	meq/100g	<0.1	<0.1	<0.1	<0.1	<0.1
Cation Exchange Capacity	----	0.1	meq/100g	2.2	1.9	3.1	1.8	1.5
Exchangeable Sodium Percent	----	0.1	%	13.4	17.6	15.0	5.0	5.3
Calcium/Magnesium Ratio	----	0.1	-	<0.1	<0.1	<0.1	0.2	<0.1



## Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Client sample ID

Client sampling date / time

				GP03, 150-300MM	GP03, 300-500MM	GP03, 500-940MM	GP02, 0-50MM	GP02, 50-140MM
				27-MAY-2014 15:00	27-MAY-2014 15:00	27-MAY-2014 15:00	27-MAY-2014 15:00	27-MAY-2014 15:00
Compound	CAS Number	LOR	Unit	ES1411884-061	ES1411884-062	ES1411884-063	ES1411884-064	ES1411884-065
<b>EA002 : pH (Soils)</b>								
pH Value	----	0.1	pH Unit	6.8	7.0	8.0	5.6	5.6
<b>EA010: Conductivity</b>								
Electrical Conductivity @ 25°C	----	1	µS/cm	205	378	558	17	10
<b>EA055: Moisture Content</b>								
Moisture Content (dried @ 103°C)	----	1.0	%	14.0	15.9	16.2	18.1	12.6
<b>ED008: Exchangeable Cations</b>								
Exchangeable Calcium	----	0.1	meq/100g	<0.1	<0.1	<0.1	1.9	1.0
Exchangeable Magnesium	----	0.1	meq/100g	8.1	6.1	10.9	1.6	1.0
Exchangeable Potassium	----	0.1	meq/100g	0.3	0.2	0.4	0.4	0.3
Exchangeable Sodium	----	0.1	meq/100g	1.2	1.0	1.9	0.1	<0.1
Exchangeable Aluminium	----	0.1	meq/100g	<0.1	<0.1	<0.1	<0.1	<0.1
Cation Exchange Capacity	----	0.1	meq/100g	9.6	7.2	13.2	4.1	2.4
Exchangeable Sodium Percent	----	0.1	%	9.7	9.9	10.4	2.9	3.5
Calcium/Magnesium Ratio	----	0.1	-	<0.1	<0.1	<0.1	1.2	1.0



## Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Client sample ID

Client sampling date / time

				GP02, 150-300MM	GP02, 320-600MM	GP02, 600-1000MM	DS2, 0-50MM	DS2, 60-140MM
				27-MAY-2014 15:00	27-MAY-2014 15:00	27-MAY-2014 15:00	27-MAY-2014 15:00	27-MAY-2014 15:00
Compound	CAS Number	LOR	Unit	ES1411884-066	ES1411884-067	ES1411884-068	ES1411884-069	ES1411884-070
<b>EA002 : pH (Soils)</b>								
pH Value	----	0.1	pH Unit	5.2	5.6	6.2	4.4	4.7
<b>EA010: Conductivity</b>								
Electrical Conductivity @ 25°C	----	1	µS/cm	10	49	207	129	55
<b>EA055: Moisture Content</b>								
Moisture Content (dried @ 103°C)	----	1.0	%	10.4	13.0	12.2	4.2	4.4
<b>ED008: Exchangeable Cations</b>								
Exchangeable Calcium	----	0.1	meq/100g	0.4	0.1	<0.1	3.3	1.0
Exchangeable Magnesium	----	0.1	meq/100g	0.7	1.4	1.9	1.7	1.4
Exchangeable Potassium	----	0.1	meq/100g	0.2	0.2	0.1	0.3	0.2
Exchangeable Sodium	----	0.1	meq/100g	<0.1	0.2	0.6	0.1	0.2
Exchangeable Aluminium	----	0.1	meq/100g	<0.1	<0.1	<0.1	<0.1	<0.1
Cation Exchange Capacity	----	0.1	meq/100g	1.4	2.0	2.6	5.4	2.8
Exchangeable Sodium Percent	----	0.1	%	4.3	9.4	13.8	1.8	5.2
Calcium/Magnesium Ratio	----	0.1	-	0.6	<0.1	<0.1	1.9	0.7



## Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Client sample ID

Client sampling date / time

				DS2, 150-300MM	DS2, 300-600MM	DS2, 600-900MM	US2, 0-50MM	US2, 50-150MM
				27-MAY-2014 15:00	27-MAY-2014 15:00	27-MAY-2014 15:00	27-MAY-2014 15:00	27-MAY-2014 15:00
Compound	CAS Number	LOR	Unit	ES1411884-071	ES1411884-072	ES1411884-073	ES1411884-074	ES1411884-075
<b>EA002 : pH (Soils)</b>								
pH Value	----	0.1	pH Unit	5.8	7.2	7.9	3.9	3.4
<b>EA010: Conductivity</b>								
Electrical Conductivity @ 25°C	----	1	µS/cm	323	442	357	23	18
<b>EA055: Moisture Content</b>								
Moisture Content (dried @ 103°C)	----	1.0	%	9.8	11.4	10.8	7.0	4.0
<b>ED008: Exchangeable Cations</b>								
Exchangeable Calcium	----	0.1	meq/100g	0.4	0.4	0.2	0.7	0.3
Exchangeable Magnesium	----	0.1	meq/100g	2.5	2.2	1.7	0.4	0.2
Exchangeable Potassium	----	0.1	meq/100g	<0.1	<0.1	<0.1	<0.1	<0.1
Exchangeable Sodium	----	0.1	meq/100g	0.8	0.8	0.6	<0.1	<0.1
Exchangeable Aluminium	----	0.1	meq/100g	<0.1	<0.1	<0.1	<0.1	<0.1
Cation Exchange Capacity	----	0.1	meq/100g	3.8	3.5	2.6	1.2	0.6
Exchangeable Sodium Percent	----	0.1	%	13.3	14.8	15.2	1.7	2.0
Calcium/Magnesium Ratio	----	0.1	-	0.2	0.2	0.1	1.8	1.5



## Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Client sample ID

Client sampling date / time

				US2, 150-300M	US2, 300-450MM	US2, 600-1000MM	----	----
				27-MAY-2014 15:00	27-MAY-2014 15:00	27-MAY-2014 15:00	----	----
Compound	CAS Number	LOR	Unit	ES1411884-076	ES1411884-077	ES1411884-078	----	----
<b>EA002 : pH (Soils)</b>								
pH Value	----	0.1	pH Unit	3.4	3.5	3.8	----	----
<b>EA010: Conductivity</b>								
Electrical Conductivity @ 25°C	----	1	µS/cm	11	9	4	----	----
<b>EA055: Moisture Content</b>								
Moisture Content (dried @ 103°C)	----	1.0	%	2.5	3.3	3.2	----	----
<b>ED008: Exchangeable Cations</b>								
Exchangeable Calcium	----	0.1	meq/100g	<0.1	<0.1	<0.1	----	----
Exchangeable Magnesium	----	0.1	meq/100g	<0.1	<0.1	<0.1	----	----
Exchangeable Potassium	----	0.1	meq/100g	<0.1	<0.1	<0.1	----	----
Exchangeable Sodium	----	0.1	meq/100g	<0.1	<0.1	<0.1	----	----
Exchangeable Aluminium	----	0.1	meq/100g	<0.1	<0.1	<0.1	----	----
Cation Exchange Capacity	----	0.1	meq/100g	0.2	0.2	<0.1	----	----
Exchangeable Sodium Percent	----	0.1	%	<0.1	<0.1	<0.1	----	----
Calcium/Magnesium Ratio	----	0.1	-	1.0	1.0	1.0	----	----





## Appendix C

### Soil descriptions

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## Brown Kurosol

### Brown Duplex Loam

**Description:** This soil unit is characterised by an abrupt texture change between the dark brown silty/loam surface soil and the clayey brown sandy clay loam and yellowish brown medium heavy clay subsurface layers (duplex soil) (Table 5). This soil unit is identified in the Australian Soil Classification as a Sodosol and has also in the past been referred to in Great Soil Group terminology as Solonetz, Solodised-Solonetz and Solodic soils.

**Location:** This soil unit is the dominant soil in the Warkworth Mine study area (40.8 per cent cover) and is associated with undulating hillslopes, particularly mid-low sloping land and creek flats. This common soil unit was profiled during the Wollombi Brook investigation, refer Appendix 4, Plate 1 and Plate 2.

**Management:** The surface 0.10m of topsoil is suitable for stripping and reuse as a topdressing material in rehabilitation works. Some topsoil profiles exhibited high sodicity values, however, soil aggregate stability was reasonable due to significant soil organic carbon content. In addition this topsoil's loamy soil texture is desirable for rehabilitation works.

The subsoil is unsuitable for rehabilitation works as it is highly sodic and dispersive.

The topsoil requires standard erosion and sediment control measures if disturbed. Given the soil's sodicity range, additional measures for stockpiling the soil and its reuse during rehabilitation works is recommended. These measures include stockpiling the soil where it is not exposed to wet conditions after stripping as this will limit dispersion and erosion, and the use of soil ameliorants such as gypsum and biosolids to improve aggregate cohesion (refer Section 4).

Table 5 – Brown Duplex Loam Profile

Layer #	Depth (m)	Description	
		Field	Laboratory
1	0.00 - 0.02	Dark (yellowish) brown (10 YR 4/4) silty loam to loam exhibiting weak peds of 10 millimetres (mm) or massive pedality. Boundary abrupt.	Moderately acidic with an average pH of 6.0 (range 5.4 - 6.3, n = 5) and non-saline with low Electrical Conductivity (ECe) of less than 1dS/m 9 (range 0.46 – 1.19dS/m, n = 5).
2	0.02 - 0.12	Dark yellowish brown (10 YR 5/4) silty loam with massive pedality. Boundary sharp.	Moderately sodic with an average Exchangeable Sodium Percentage (ESP) of 12%, (range 5 - 18.9, n = 5) with generally stable soil aggregates as indicated by Emerson Aggregate Test (EAT) classifications of 3-5.
3	0.12 - 0.45	Brown (7.5 YR 5/8 - 7.5 YR 4/8) heavy clay with a strong structure (polyhedral to prismatic). Boundary gradual.	Moderately acidic with an average pH of 6.0 (range 5.8 - 6.7, n = 12) and non-saline with average low ECe of less than 2dS/m (range 0.34 - 4.24, n = 12; note >4dS/m was an exception).  Highly sodic with an average ESP of 27% (range 14.3 - 37.1; n = 5) and low aggregate stability with EAT classes of 1 and 2 (n = 10).
4	0.45 - 0.70	Yellowish brown (10 YR 5/8) heavy clay with strong structure (polyhedral to angular blocky peds). Boundary gradual.	
5	0.70 - 2.00	Yellowish (10 YR 6/8) medium clay to silty clay with moderate structure (polyhedral to angular blocky peds).	

n = number of replicate soil profile sites, actual data replicates often larger as vertical sampling per layer varied (e.g. layer 2 may have been sampled at 0.05 and 0.10m at some soil profile sites).

## Yellow Sodosol

### Duplex Sand

**Description:** This soil unit is characterised by an abrupt texture change between the sandy surface soil and the medium-heavy clayey subsurface soil (duplex soil). Subsurface soils may be greyish, brownish or yellowish in colour (Table 7).

**Location:** This soil unit is the third most dominant soil in the Warkworth Mine study area (16.5 per cent cover) and is associated with the Uniform Sands in the northern part of the study area.

**Management:** The top 0.30m of topsoil is suitable to marginally suitable for stripping and reuse as topdressing in rehabilitation works. The top 0.05m of this soil is of suitable nature and the subsequent 0.25m is of marginal nature due to its single grain structure. It is recommended that the full 0.30m of topsoil be utilised, however, additional measures to treat the 0.05-0.30m fraction are recommended. These measures are discussed below.

The subsoil is not recommended for reuse in rehabilitation activities due to the limiting factors of texture, high sodicity and dispersion. Sodicinity in the topsoil was observed to increase in a minority of soil profiles which contained clayey sand textures. As sodicity is related to exchangeable cations and soil clay content, these few outliers with small clay contents do not impact overall stripping depth recommendations.

The topsoil requires standard erosion and sediment control measures if disturbed and given its textural structure additional measures are recommended. Suitable measures include storing the soil where it is not exposed to wet conditions after stripping as this will limit dispersion and erosion, and the use of soil ameliorants (e.g. gypsum and biosolids) to improve aggregate cohesion (refer Section 4).

This soil unit is closely related to the uniform soil unit (Table 9) which supports the endangered Warkworth Sands vegetation community. This soil may contain a viable seed-bank for this community and utilisation of all sandy topsoil to aid restoration efforts in alternative Green Offset zones is feasible. Stripping depth may be in places as deep as 1m for this purpose.

Table 7 – Duplex Sand Profile

Layer	Depth	Description	
#	(m)	Field	Laboratory
1	0.00 - 0.05	Dark yellowish brown (105 YR 4/4) loamy sand with weak subangular structure and very weak consistence. Boundary gradual.	Moderately acidic with an average pH of 6.0 (range 5.8 - 7.5, n = 5) and non-saline with low ECe of less than 1dS/m (range 0.17 - 2.05dS/m, n = 5).
2	0.05 - 0.30	Pale brown (10 YR 7/3) sand with single grain structure and loose consistence. Boundary abrupt.	Sodicinity was low with average ESP of 6.15% (range 2.3 - 12.3, n = 5) and moderate to high aggregate stability with EAT class measurements of 5. The higher ESP was a class 3b.
3	0.30 - 0.50+	Light brownish grey to brown (10 YR 6/2 - 10 YR 5/3) medium heavy clay with strong blocky structure and strong consistence.	Slightly acidic with an average pH of 6.3 (range 5.5 - 7.6, n = 13) and non-saline with low ECe of less than 1dS/m (range 0.16 - 1.86dS/m, n = 12).  Highly sodic however with an ESP range of 10-50% (n = 3) and low-moderate aggregate stability with EAT classifications of 1 and 2 (n = 12).
n = number of replicate soil profile sites, actual data replicates often larger as vertical sampling per layer varied (e.g. layer 2 may have been sampled at 0.05 and 0.10m at some soil profile sites).			

## Grey Sodosol

### Grey-Pink Duplex Loam

**Description:** This soil unit is characterised by an abrupt texture change between the grey-brown sandy-loam surface soil and the underlying grey-pinkish clayey subsurface soil (Table 8). This soil unit is also identified in the Australian Soil Classification as a Sodosol. A distinguishing feature of this duplex unit is the grey clayey subsurface horizon. Grey colours occur in the landscape as seasonal saturation of the soil profile mobilises insitu-pigment bearing minerals (iron oxides) which are subsequently lost to free draining waters.

**Location:** This soil unit occurs mainly in and around Wallaby Scrub Road sloping towards Wollombi Brook. This soil unit generally occurs in the landscape on the lower-slopes and is a minor soil unit covering 10.2 per cent of the study area. Grey layers also occur higher up the hill-slope (termed gley) where impermeable or poorly draining horizons result in a localised saturated environment which favours mobilisation and loss of pigment bearing minerals.

This soil unit was profiled during the Wollombi Brook investigation, refer **Appendix 4**, **Plate 3** and **Plate 4**.

**Management:** The surface 0.30m of this soil is suitable for stripping and reuse as topdressing in rehabilitation. The subsoil is not recommended for reuse in rehabilitation due to the limiting factors of textural structure and likely high sodicity and dispersion issues.

The topsoil soil requires standard erosion and sediment control measures if disturbed. Caution during stripping is advised as mixing of the quality topsoil with the subsoil will negatively impact on rehabilitation works.

Table 8 – Grey-Pink Duplex Loam Profile

Layer	Depth	Description	
#	(m)	Field	Laboratory
1	0.0 - 0.05	Brown (10 YR 4/3) sandy loam with massive structure and weak consistence. Boundary clear.	Moderately acidic with a pH of 6.0 and non-saline with low ECE of less than 0.5dS/m (n = 1).
2	0.05 - 0.30	Light grey to pinkish-grey (10 YR 7/2 - 7.5YR 6/2) sandy loam with weak (20 - 30mm block peds) to massive pedality and weak consistence. Boundary abrupt.	Non sodic with ESP of 5% and high aggregate stability with an EAT classification of 5 (n = 1).
3	0.30 - 0.50+	Light brownish - grey to pinkish-grey (10 YR 6/2 - 7.5YR 6/2) medium clay with moderate structure (blocky, angular peds) and strong consistence.	Slightly acidic with an average pH of 6.3 (range 5.9 - 6.7, n = 2) and non-saline with low ECE of less than 2dS/m (range 1.11 - 2.43dS/m, n = 2).  A high sodic value was recorded (ESP of 30%) combined with a low-moderate aggregate stability with EAT classifications of 1 and 2 (n = 2).
n = number of replicate soil profile sites, actual data replicates often larger as vertical sampling per layer varied (e.g. layer 2 may have been sampled at 0.05 and 0.10m at some soil profile sites).			

## Arenic Rudosol

### **Uniform Sand**

**Description:** This soil unit is characterised by predominately yellowish-brown sand throughout the soil profile for a minimum of two metres (Table 9).

**Location:** This minor soil unit (6.9 per cent of the study area) occurs in the northern part of the study area, predominately to the north-western boundary. This deep sand is associated with the Warkworth Sands vegetation community. It has developed from aeolian deposition of sand particles and its location reflects recent and past wind direction (McKensie et al., 2008). It is termed a continental dune. This soil unit is identified in the Australian Soil Classification as a Tenosol as it exhibits weak pedological development.

This soil unit was profiled during the Wollombi Brook investigation, refer Appendix 4, Plate 5 and Plate 6.

**Management:** This soil is not suitable for stripping and reuse as topdressing in mine rehabilitation works due to its single grain sandy structure.

This soil supports the endangered Warkworth Sands vegetation community and as such the stripping and reuse of this soil to support restoration/recreation works in alternative Green Offset zones is feasible. Recommended stripping depth is 1-2m. This soil does not present any sodic, erodibility or acidity issues that would prevent its re-use in this context, either in its removal, transport or storage. Due to its single grain texture, preventing wind erosion during storage is recommended. This soil is strongly acidic which is appropriate for this specific vegetation community. Generally strong soil acidity is not considered optimal for mine rehabilitation works.

Table 9 – Uniform Sand Profile

Layer	Depth	Description	
#	(m)	Field	Laboratory
1	0.00 - 0.05	Grey or Brown sand (7.5 YR 5/1 - 7.5 YR 4/2) sand. Single grained with loose consistence. Boundary diffuse to gradual.	Strongly acidic with a pH of 4.7 - 5.3 throughout the profile (n = 2) and non-saline with low average ECe of less than 1.5dS/m (range 0.13 - 10.23, n = 2).
2	0.05 - 2.00	Pink-greyish or light brown (7.5 YR 6/2 - 7.5 YR 6/4) sand. Single grained with loose consistence.	Non sodic with ESP of <3% (range 1.8 - 6.8, n = 2).
n = number of replicate soil profile sites, actual data replicates often larger as vertical sampling per layer varied (e.g. layer 2 may have been sampled at 0.05 and 0.10m at some soil profile sites).			





## Appendix D

### BSAL soil data cards

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SURVEY TITLE: WARRK WORTH

SITE LOCATION: B.O.I

PROFILE MAP DETAILS				SURVEY DETAILS			
Profile No.	Map Sheet No.	Eastings	Northings	Described By	Profile Date	Photo Taken (1)	No. of Layers
00	00	00	00	00	00	profile	00
01	01	01	01	01	01	site	01
02	02	02	02	02	02	both profile & site	02
03	03	03	03	03	03	Nature of Exposure (2)	03
04	04	04	04	04	04	auger	04
05	05	05	05	05	05	pit	05
06	06	06	06	06	06	batter	06
07	07	07	07	07	07	gully	07
08	08	08	08	08	08	core sample	08
09	09	09	09	09	09	other	09

Potential BSAL? (1)	Site type (1)
yes <input type="checkbox"/> no <input type="checkbox"/>	checked <input type="checkbox"/> detailed <input type="checkbox"/> exclusion <input type="checkbox"/>

## BIOPHYSICAL STRATEGIC AGRICULTURAL LAND SOIL DATA CARD

SOIL TYPE	VEGETATION	LANDFORM ELEMENT (1)			
A.S.C.	Vegetation Community (1)	alcove (43)	cone (3)	footslope (21)	ox-bow (57)
0	unknown (1)	backplain (31)	crater (51)	foredune (12)	sink hole/doline (52)
SO	rainforest (2)	bank (25)	cut face (28)	gully (42)	stream channel (46)
AB	wet sclerophyll forest (3)	bar (6)	cut-over surface (39)	hillcrest (1)	streambed (45)
GG	dry sclerophyll forest (4)	beach (26)	dam (16)	hillslope (3)	summit surface (2)
FD	woodland grass u'storey (5)	beach ridge (7)	drainage depression (41)	lagoon (54)	swale (47)
AZ	woodland shrub u'storey (6)	bench (19)	dune (11)	lake (55)	swamp (58)
SG	tall shrubland (7)	berm (29)	embankment (14)	landslide (20)	talus (23)
FE	low shrubland (8)	blow-out (59)	estuary (44)	levee (8)	tidal creek (48)
AW	heath (9)	channel bench (33)	fan (27)	lunette (13)	tidal flat (37)
CL	grassland/herbland (10)	cirque (50)	fill top (40)	maar (53)	tor (4)
CO	swamp complex (11)	cliff (5)	flood-out (32)	mound (15)	trench (49)
CH	littoral complex (12)				valley flat (38)
CI	no vegetation (13)				

LITHOLOGY				TOPOGRAPHY	
Substrate (3)				Slope Percent	Site Morphology (1)
not identified (1)				00 00 00	flat (1)
unconsolidated (2)				01 01 01	crest (2)
gravel (3)				02 02 02	hillock (3)
sand (4)				03 03 03	ridge (4)
silt (5)				04 04 04	upper slope (5)
clay (6)				05 05 05	midslope (6)
organic material (7)				06 06 06	simple slope (7)
alluvium (8)				07 07 07	lower slope (8)
colluvium (9)				08 08 08	open depression (9)
lacustrine (10)				09 09 09	closed depression (10)
aeolian (11)					
marine (12)					
calcareous sand (13)					
fill (14)					
mud (15)					
till (16)					
sedimentary (17)					
shale (18)					
siltstone/mudstone (19)					
sandstone-quartz (20)					
sandstone-lithic (21)					
conglomerate (22)					
limestone (23)					
tuff (24)					
breccia (25)					
greywacke (26)					
arkose (27)					
dolomite (28)					
calcrete (29)					
aeolianite (30)					
chert (31)					
jasper (32)					
metamorphic (33)					
gneiss (34)					
schist/phyllite (35)					
slate (36)					
hornfels (37)					
quartzite (38)					
greenstone (39)					
amphibolite (40)					
marble (41)					
igneous (42)					
coarse-acidic (43)					
coarse-intermediate (44)					
coarse-basic (45)					
fine-acidic (46)					
fine-intermediate (47)					
fine-basic (48)					
serpentine (49)					
gabbro (50)					
dolerite (51)					
diomite (52)					
syenite (53)					
granodiorite (54)					
adamellite (55)					
granite (56)					
aplite (57)					
quartz porphyry (58)					
basalt (59)					
andesite (60)					
trachyte (61)					
rhyolite (62)					
obsidian (63)					
scoria (64)					
ash (65)					
agglomerate (66)					
other (67)					

LAND USE (1)		HYDROLOGY	
national/state parks (1)	personal assessment (1)	Profile Drainage (1)	Permeability (1)
timber/scrub/unused (2)	geology map (2)	very poorly drained (1)	very slowly permeable (1)
logged native forest (3)	both assessment & map (3)	poorly drained (2)	slowly permeable (2)
hardwood plantation (4)	Rock Outcrop % (1)	imperfectly drained (3)	moderately permeable (3)
softwood plantation (5)	nil (1) >20-30% (5)	mod. well-drained (4)	highly permeable (4)
volun./native pasture (6)	<2% (2) >30-50% (6)	well-drained (5)	
improved pasture (7)	2-10% (3) >50% (7)	rapidly drained (6)	
cropping (8)	>10-20% (4)		
orchard/vineyard (9)			
vegetables/flowers (10)			
urban (11)			
industrial (12)			
quarry/mining (13)			
other (14)			

SITE CONDITION		Surface Condition		Expected	
		Current (2)	Wet (2)	Dry (2)	
Site Disturbance(s) (2)	Ground Cover %	cracked (2)	(2)	(2)	
natural disturbance (1)		self-mulched (3)	(3)	(3)	
no effective disturbance (2)		loose (4)	(4)	(4)	
limited clearing (3)	(1) (1) (1)	soft (5)	(5)	(5)	
extensive clearing (4)	(2) (2) (2)	firm (6)	(6)	(6)	
cleared, no cultivation (5)	(3) (3) (3)	hardset (7)	(7)	(7)	
occasional cultivation (6)	(4) (4) (4)	surface crust (8)	(8)	(8)	
rainfed cultivation (7)	(5) (5) (5)	trampled (9)	(9)	(9)	
irrigated cultivation (8)	(6) (6) (6)	poached (10)	(10)	(10)	
highly disturbed (9)	(7) (7) (7)	recently cultivated (11)	(11)	(11)	
	(8) (8) (8)	water repellent (12)	(12)	(12)	
	(9) (9) (9)	gravelly (13)	(13)	(13)	
		other (14)	(14)	(14)	

Photo file name/s:

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4054

NSW SOIL  
AND LAND  
INFORMATION  
SYSTEMPlease MARK  
LIKE THIS ONLY:

- Use 2B pencil
- No pen or biro
- Fully erase mistakes
- Make no stray marks
- Numbers in ( ) show max. entries allowed

flat (1)

crest (2)

hillock (3)

ridge (4)

upper slope (5)

midslope (6)

simple slope (7)

lower slope (8)

open depression (9)

closed depression (10)

Slope Measurement Method (1)

inclinometer (1)

Abney level (2)

total station (3)

RTK GPS (4)

LIDAR (5)

Microrelief Type (1)

none (1)

normal gilgai (2)

crabhole gilgai (3)

linear gilgai (4)

lattice gilgai (5)

melonhole gilgai (6)

other (7)

Depth (1) &amp; Extent (1)

&lt; 500 mm depth (1)

&gt; 500 mm depth (2)

&lt; 50% area (1)

&gt; 50% area (2)

Aspect (1)

(N)

(NW)

(NE)

(W)

(O)

(E)

(SE)

(S)





LAYER STATUS		COLOUR (Munsell, 1994)		Field pH	LAYER NOTES	Field pH Test Method (1)	
Lower	Horizon	Moist Munsell	Dry Munsell	(1 per layer)		Raupach (1) test strip (3)	pH meter (3)
1	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (H) (6.5) (17) (0)	(2.5) (H) (6.5) (17) (0)	(1) (1) (1)	no effervescence (1) (1) (1) (1) (1)	
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (P) (2.5) (2)	(5) (Y) (P) (2.5) (2)	(1) (1) (1)	audible/slight efferv. (2) (2) (2) (2) (2)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(2) (2) (2)	strong effervescence (3) (3) (3) (3) (3)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)	Boundary Distinctiveness	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)	(1 per layer) 1 2 3 4 5	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)	not evident (1) (1) (1) (1) (1)	
	(6) (6) (6) (6)				(6) (6) (6)	sharp (<5 mm) (2) (2) (2) (2) (2)	
	(7) (7) (7) (7)				(7) (7) (7)	abrupt (5-20 mm) (3) (3) (3) (3) (3)	
	(8) (8) (8) (8)				(8) (8) (8)	clear (20-50 mm) (4) (4) (4) (4) (4)	
2	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (H) (6.5) (17) (0)	(2.5) (H) (6.5) (17) (0)	(1) (1) (1)	gradual (50-100 mm) (5) (5) (5) (5) (5)	
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (P) (2.5) (2)	(5) (Y) (P) (2.5) (2)	(2) (2) (2)	diffuse (>100 mm) (6) (6) (6) (6) (6)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(3) (3) (3)	STRUCTURE	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(4) (4) (4)	Grade of Pedality (1) 1 2 3 4 5	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(5) (5) (5)	single-grained (1) (1) (1) (1) (1)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(6) (6) (6)	massive (2) (2) (2) (2) (2)	
	(6) (6) (6) (6)				(7) (7) (7)	weak pedality (3) (3) (3) (3) (3)	
	(7) (7) (7) (7)				(8) (8) (8)	moderate pedality (4) (4) (4) (4) (4)	
	(8) (8) (8) (8)				(9) (9) (9)	strong pedality (5) (5) (5) (5) (5)	
3	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (H) (6.5) (17) (0)	(2.5) (H) (6.5) (17) (0)	(1) (1) (1)	Fabric (1) 1 2 3 4 5	
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (P) (2.5) (2)	(5) (Y) (P) (2.5) (2)	(2) (2) (2)	sandy (1) (1) (1) (1) (1)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(3) (3) (3)	earthy (2) (2) (2) (2) (2)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(4) (4) (4)	rough-faced peds (3) (3) (3) (3) (3)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(5) (5) (5)	smooth-faced peds (4) (4) (4) (4) (4)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(6) (6) (6)	Dominant (1)	
	(6) (6) (6) (6)				(7) (7) (7)	Ped Shape	
	(7) (7) (7) (7)				(8) (8) (8)	Sub-dominant (1)	
	(8) (8) (8) (8)				(9) (9) (9)		
4	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (H) (6.5) (17) (0)	(2.5) (H) (6.5) (17) (0)	(1) (1) (1)	1 2 3 4 5	
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (P) (2.5) (2)	(5) (Y) (P) (2.5) (2)	(2) (2) (2)	platy (1) (1) (1) (1) (1)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(3) (3) (3)	lenticular (2) (2) (2) (2) (2)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(4) (4) (4)	prismatic (3) (3) (3) (3) (3)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(5) (5) (5)	columnar (4) (4) (4) (4) (4)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(6) (6) (6)	angular blocky (5) (5) (5) (5) (5)	
	(6) (6) (6) (6)				(7) (7) (7)	sub-ang. blocky (6) (6) (6) (6) (6)	
	(7) (7) (7) (7)				(8) (8) (8)	polyhedral (7) (7) (7) (7) (7)	
	(8) (8) (8) (8)				(9) (9) (9)	granular (8) (8) (8) (8) (8)	
5	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (H) (6.5) (17) (0)	(2.5) (H) (6.5) (17) (0)	(1) (1) (1)	crumb (9) (9) (9) (9) (9)	
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (P) (2.5) (2)	(5) (Y) (P) (2.5) (2)	(2) (2) (2)	round (10) (10) (10) (10) (10)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(3) (3) (3)	Dominant (1)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(4) (4) (4)	Ped Size	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(5) (5) (5)	Sub-dominant (1)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(6) (6) (6)	1 2 3 4 5	
	(6) (6) (6) (6)				(7) (7) (7)	<2 mm (1) (1) (1) (1) (1)	
	(7) (7) (7) (7)				(8) (8) (8)	2-5 mm (2) (2) (2) (2) (2)	
	(8) (8) (8) (8)				(9) (9) (9)	5-10 mm (3) (3) (3) (3) (3)	
SUBSTRATE	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (H) (6.5) (17) (0)	(2.5) (H) (6.5) (17) (0)	(1) (1) (1)	10-20 mm (4) (4) (4) (4) (4)	
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (P) (2.5) (2)	(5) (Y) (P) (2.5) (2)	(2) (2) (2)	20-50 mm (5) (5) (5) (5) (5)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(3) (3) (3)	50-100 mm (6) (6) (6) (6) (6)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(4) (4) (4)	100-200 mm (7) (7) (7) (7) (7)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(5) (5) (5)	200-500 mm (8) (8) (8) (8) (8)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(6) (6) (6)	> 500 mm (9) (9) (9) (9) (9)	
	(6) (6) (6) (6)				(7) (7) (7)	SEGREGATIONS	
	(7) (7) (7) (7)				(8) (8) (8)	Soil Water Status (1 each per layer)	
	(8) (8) (8) (8)				(9) (9) (9)	1 2 3 4 5	
ESTIMATED EFFECTIVE ROOTING DEPTH (m)	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (H) (6.5) (17) (0)	(2.5) (H) (6.5) (17) (0)	(1) (1) (1)	dry (1) (1) (1) (1) (1)	
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (P) (2.5) (2)	(5) (Y) (P) (2.5) (2)	(2) (2) (2)	mod. moist (2) (2) (2) (2) (2)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(3) (3) (3)	moist (3) (3) (3) (3) (3)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(4) (4) (4)	wet (4) (4) (4) (4) (4)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(5) (5) (5)	TEXTURE	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(6) (6) (6)	(1 each per layer)	
	(6) (6) (6) (6)				(7) (7) (7)	Texture Grade 1 2 3 4 5	
	(7) (7) (7) (7)				(8) (8) (8)	sand (1) (1) (1) (1) (1)	
	(8) (8) (8) (8)				(9) (9) (9)	loamy sand (2) (2) (2) (2) (2)	
DOMINANT (1)	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (H) (6.5) (17) (0)	(2.5) (H) (6.5) (17) (0)	(1) (1) (1)	clayey sand (3) (3) (3) (3) (3)	
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (P) (2.5) (2)	(5) (Y) (P) (2.5) (2)	(2) (2) (2)	sandy loam (4) (4) (4) (4) (4)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(3) (3) (3)	loam (5) (5) (5) (5) (5)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(4) (4) (4)	silty loam (6) (6) (6) (6) (6)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(5) (5) (5)	sandy clay loam (7) (7) (7) (7) (7)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(6) (6) (6)	clay loam (8) (8) (8) (8) (8)	
	(6) (6) (6) (6)				(7) (7) (7)	clay loam sandy (9) (9) (9) (9) (9)	
	(7) (7) (7) (7)				(8) (8) (8)	silty clay loam (10) (10) (10) (10) (10)	
	(8) (8) (8) (8)				(9) (9) (9)	sandy clay (11) (11) (11) (11) (11)	
MOTTLES	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (H) (6.5) (17) (0)	(2.5) (H) (6.5) (17) (0)	(1) (1) (1)	silty clay (12) (12) (12) (12) (12)	
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (P) (2.5) (2)	(5) (Y) (P) (2.5) (2)	(2) (2) (2)	clay (13) (13) (13) (13) (13)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(3) (3) (3)	fibric peat (14) (14) (14) (14) (14)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(4) (4) (4)	hemic peat (15) (15) (15) (15) (15)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(5) (5) (5)	sapric peat (16) (16) (16) (16) (16)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(6) (6) (6)	Sand Fraction 1 2 3 4 5	
	(6) (6) (6) (6)				(7) (7) (7)	coarse (1) (1) (1) (1) (1)	
	(7) (7) (7) (7)				(8) (8) (8)	fine (2) (2) (2) (2) (2)	
	(8) (8) (8) (8)				(9) (9) (9)	Clay Fraction 1 2 3 4 5	
COLOUR (Munsell, 1994)	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (H) (6.5) (17) (0)	(2.5) (H) (6.5) (17) (0)	(1) (1) (1)	light (1) (1) (1) (1) (1)	
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (P) (2.5) (2)	(5) (Y) (P) (2.5) (2)	(2) (2) (2)	light medium (2) (2) (2) (2) (2)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(3) (3) (3)	medium (3) (3) (3) (3) (3)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(4) (4) (4)	medium heavy (4) (4) (4) (4) (4)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(5) (5) (5)	heavy (5) (5) (5) (5) (5)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(6) (6) (6)	Size (1 per layer)	
	(6) (6) (6) (6)				(7) (7) (7)	1 2 3 4 5	
	(7) (7) (7) (7)				(8) (8) (8)	very few (<2%) (2) (2) (2) (2) (2)	
	(8) (8) (8) (8)				(9) (9) (9)	few (2-10%) (3) (3) (3) (3) (3)	
CONTRAST	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (H) (6.5) (17) (0)	(2.5) (H) (6.5) (17) (0)	(1) (1) (1)	common (10-20%) (4) (4) (4) (4) (4)	
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (P) (2.5) (2)	(5) (Y) (P) (2.5) (2)	(2) (2) (2)	many (20-50%) (5) (5) (5) (5) (5)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(3) (3) (3)	abundant (50-90%) (6) (6) (6) (6) (6)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(4) (4) (4)	very abundant (>90%) (7) (7) (7) (7) (7)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(5) (5) (5)	Amount (1 per layer)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(6) (6) (6)	1 2 3 4 5	
	(6) (6) (6) (6)				(7) (7) (7)	none (1) (1) (1) (1) (1)	
	(7) (7) (7) (7)				(8) (8) (8)	very few (<2%) (2) (2) (2) (2) (2)	
	(8) (8) (8) (8)				(9) (9) (9)	few (2-10%) (3) (3) (3) (3) (3)	
ESTIMATED EFFECTIVE ROOTING DEPTH (m)	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (H) (6.5) (17) (0)	(2.5) (H) (6.5) (17) (0)	(1) (1) (1)	common (10-20%) (4) (4) (4) (4) (4)	
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (P) (2.5) (2)	(5) (Y) (P) (2.5) (2)	(2) (2) (2)	many (20-50%) (5) (5) (5) (5) (5)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(3) (3) (3)	abundant (>50%) (6) (6) (6) (6) (6)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(4) (4) (4)	Strength (1 per layer)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(5) (5) (5)	1 2 3 4 5	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(6) (6) (6)	weak (1) (1) (1) (1) (1)	
	(6) (6) (6) (6)				(7) (7) (7)	strong (2) (2) (2) (2) (2)	
	(7) (7) (7) (7)				(8) (8) (8)	Form (1 per layer)	
	(8) (8) (8) (8)				(9) (9) (9)	1 2 3 4 5	
COARSE FRAGMENTS	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (H) (6.5) (17) (0)	(2.5) (H) (6.5) (17) (0)	(1) (1) (1)	soft segregations (1) (1) (1) (1) (1)	
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (P) (2.5) (2)	(5) (Y) (P) (2.5) (2)	(2) (2) (2)	nodules (2) (2) (2) (2) (2)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(3) (3) (3)	fragments (3) (3) (3) (3) (3)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(4) (4) (4)	crystals (4) (4) (4) (4) (4)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(5) (5) (5)	veins (5) (5) (5) (5) (5)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(6) (6) (6)	concretions (6) (6) (6) (6) (6)	
	(6) (6) (6) (6)				(7) (7) (7)	root linings (7) (7) (7) (7) (7)	
	(7) (7) (7) (7)				(8) (8) (8)	tubules (8) (8) (8) (8) (8)	
	(8) (8) (8) (8)				(9) (9) (9)	Size (1 per layer)	
SUBSTRATE	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (H) (6.5) (17) (0)	(2.5) (H) (6.5) (17) (0)	(1) (1) (1)	1 2 3 4 5	
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (P) (2.5) (2)	(5) (Y) (P) (2.5) (2)	(2) (2) (2)	fine (<2 mm) (1) (1) (1) (1) (1)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(3) (3) (3)	medium (2-6 mm) (2) (2) (2) (2) (2)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(4) (4) (4)	coarse (6-20 mm) (3) (3) (3) (3) (3)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(5) (5) (5)	v coarse (20-60 mm) (4) (4) (4) (4) (4)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(6) (6) (6)	ext coarse (>60 mm) (5) (5) (5) (5) (5)	
	(6) (6) (6) (6)				(7) (7) (7)	Type (1 per layer)	
	(7) (7) (7) (7)				(8) (8) (8)	1 2 3 4 5	
	(8) (8) (8) (8)				(9) (9) (9)	not evident (1) (1) (1) (1) (1)	
ESTIMATED EFFECTIVE ROOTING DEPTH (m)	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (H) (6.5) (17) (0)	(2.5) (H) (6.5) (17) (0)	(1) (1) (1)	calcareous (2) (2) (2) (2) (2)	
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (P) (2.5) (2)	(5) (Y) (P) (2.5) (2)	(2) (2) (2)	gypseous (3) (3) (3) (3) (3)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(3) (3) (3)	manganiferous (4) (4) (4) (4) (4)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(4) (4) (4)	ferruginous (5) (5) (5) (5) (5)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(5) (5) (5)	ferromanganiferous (6) (6) (6) (6) (6)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(6) (6) (6)	organic (7) (7) (7) (7) (7)	
	(6) (6) (6) (6)				(7) (7) (7)	not identified (8) (8) (8) (8) (8)	
	(7) (						



SURVEY TITLE: WARKWORTHSITE LOCATION: 802

PROFILE MAP DETAILS				SURVEY DETAILS			
Profile No.	Map Sheet No.	Eastings	Northings	Described By	Profile Date	Photo Taken (1)	No. of Layers
0 0 0	0 0 0	0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0	0 0 0 0 0 0 0 0	profile 1	
1 1 1	1 1 1	1 1 1 1 1 1	1 1 1 1 1 1 1 1	1 1 1 1 1	1 1 1 1 1 1 1 1	site 2	0
2 2 2	2 2 2	2 2 2 2 2 2	2 2 2 2 2 2 2 2	2 2 2 2 2	2 2 2 2 2 2 2 2	both profile & site 3	1
3 3 3	3 3 3	3 3 3 3 3 3	3 3 3 3 3 3 3 3	3 3 3 3 3	3 3 3 3 3 3 3 3	Nature of Exposure (2)	2
4 4 4	4 4 4	4 4 4 4 4 4	4 4 4 4 4 4 4 4	4 4 4 4 4	4 4 4 4 4 4 4 4	auger 1	3
5 5 5	5 5 5	5 5 5 5 5 5	5 5 5 5 5 5 5 5	5 5 5 5 5	5 5 5 5 5 5 5 5	pit 2	4
6 6 6	6 6 6	6 6 6 6 6 6	6 6 6 6 6 6 6 6	6 6 6 6 6	6 6 6 6 6 6 6 6	batter 3	5
7 7 7	7 7 7	7 7 7 7 7 7	7 7 7 7 7 7 7 7	7 7 7 7 7	7 7 7 7 7 7 7 7	gully 4	6
8 8 8	8 8 8	8 8 8 8 8 8	8 8 8 8 8 8 8 8	8 8 8 8 8	8 8 8 8 8 8 8 8	core sample 5	7
9 9 9	9 9 9	9 9 9 9 9 9	9 9 9 9 9 9 9 9	9 9 9 9 9	9 9 9 9 9 9 9 9	other 6	8
Potential BSAL? (1)		Site type (1)		BIOPHYSICAL STRATEGIC AGRICULTURAL LAND SOIL DATA CARD			
yes 1 no 2	checked 1 detailed 2 exclusion 3						
SOIL TYPE		VEGETATION		LANDFORM ELEMENT (1)			
A.S.C.	Ku	Vegetation Community (1)		Please MARK LIKE THIS ONLY: ○ ○ ○ ○ • Use 2B pencil • No pen or biro • Fully erase mistakes • Make no stray marks • Numbers in ( ) show max. entries allowed			
O	AB	unknown 1 rainforest 2 wet sclerophyll forest 3 dry sclerophyll forest 4 woodland grass u'storey 5 woodland shrub u'storey 6 tall shrubland 7 low shrubland 8 heath 9 grassland/herbland 10 swamp complex 11 littoral complex 12 no vegetation 13		alcove 43 backplain 31 bank 25 bar 35 beach 26 beach ridge 7 bench 19 berm 29 blow-out 59 channel bench 33 cirque 50 cliff 5 cone 3 crater 51 cut face 28 cut-over surface 39 dam 18 drainage depression 41 dune 11 embankment 14 estuary 44 fan 27 fill top 40 flood-out 32 footslope 21 foredune 12 gully 42 hillcrest 1 hillslope 2 lagoon 54 lake 55 landslide 20 levee 8 lunette 13 maar 53 mound 15 ox-bow 57 pan/playa 55 pediment 22 pit 60 plain 30 prior stream 9 rock flat 34 rock platform 35 scald 36 scarp 18 scree 24 scroll 10 sink hole/doline 52 stream channel 46 streambed 45 summit surface 2 swale 47 swamp 58 talus 23 tidal creek 48 tidal flat 37 tor 4 trench 49 valley flat 38			
SO	FD	Growth Forms (4)		LITHOLOGY			
GG	AZ	tree 1 tree mallee 2 shrub 3 mallee shrub 4 heath shrub 5 chenopod shrub 6 hummock grass 7 tussock grass 8 sod grass 9 sedge 10 rush 11 forb 12 fern/cycad 13 moss 14 lichen 15 liverwort 16 vine 17		Substrate (3) not identified 1 unconsolidated 2 gravel 3 sand 4 silt 5 clay 6 organic material 7 alluvium 8 colluvium 9 lacustrine 10 aeolian 11 marine 12 calcareous sand 13 fill 14 mud 15 till 16 sedimentary 17 shale 18 siltstone/mudstone 19 sandstone-quartz 20 sandstone-lithic 21 conglomerate 22 limestone 23 tuff 24 breccia 25 greywacke 26 arkose 27 dolomite 28 calcrete 29 aeolianite 30 chert 31 jasper 32 metamorphic 33 gneiss 34 schist/phyllite 35 slate 36 hornfels 37 quartzite 38 greenstone 39 amphibolite 40 marble 41 igneous 42 coarse-acidic 43 coarse-intermediate 44 coarse-basic 45 fine-acidic 46 fine-intermediate 47 fine-basic 48 serpentine 49 gabbro 50 dolerite 51 diorite 52 syenite 53 granodiorite 54 adamellite 55 granite 56 aplite 57 quartz porphyry 58 basalt 59 andesite 60 trachyte 61 rhyolite 62 obsidian 63 scoria 64 ash 65 agglomerate 66 other 67			
SG	AZ	LAND USE (1)		TOPOGRAPHY			
FAMILY	BELOW	national/state parks 1 timber/scrub/unused 2 logged native forest 3 hardwood plantation 4 softwood plantation 5 volun./native pasture 6 improved pasture 7 cropping 8 orchard/vineyard 9 vegetables/flowers 10 urban 11 industrial 12 quarry/mining 13 other 14		Slope Percent 0 0 0 1 1 1 2 2 2 3 3 3 4 4 4 5 5 5 6 6 6 7 7 7 8 8 8 9 9 9 Site Morphology (1) flat 1 crest 2 hillock 3 ridge 4 upper slope 5 midslope 6 simple slope 7 lower slope 8 open depression 9 closed depression 10 Slope Measurement Method (1) inclinometer 1 Abney level 4 total station 5 RTK GPS 6 LIDAR 7 Slope Morphology (1) waxing 1 waning 2 maximal 3 minimal 4 Aspect (1) N NW NE W E SW SE S			
G.S.G.	A	Identification Method (1)		HYDROLOGY			
B	B	personal assessment 1 geology map 2 both assessment & map 3		Profile Drainage (1) very poorly drained 1 poorly drained 2 imperfectly drained 3 mod. well-drained 4 well-drained 5 rapidly drained 6			
C	C	Rock Outcrop % (1)		Permeability (1) very slowly permeable 1 slowly permeable 2 moderately permeable 3 highly permeable 4			
D	D	nil 1 >20-30% 5 <2% 2 >30-50% 6 2-10% 3 >50% 7 >10-20% 4		Depth (1) & Extent (1) ≤ 500 mm depth 1 > 500 mm depth 2 ≤ 50% area 1 > 50% area 2			
E	E	Surface Condition		SITE FIELD NOTES			
F	F	Current (2)		Photo file name/s:			
G	G	Expected					
H	H	Wet (2)					
I	I	Dry (2)					
J	J	Site Disturbance(s) (2)					
K	K	natural disturbance 1					
L	L	no effective disturbance 2					
M	M	limited clearing 3					
N	N	extensive clearing 4					
O	O	cleared, no cultivation 5					
P	P	occasional cultivation 6					
Q	Q	rainfed cultivation 7					
R	R	irrigated cultivation 8					
S	S	highly disturbed 9					
T	T	Ground Cover %					
U	U	0 1 2 3 4 5 6 7 8 9					
V	V	cracked 2					
W	W	self-mulched 3					
X	X	loose 4					
Y	Y	soft 5					
Z	Z	firm 6					
AA	AA	hardset 7					
AB	AB	surface crust 8					
AC	AC	trampled 9					
AD	AD	poached 10					
AE	AE	recently cultivated 11					
AF	AF	water repellent 12					
AG	AG	gravelly 13					
AH	AH	other 14					

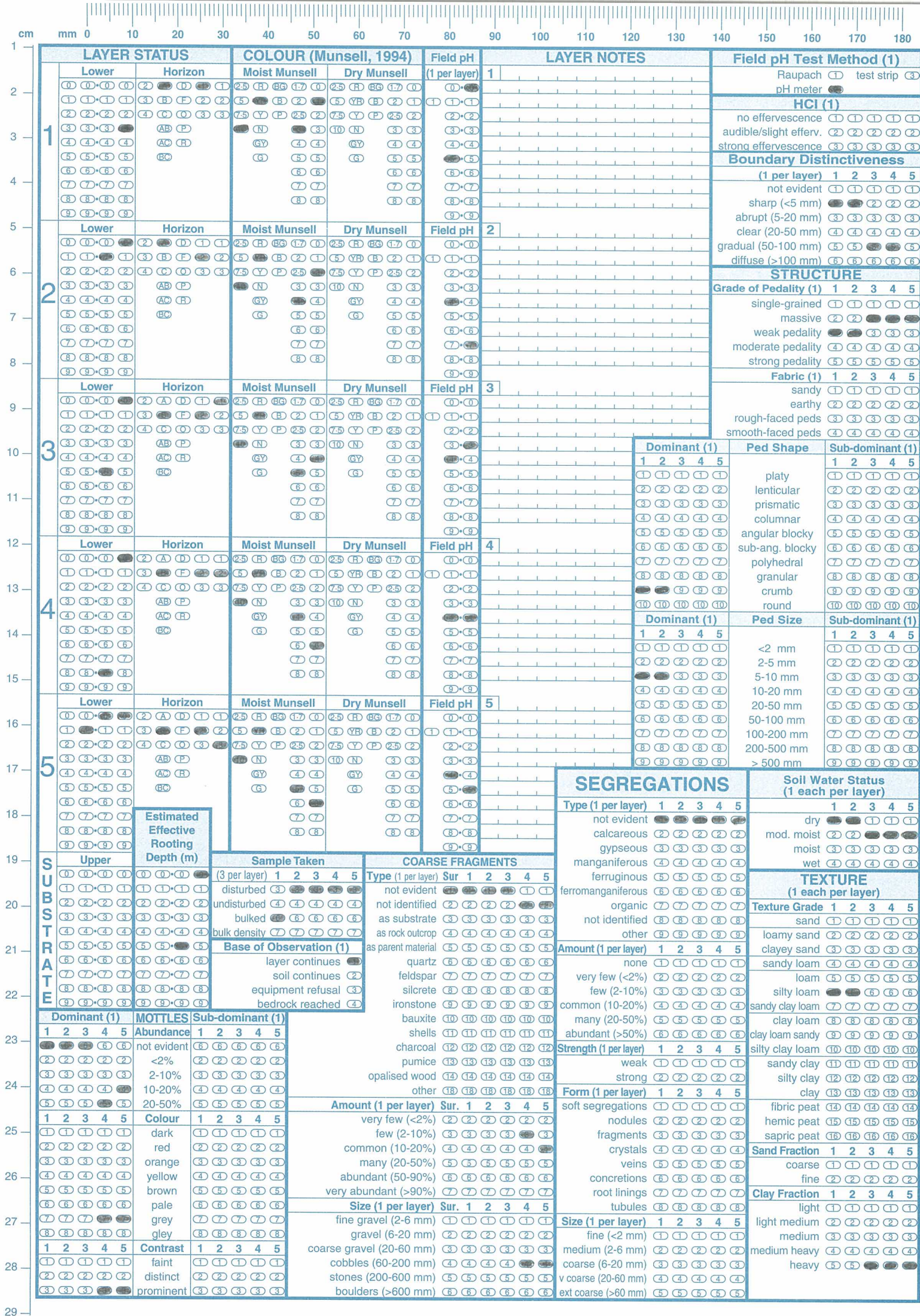
NSW SOIL  
AND LAND  
INFORMATION  
SYSTEMPlease MARK  
LIKE THIS ONLY:

- Use 2B pencil
- No pen or biro
- Fully erase mistakes
- Make no stray marks
- Numbers in ( ) show max. entries allowed

Please do not mark this space.

4055







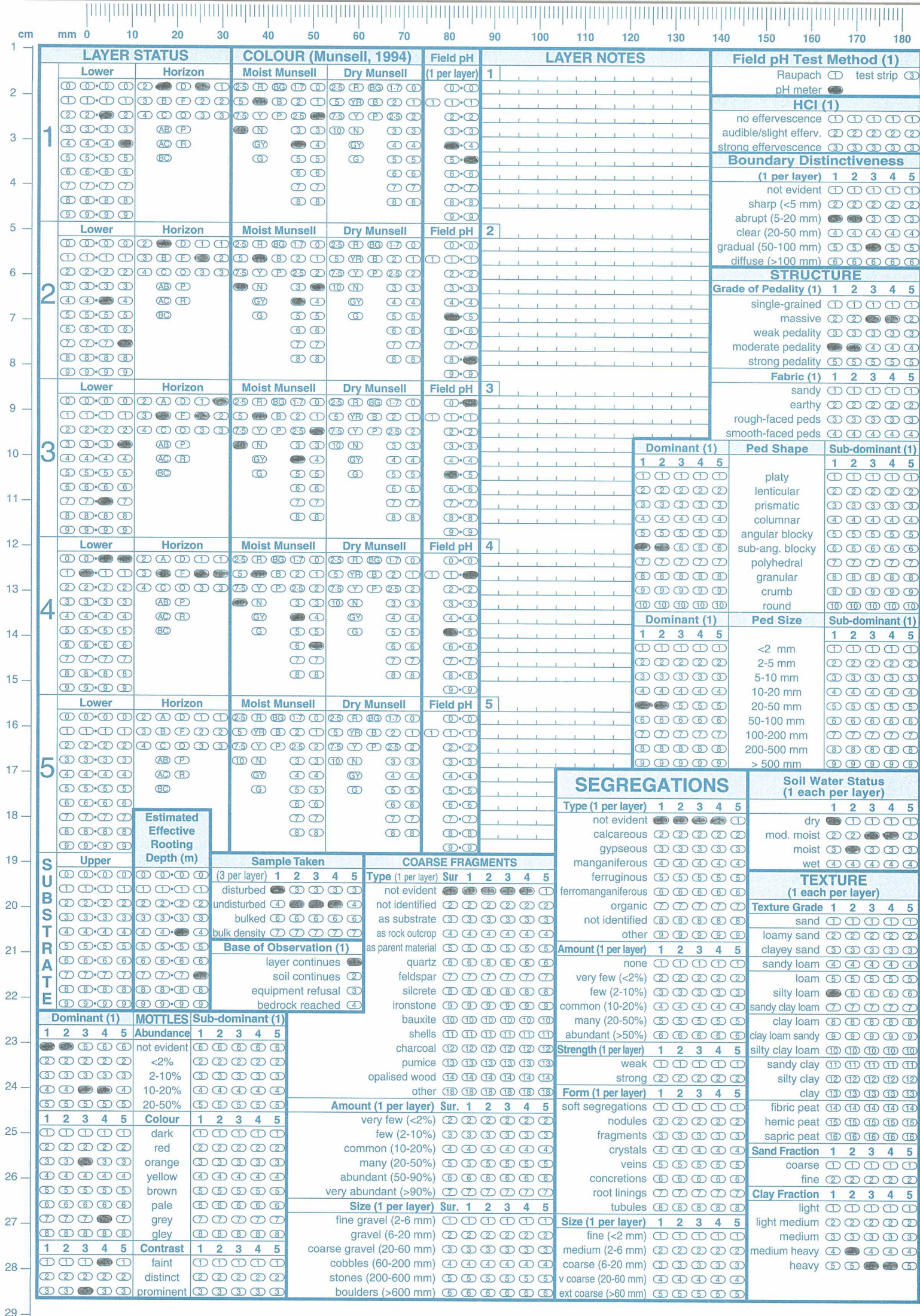
**SITE LOCATION:** B.O.3

## SITE FIELD NOTES

13	13
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4056







SURVEY TITLE: WARKWORTHSITE LOCATION: 804NSW SOIL  
AND LAND  
INFORMATION  
SYSTEMPlease MARK  
LIKE THIS ONLY:

- Use 2B pencil
- No pen or biro
- Fully erase mistakes
- Make no stray marks
- Numbers in ( ) show max. entries allowed

PROFILE MAP DETAILS				SURVEY DETAILS			
Profile No.	Map Sheet No.	Eastings	Northings	Described By	Profile Date	Photo Taken (1)	No. of Layers
(1) (2) (3)	(1) (2) (3)	(1) (2) (3) (4) (5)	(1) (2) (3) (4) (5)	(1) (2) (3) (4)	(1) (2) (3) (4) (5)	profile (1)	(1)
(1) (2) (3)	(1) (2) (3)	(1) (2) (3) (4) (5)	(1) (2) (3) (4) (5)	(1) (2) (3) (4)	(1) (2) (3) (4) (5)	site (2)	(1)
(1) (2) (3)	(1) (2) (3)	(1) (2) (3) (4) (5)	(1) (2) (3) (4) (5)	(1) (2) (3) (4)	(1) (2) (3) (4) (5)	both profile & site (2)	(1)
(1) (2) (3)	(1) (2) (3)	(1) (2) (3) (4) (5)	(1) (2) (3) (4) (5)	(1) (2) (3) (4)	(1) (2) (3) (4) (5)	Nature of Exposure (2)	(2)
(1) (2) (3)	(1) (2) (3)	(1) (2) (3) (4) (5)	(1) (2) (3) (4) (5)	(1) (2) (3) (4)	(1) (2) (3) (4) (5)	auger (1)	(3)
(1) (2) (3)	(1) (2) (3)	(1) (2) (3) (4) (5)	(1) (2) (3) (4) (5)	(1) (2) (3) (4)	(1) (2) (3) (4) (5)	pit (2)	(4)
(1) (2) (3)	(1) (2) (3)	(1) (2) (3) (4) (5)	(1) (2) (3) (4) (5)	(1) (2) (3) (4)	(1) (2) (3) (4) (5)	batter (3)	(5)
(1) (2) (3)	(1) (2) (3)	(1) (2) (3) (4) (5)	(1) (2) (3) (4) (5)	(1) (2) (3) (4)	(1) (2) (3) (4) (5)	gully (4)	(6)
(1) (2) (3)	(1) (2) (3)	(1) (2) (3) (4) (5)	(1) (2) (3) (4) (5)	(1) (2) (3) (4)	(1) (2) (3) (4) (5)	core sample (5)	(7)
(1) (2) (3)	(1) (2) (3)	(1) (2) (3) (4) (5)	(1) (2) (3) (4) (5)	(1) (2) (3) (4)	(1) (2) (3) (4) (5)	other (6)	(8)

Potential BSAL? (1)	Site type (1)
yes (1) no (2)	checked (1) detailed (2) exclusion (3)

BIOPHYSICAL STRATEGIC AGRICULTURAL  
LAND SOIL DATA CARD

SOIL TYPE	VEGETATION	LANDFORM ELEMENT (1)									
A.S.C.	Vegetation Community (1)	alcove (43)	cone (3)	footslope (21)	ox-bow (57)	sink hole/doline (52)					
O	unknown (1)	backplain (31)	crater (51)	foredune (12)	pan/playa (56)	stream channel (46)					
	rainforest (2)	bank (25)	cut face (28)	gully (42)	pediment (22)	streambed (45)					
SO	wet sclerophyll forest (3)	bar (6)	cut-over surface (39)	hillcrest (1)	pit (60)	summit surface (2)					
	dry sclerophyll forest (4)	beach (26)	dam (16)	hillslope (3)	plain (30)	swale (47)					
GG	woodland grass u'storey (5)	beach ridge (7)	drainage depression (41)	lagoon (54)	prior stream (3)	swamp (58)					
	woodland shrub u'storey (6)	bench (19)	dune (11)	lake (55)	rock flat (34)	talus (23)					
SG	tall shrubland (7)	berm (29)	embankment (14)	landslide (20)	rock platform (35)	tidal creek (48)					
	low shrubland (8)	blow-out (59)	estuary (44)	levee (8)	scald (36)	tidal flat (37)					
	heath (9)	channel bench (33)	fan (27)	lunette (13)	scarp (18)	tor (4)					
	grassland/herbland (10)	cirque (50)	fill top (40)	maar (53)	scree (24)	trench (49)					
	swamp complex (11)	cliff (5)	flood-out (32)	mound (15)	scroll (10)	valley flat (38)					
	littoral complex (12)										
	no vegetation (13)										

FAMILY	B	littoral complex (12)	LITHOLOGY										TOPOGR				
	E	no vegetation (13)															
	L	Growth Forms (4) <th colspan="10">Substrate (3)</th> <th colspan="5">Slope Percent</th>	Substrate (3)										Slope Percent				
	O	tree (1)	not identified (1)	limestone (23)	coarse-basic (45)	(0) (0) (0)					S						
	W	tree mallee (2)	unconsolidated (2)	tuff (24)	fine-acidic (46)	(1) (1) (1) (1)											
		shrub (3)	gravel (3)	breccia (25)	fine-intermediate (47)	(2) (2) (2)											
		mallee shrub (4)	sand (4)	greywacke (26)	fine-basic (48)	(3) (3) (3)											
		heath shrub (5)	silt (5)	arkose (27)	serpentine (49)	(4) (4) (4)											
		chenopod shrub (6)	clay (6)	dolomite (28)	gabbro (50)	(5) (5) (5)											
		hummock grass (7)	organic material (7)	calcrete (29)	dolerite (51)	(6) (6) (6)											
	tussock grass (8)	alluvium (8)	aeolianite (30)	diorite (52)	(7) (7) (7)												
	sod grass (9)	colluvium (9)	chert (31)	syenite (53)	(8) (8) (8)												
C		sedge (10)	lacustrine (10)	jasper (32)	granodiorite (54)	(9) (9) (9)											
	G.S.G.	rush (11)	aeolian (11)	metamorphic (33)	adamellite (55)	Slope Measurement Method (1)					SI						
A		forb (12)	marine (12)	gneiss (34)	granite (56)												
B	B	fern/cycad (13)	calcareous sand (13)	schist/phyllite (35)	aplite (57)	inclinometer (5)											
C	C	moss (14)	fill (14)	slate (36)	quartz porphyry (58)	Abney level (4)											
D	D	lichen (15)	mud (15)	hornfels (37)	basalt (59)	total station (5)											
E	E	liverwort (16)	till (16)	quartzite (38)	andesite (60)	RTK GPS (6)											
F	F	vine (17)	sedimentary (17)	greenstone (39)	trachyte (61)	LIDAR (7)											
G	G		shale (18)	amphibolite (40)	rhyolite (62)	Microrelief Type (1)											
H	H		siltstone/mudstone (19)	marble (41)	obsidian (63)	none (5)											
I	I		sandstone-quartz (20)	igneous (42)	scoria (64)	normal gilgai (2)											
J	J		sandstone-lithic (21)	coarse-acidic (43)	ash (65)	crabhole gilgai (3)											
K	K		conglomerate (22)	coarse-intermediate (44)	agglomerate (66)	linear gilgai (4)											
L	L				other (67)	lattice gilgai (5)											

LAND USE (1)				HYDROLOGY			
national/state parks (1)				Profile Drainage (1)		Permeability (1)	
timber/scrub/unused (2)				very poorly drained (1)		very slowly permeable (1)	
logged native forest (3)				poorly drained (2)		slowly permeable (2)	
hardwood plantation (4)				imperfectly drained (3)		moderately permeable (3)	
softwood plantation (5)				mod. well-drained (4)		highly permeable (4)	
volun./native pasture (6)				well-drained (5)			
improved pasture (7)				rapidly drained (6)			
cropping (8)							
orchard/vineyard (9)							
vegetables/flowers (10)							
urban (11)							
industrial (12)							
quarry/mining (13)							
other (14)							

SITE CONDITION				SITE FIELD NOTES			
Site Disturbance(s) (2)		Surface Condition					
natural disturbance (1)		Current (2)	Expected				
no effective disturbance (2)		cracked (2)	Wet (2) Dry (2)				
limited clearing (3)		self-mulched (3)	(2) (2)				
extensive clearing (4)		loose (4)	(3) (3)				
cleared, no cultivation (5)		soft (5)	(4) (4)				
occasional cultivation (6)		firm (6)	(5) (5)				
rainfed cultivation (7)		hardset (7)	(6) (6)				
irrigated cultivation (8)		surface crust (8)	(7) (7)				
highly disturbed (9)		trampled (9)	(8) (8)				
		poached (10)	(9) (9)	Photo file name/s:			
		recently cultivated (11)	(10) (10)				
		water repellent (12)	(11) (11)				
		gravelly (13)	(12) (12)				
		other (14)	(13) (13)				

Please do not mark this space.

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cm	mm	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180							
1	LAYER STATUS										COLOUR (Munsell, 1994)					Field pH		LAYER NOTES					Field pH Test Method (1)				
	Lower		Horizon		Moist Munsell		Dry Munsell		Field pH		(1 per layer)		1				Raupach (1) test strip (3)		pH meter (2)								
2	(0) (0) (0) (0)		(2) (2) (0) (0)		(2.5) (H) (5) (17) (0)		(2.5) (H) (5) (17) (0)		(0) (0)								no effervescence (1) (1) (1) (1)		audible/slight efferv. (2) (2) (2) (2)								
3	(1) (1) (1) (1)		(3) (B) (F) (2) (2)		(5) (Y) (B) (2) (1)		(5) (Y) (B) (2) (1)		(1) (1) (1)								strong effervescence (3) (3) (3) (3)										
4	(2) (2) (2) (2)		(4) (C) (0) (3) (3)		(7.5) (Y) (P) (25) (2)		(7.5) (Y) (P) (25) (2)		(2) (2)								Boundary Distinctiveness										
5	(3) (3) (3) (3)		AB P		(10) (N) (3) (3)		(10) (N) (3) (3)		(3) (3)								(1 per layer) 1 2 3 4 5										
6	(4) (4) (4) (4)		AC H		(6) (6)		(6) (6)		(6) (6)								not evident (1) (1) (1) (1)		sharp (<5 mm) (2) (2) (2) (2)								
7	(5) (5) (5) (5)		BC		(8) (8)		(8) (8)		(8) (8)								abrupt (5-20 mm) (2) (2) (2) (2)		clear (20-50 mm) (4) (4) (4) (4)								
8	(6) (6) (6) (6)				(9) (9)		(9) (9)		(9) (9)								gradual (50-100 mm) (5) (5) (5) (5)		diffuse (>100 mm) (6) (6) (6) (6)								
9	(7) (7) (7) (7)								(7) (7)								STRUCTURE										
10	(8) (8) (8) (8)								(8) (8)								Grade of Pedality (1) 1 2 3 4 5										
11	(9) (9) (9) (9)								(9) (9)								single-grained (1) (1) (1) (1)		massive (2) (2) (2) (2)								
12																	weak pedality (3) (3) (3) (3)		moderate pedality (4) (4) (4) (4)								
13																	strong pedality (5) (5) (5) (5)		Fabric (1) 1 2 3 4 5								
14																	sandy (1) (1) (1) (1)		earthy (2) (2) (2) (2)								
15																	rough-faced peds (3) (3) (3) (3)		smooth-faced peds (4) (4) (4) (4)								
16																	Dominant (1)		Ped Shape								
17																	1 2 3 4 5		Sub-dominant (1)								
18																	1 2 3 4 5		1 2 3 4 5								
19																	platy (1) (1) (1) (1)		lenticular (2) (2) (2) (2)								
20																	prismatic (3) (3) (3) (3)		columnar (4) (4) (4) (4)								
21																	angular blocky (5) (5) (5) (5)		sub-ang. blocky (6) (6) (6) (6)								
22																	polyhedral (7) (7) (7) (7)		granular (8) (8) (8) (8)								
23																	crumb (9) (9) (9) (9)		round (10) (10) (10) (10)								
24																	Dominant (1)		Ped Size								
25																	1 2 3 4 5		Sub-dominant (1)								
26																	1 2 3 4 5		1 2 3 4 5								
27																	<2 mm (1) (1) (1) (1)		2-5 mm (2) (2) (2) (2)								
28																	5-10 mm (3) (3) (3) (3)		10-20 mm (4) (4) (4) (4)								
29																	20-50 mm (5) (5) (5) (5)		50-100 mm (6) (6) (6) (6)								
30																	100-200 mm (7) (7) (7) (7)		200-500 mm (8) (8) (8) (8)								
31																	> 500 mm (9) (9) (9) (9)										
32																	SEGREGATIONS		Soil Water Status								
33																	Type (1 per layer) 1 2 3 4 5		(1 each per layer) 1 2 3 4 5								
34																	not evident (1) (1) (1) (1)		dry (1) (1) (1) (1)								
35																	calcareous (2) (2) (2) (2)		mod. moist (2) (2) (2) (2)								
36																	gypseous (3) (3) (3) (3)		moist (3) (3) (3) (3)								
37																	manganiferous (4) (4) (4) (4)		wet (4) (4) (4) (4)								
38																	ferruginous (5) (5) (5) (5)										
39																	ferromanganiferous (6) (6) (6) (6)										
40																	organic (7) (7) (7) (7)		TEXTURE								
41																	not identified (8) (8) (8) (8)		(1 each per layer)								
42																	other (9) (9) (9) (9)		Texture Grade 1 2 3 4 5								
43																	Amount (1 per layer) 1 2 3 4 5		sand (1) (1) (1) (1)								
44																	none (1) (1) (1) (1)		loamy sand (2) (2) (2) (2)								
45																	very few (<2%) (2) (2) (2) (2)		clayey sand (3) (3) (3) (3)								
46																	few (2-10%) (3) (3) (3) (3)		sandy loam (4) (4) (4) (4)								
47																	common (10-20%) (4) (4) (4) (4)		loam (5) (5) (5) (5)								
48																	many (20-50%) (5) (5) (5) (5)		silty loam (6) (6) (6) (6)								
49																	abundant (>50%) (6) (6) (6) (6)		sandy clay loam (7) (7) (7) (7)								
50																	Strength (1 per layer) 1 2 3 4 5		clay loam (8) (8) (8) (8)								
51																	weak (1) (1) (1) (1)		silty clay loam (9) (9) (9) (9)								
52																	strong (2) (2) (2) (2)		clay (10) (10) (10) (10)								
53																	Form (1 per layer) 1 2 3 4 5		sandy clay (11) (11) (11) (11)								
54																	soft segregations (1) (1) (1) (1)		silty clay (12) (12) (12) (12)								
55																	nodules (2) (2) (2) (2)		clay (13) (13) (13) (13)								
56																	fragments (3) (3) (3) (3)		fibric peat (14) (14) (14) (14)								
57																	crystals (4) (4) (4) (4)		hemic peat (15) (15) (15) (15)								
58																	veins (5) (5) (5) (5)		sapric peat (16) (16) (16) (16)								
59																	concretions (6) (6) (6) (6)		Sand Fraction 1 2 3 4 5								
60																	root linings (7) (7) (7) (7)		coarse (1) (1) (1) (1)								
61																	tubules (8) (8) (8) (8)		fine (2) (2) (2) (2)								
62																	Size (1 per layer) 1 2 3 4 5		Clay Fraction 1 2 3 4 5								
63																	fine gravel (2-6 mm) (1) (1) (1) (1)		light (1) (1) (1) (1)								
64																	gravel (6-20 mm) (2) (2) (2) (2)		light medium (2) (2) (2) (2)								
65																	coarse gravel (20-60 mm) (3) (3) (3) (3)		medium (3) (3) (3) (3)								
66																	cobbles (60-200 mm) (4) (4) (4) (4)		medium heavy (4) (4) (4) (4)								
67																	stones (200-600 mm) (5) (5) (5) (5)		heavy (5) (5) (5) (5)								
68																	boulders (>600 mm) (6) (6) (6) (6)										
69																	ext coarse (>60 mm) (5) (5) (5) (5)										
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**SITE LOCATION:** DS1

NSW SOIL  
AND LAND  
INFORMATION  
SYSTEM

Please MARK  
LIKE THIS ONLY:

- Use 2B pencil
- No pen or biro
- Fully erase mistakes
- Make no stray marks
- Numbers in ( ) show max. entries allowed



1	LAYER STATUS		COLOUR (Munsell, 1994)		Field pH	LAYER NOTES	Field pH Test Method (1)	
	Lower	Horizon	Moist Munsell	Dry Munsell	(1 per layer)		Raupach (1) test strip (3)	pH meter (3)
2	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (H) (B) (17) (0)	(2.5) (H) (B) (17) (0)	(1) (1) (1)		HCl (1)	
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (B) (2) (1)	(5) (Y) (B) (2) (1)	(1) (1) (1)		no effervescence (1) (1) (1) (1)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (25) (2)	(7.5) (Y) (P) (25) (2)	(2) (2) (2)		audible/slight efferv. (2) (2) (2) (2)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)		strong effervescence (3) (3) (3) (3)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)		Boundary Distinctiveness	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)		(1 per layer) 1 2 3 4 5	
	(6) (6) (6) (6)				(6) (6) (6)		not evident (1) (1) (1) (1)	
	(7) (7) (7) (7)				(7) (7) (7)		sharp (<5 mm) (2) (2) (2) (2)	
	(8) (8) (8) (8)				(8) (8) (8)		abrupt (5-20 mm) (3) (3) (3) (3)	
3	(1) (1) (1) (1)	(2) (A) (D) (1) (1)	(2.5) (H) (B) (17) (0)	(2.5) (H) (B) (17) (0)	(1) (1) (1)		clear (20-50 mm) (4) (4) (4) (4)	
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (B) (2) (1)	(5) (Y) (B) (2) (1)	(1) (1) (1)		gradual (50-100 mm) (5) (5) (5) (5)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (25) (2)	(7.5) (Y) (P) (25) (2)	(2) (2) (2)		diffuse (>100 mm) (6) (6) (6) (6)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)		STRUCTURE	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)		Grade of Pedality (1) 1 2 3 4 5	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)		single-grained (1) (1) (1) (1)	
	(6) (6) (6) (6)				(6) (6) (6)		massive (2) (2) (2) (2)	
	(7) (7) (7) (7)				(7) (7) (7)		weak pedality (3) (3) (3) (3)	
	(8) (8) (8) (8)				(8) (8) (8)		moderate pedality (4) (4) (4) (4)	
4	(1) (1) (1) (1)	(2) (A) (D) (1) (1)	(2.5) (H) (B) (17) (0)	(2.5) (H) (B) (17) (0)	(1) (1) (1)		strong pedality (5) (5) (5) (5)	
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (B) (2) (1)	(5) (Y) (B) (2) (1)	(1) (1) (1)		Fabric (1) 1 2 3 4 5	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (25) (2)	(7.5) (Y) (P) (25) (2)	(2) (2) (2)		sandy (1) (1) (1) (1)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)		earthy (2) (2) (2) (2)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)		rough-faced peds (3) (3) (3) (3)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)		smooth-faced peds (4) (4) (4) (4)	
	(6) (6) (6) (6)				(6) (6) (6)		Dominant (1)	
	(7) (7) (7) (7)				(7) (7) (7)		Ped Shape	
	(8) (8) (8) (8)				(8) (8) (8)		Sub-dominant (1)	
5	(1) (1) (1) (1)	(2) (A) (D) (1) (1)	(2.5) (H) (B) (17) (0)	(2.5) (H) (B) (17) (0)	(1) (1) (1)		1 2 3 4 5	
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (B) (2) (1)	(5) (Y) (B) (2) (1)	(1) (1) (1)		platy (1) (1) (1) (1)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (25) (2)	(7.5) (Y) (P) (25) (2)	(2) (2) (2)		lenticular (2) (2) (2) (2)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)		prismatic (3) (3) (3) (3)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)		columnar (4) (4) (4) (4)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)		angular blocky (5) (5) (5) (5)	
	(6) (6) (6) (6)				(6) (6) (6)		sub-ang. blocky (6) (6) (6) (6)	
	(7) (7) (7) (7)				(7) (7) (7)		polyhedral (7) (7) (7) (7)	
	(8) (8) (8) (8)				(8) (8) (8)		granular (8) (8) (8) (8)	
SUBSTRATE	(1) (1) (1) (1)	(2) (A) (D) (1) (1)	(2.5) (H) (B) (17) (0)	(2.5) (H) (B) (17) (0)	(1) (1) (1)		crumb (9) (9) (9) (9)	
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (B) (2) (1)	(5) (Y) (B) (2) (1)	(1) (1) (1)		round (10) (10) (10) (10)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (25) (2)	(7.5) (Y) (P) (25) (2)	(2) (2) (2)		Dominant (1)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)		Ped Size	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)		Sub-dominant (1)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)		1 2 3 4 5	
	(6) (6) (6) (6)				(6) (6) (6)		<2 mm (1) (1) (1) (1)	
	(7) (7) (7) (7)				(7) (7) (7)		2-5 mm (2) (2) (2) (2)	
	(8) (8) (8) (8)				(8) (8) (8)		5-10 mm (3) (3) (3) (3)	
ESTIMATED EFFECTIVE ROOTING DEPTH (m)	(1) (1) (1) (1)	(2) (A) (D) (1) (1)	(2.5) (H) (B) (17) (0)	(2.5) (H) (B) (17) (0)	(1) (1) (1)		10-20 mm (4) (4) (4) (4)	
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (B) (2) (1)	(5) (Y) (B) (2) (1)	(1) (1) (1)		20-50 mm (5) (5) (5) (5)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (25) (2)	(7.5) (Y) (P) (25) (2)	(2) (2) (2)		50-100 mm (6) (6) (6) (6)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)		100-200 mm (7) (7) (7) (7)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)		200-500 mm (8) (8) (8) (8)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)		> 500 mm (9) (9) (9) (9)	
	(6) (6) (6) (6)				(6) (6) (6)		SEGREGATIONS	
	(7) (7) (7) (7)				(7) (7) (7)		Soil Water Status (1 each per layer)	
	(8) (8) (8) (8)				(8) (8) (8)		1 2 3 4 5	
Upper	(1) (1) (1) (1)	(2) (A) (D) (1) (1)	(2.5) (H) (B) (17) (0)	(2.5) (H) (B) (17) (0)	(1) (1) (1)		dry (1) (1) (1) (1)	
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (B) (2) (1)	(5) (Y) (B) (2) (1)	(1) (1) (1)		mod. moist (2) (2) (2) (2)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (25) (2)	(7.5) (Y) (P) (25) (2)	(2) (2) (2)		moist (3) (3) (3) (3)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)		wet (4) (4) (4) (4)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)		TEXTURE	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)		(1 each per layer)	
	(6) (6) (6) (6)				(6) (6) (6)		Texture Grade 1 2 3 4 5	
	(7) (7) (7) (7)				(7) (7) (7)		sand (1) (1) (1) (1)	
	(8) (8) (8) (8)				(8) (8) (8)		loamy sand (2) (2) (2) (2)	
Sample Taken	(1) (1) (1) (1)	(2) (A) (D) (1) (1)	(2.5) (H) (B) (17) (0)	(2.5) (H) (B) (17) (0)	(1) (1) (1)		clayey sand (3) (3) (3) (3)	
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (B) (2) (1)	(5) (Y) (B) (2) (1)	(1) (1) (1)		sandy loam (4) (4) (4) (4)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (25) (2)	(7.5) (Y) (P) (25) (2)	(2) (2) (2)		loam (5) (5) (5) (5)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)		silty loam (6) (6) (6) (6)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)		sandy clay loam (7) (7) (7) (7)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)		clay loam (8) (8) (8) (8)	
	(6) (6) (6) (6)				(6) (6) (6)		clay loam sandy (9) (9) (9) (9)	
	(7) (7) (7) (7)				(7) (7) (7)		silty clay loam (10) (10) (10) (10)	
	(8) (8) (8) (8)				(8) (8) (8)		sandy clay (11) (11) (11) (11)	
COARSE FRAGMENTS	(1) (1) (1) (1)	(2) (A) (D) (1) (1)	(2.5) (H) (B) (17) (0)	(2.5) (H) (B) (17) (0)	(1) (1) (1)		silty clay (12) (12) (12) (12)	
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (B) (2) (1)	(5) (Y) (B) (2) (1)	(1) (1) (1)		clay (13) (13) (13) (13)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (25) (2)	(7.5) (Y) (P) (25) (2)	(2) (2) (2)		fibric peat (14) (14) (14) (14)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)		hemic peat (15) (15) (15) (15)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)		sapric peat (16) (16) (16) (16)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)		Sand Fraction 1 2 3 4 5	
	(6) (6) (6) (6)				(6) (6) (6)		coarse (1) (1) (1) (1)	
	(7) (7) (7) (7)				(7) (7) (7)		fine (2) (2) (2) (2)	
	(8) (8) (8) (8)				(8) (8) (8)		Clay Fraction 1 2 3 4 5	
Base of Observation (1)	(1) (1) (1) (1)	(2) (A) (D) (1) (1)	(2.5) (H) (B) (17) (0)	(2.5) (H) (B) (17) (0)	(1) (1) (1)		light (1) (1) (1) (1)	
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (B) (2) (1)	(5) (Y) (B) (2) (1)	(1) (1) (1)		light medium (2) (2) (2) (2)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (25) (2)	(7.5) (Y) (P) (25) (2)	(2) (2) (2)		medium (3) (3) (3) (3)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)		medium heavy (4) (4) (4) (4)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)		heavy (5) (5) (5) (5)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)			
	(6) (6) (6) (6)				(6) (6) (6)			
	(7) (7) (7) (7)				(7) (7) (7)			
	(8) (8) (8) (8)				(8) (8) (8)			
Contrast	(1) (1) (1) (1)	(2) (A) (D) (1) (1)	(2.5) (H) (B) (17) (0)	(2.5) (H) (B) (17) (0)	(1) (1) (1)			
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (B) (2) (1)	(5) (Y) (B) (2) (1)	(1) (1) (1)			
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (25) (2)	(7.5) (Y) (P) (25) (2)	(2) (2) (2)			
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)			
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)			
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)			
	(6) (6) (6) (6)				(6) (6) (6)			
	(7) (7) (7) (7)				(7) (7) (7)			
	(8) (8) (8) (8)				(8) (8) (8)			
faint	(1) (1) (1) (1)	(2) (A) (D) (1) (1)	(2.5) (H) (B) (17) (0)	(2.5) (H) (B) (17) (0)	(1) (1) (1)			
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (B) (2) (1)	(5) (Y) (B) (2) (1)	(1) (1) (1)			
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (25) (2)	(7.5) (Y) (P) (25) (2)	(2) (2) (2)			
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)			
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)			
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)			
	(6) (6) (6) (6)				(6) (6) (6)			
	(7) (7) (7) (7)				(7) (7) (7)			
	(8) (8) (8) (8)				(8) (8) (8)			
distinct	(1) (1) (1) (1)	(2) (A) (D) (1) (1)	(2.5) (H) (B) (17) (0)	(2.5) (H) (B) (17) (0)	(1) (1) (1)			
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (B) (2) (1)	(5) (Y) (B) (2) (1)	(1) (1) (1)			
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (25) (2)	(7.5) (Y) (P) (25) (2)	(2) (2) (2)			
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)			
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)			
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)			
	(6) (6) (6) (6)				(6) (6) (6)			
	(7) (7) (7) (7)				(7) (7) (7)			
	(8) (8) (8) (8)				(8) (8) (8)			
prominent	(1) (1) (1) (1)	(2) (A) (D) (1) (1)	(2.5) (H) (B) (17) (0)	(2.5) (H) (B) (17) (0)	(1) (1) (1)			
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (B) (2) (1)	(5) (Y) (B) (2) (1)	(1) (1) (1)			
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (25) (2)	(7.5) (Y) (P) (25) (2)	(2) (2) (2)			
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)			
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)			
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)			
	(6) (6) (6) (6)				(6) (6) (6)			
	(7) (7) (7) (7)				(7) (7) (7)			
	(8) (8) (8) (8)				(8) (8) (8)			
Size (1 per layer)	(1) (1) (1) (1)	(2) (A) (D) (1) (1)	(2.5) (H) (B) (17) (0)	(2.5) (H) (B) (17) (0)	(1) (1) (1)			
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (B) (2) (1)	(5) (Y) (B) (2) (1)	(1) (1) (1)			
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (25) (2)	(7.5) (Y) (P) (25) (2)	(2) (2) (2)			
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)			
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)			
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)			
	(6) (6) (6) (6)				(6) (6) (6)			
	(7) (7) (7) (7)				(7) (7) (7)			
	(8) (8) (8) (8)				(8) (8) (8)			
Amount (1 per layer)	(1) (1) (1) (1)	(2) (A) (D) (1) (1)	(2.5) (H) (B) (17) (0)	(2.5) (H) (B) (17) (0)	(1) (1) (1)			
	(1) (1) (1) (1)	(3) (B) (P) (2) (2)	(5) (Y) (B) (2) (1)	(5) (Y) (B) (2) (1)	(1) (1) (1)			
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (25) (2)	(7.5) (Y) (P) (25) (2)	(2) (2) (2)			
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)			
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)			
	(							



**SITE LOCATION:** GPO2

[illegible]



LAYER STATUS		COLOUR (Munsell, 1994)		Field pH	LAYER NOTES	Field pH Test Method (1)	
Lower	Horizon	Moist Munsell	Dry Munsell	(1 per layer)		Raupach (1) test strip (3)	pH meter (3)
1	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (R) (B) (17) (10)	(2.5) (R) (B) (17) (10)	(1) (1) (1)	no effervescence (1) (1) (1) (1) (1)	
	(1) (1) (1) (1)	(3) (B) (F) (2) (2)	(5) (Y) (B) (2) (2)	(5) (Y) (B) (2) (2)	(1) (1) (1)	audible/slight efferv. (2) (2) (2) (2) (2)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(2) (2) (2)	strong effervescence (3) (3) (3) (3) (3)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)	Boundary Distinctiveness	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)	(1 per layer) 1 2 3 4 5	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)	not evident (1) (1) (1) (1) (1)	
	(6) (6) (6) (6)		(6) (6) (6)	(6) (6) (6)	(6) (6) (6)	sharp (<5 mm) (2) (2) (2) (2) (2)	
	(7) (7) (7) (7)		(7) (7) (7)	(7) (7) (7)	(7) (7) (7)	abrupt (5-20 mm) (3) (3) (3) (3) (3)	
	(8) (8) (8) (8)		(8) (8) (8)	(8) (8) (8)	(8) (8) (8)	clear (20-50 mm) (4) (4) (4) (4) (4)	
2	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (R) (B) (17) (10)	(2.5) (R) (B) (17) (10)	(1) (1) (1)	gradual (50-100 mm) (5) (5) (5) (5) (5)	
	(1) (1) (1) (1)	(3) (B) (F) (2) (2)	(5) (Y) (B) (2) (2)	(5) (Y) (B) (2) (2)	(1) (1) (1)	diffuse (>100 mm) (6) (6) (6) (6) (6)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(2) (2) (2)	STRUCTURE	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)	Grade of Pedality (1) 1 2 3 4 5	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)	single-grained (1) (1) (1) (1) (1)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)	massive (2) (2) (2) (2) (2)	
	(6) (6) (6) (6)		(6) (6) (6)	(6) (6) (6)	(6) (6) (6)	weak pedality (3) (3) (3) (3) (3)	
	(7) (7) (7) (7)		(7) (7) (7)	(7) (7) (7)	(7) (7) (7)	moderate pedality (4) (4) (4) (4) (4)	
	(8) (8) (8) (8)		(8) (8) (8)	(8) (8) (8)	(8) (8) (8)	strong pedality (5) (5) (5) (5) (5)	
3	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (R) (B) (17) (10)	(2.5) (R) (B) (17) (10)	(1) (1) (1)	Fabric (1) 1 2 3 4 5	
	(1) (1) (1) (1)	(3) (B) (F) (2) (2)	(5) (Y) (B) (2) (2)	(5) (Y) (B) (2) (2)	(1) (1) (1)	sandy (1) (1) (1) (1) (1)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(2) (2) (2)	earthy (2) (2) (2) (2) (2)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)	rough-faced peds (3) (3) (3) (3) (3)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)	smooth-faced peds (4) (4) (4) (4) (4)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)	Dominant (1) 1 2 3 4 5	
	(6) (6) (6) (6)		(6) (6) (6)	(6) (6) (6)	(6) (6) (6)	Ped Shape	
	(7) (7) (7) (7)		(7) (7) (7)	(7) (7) (7)	(7) (7) (7)	Sub-dominant (1) 1 2 3 4 5	
	(8) (8) (8) (8)		(8) (8) (8)	(8) (8) (8)	(8) (8) (8)	platy (1) (1) (1) (1) (1)	
4	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (R) (B) (17) (10)	(2.5) (R) (B) (17) (10)	(1) (1) (1)	lenticular (2) (2) (2) (2) (2)	
	(1) (1) (1) (1)	(3) (B) (F) (2) (2)	(5) (Y) (B) (2) (2)	(5) (Y) (B) (2) (2)	(1) (1) (1)	prismatic (3) (3) (3) (3) (3)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(2) (2) (2)	columnar (4) (4) (4) (4) (4)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)	angular blocky (5) (5) (5) (5) (5)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)	sub-ang. blocky (6) (6) (6) (6) (6)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)	polyhedral (7) (7) (7) (7) (7)	
	(6) (6) (6) (6)		(6) (6) (6)	(6) (6) (6)	(6) (6) (6)	granular (8) (8) (8) (8) (8)	
	(7) (7) (7) (7)		(7) (7) (7)	(7) (7) (7)	(7) (7) (7)	crumb (9) (9) (9) (9) (9)	
	(8) (8) (8) (8)		(8) (8) (8)	(8) (8) (8)	(8) (8) (8)	round (10) (10) (10) (10) (10)	
5	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (R) (B) (17) (10)	(2.5) (R) (B) (17) (10)	(1) (1) (1)	Dominant (1) 1 2 3 4 5	
	(1) (1) (1) (1)	(3) (B) (F) (2) (2)	(5) (Y) (B) (2) (2)	(5) (Y) (B) (2) (2)	(1) (1) (1)	Ped Size	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(2) (2) (2)	Sub-dominant (1) 1 2 3 4 5	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)	<2 mm (1) (1) (1) (1) (1)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)	2-5 mm (2) (2) (2) (2) (2)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)	5-10 mm (3) (3) (3) (3) (3)	
	(6) (6) (6) (6)		(6) (6) (6)	(6) (6) (6)	(6) (6) (6)	10-20 mm (4) (4) (4) (4) (4)	
	(7) (7) (7) (7)		(7) (7) (7)	(7) (7) (7)	(7) (7) (7)	20-50 mm (5) (5) (5) (5) (5)	
	(8) (8) (8) (8)		(8) (8) (8)	(8) (8) (8)	(8) (8) (8)	50-100 mm (6) (6) (6) (6) (6)	
SUBSTRATE	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (R) (B) (17) (10)	(2.5) (R) (B) (17) (10)	(1) (1) (1)	100-200 mm (7) (7) (7) (7) (7)	
	(1) (1) (1) (1)	(3) (B) (F) (2) (2)	(5) (Y) (B) (2) (2)	(5) (Y) (B) (2) (2)	(1) (1) (1)	200-500 mm (8) (8) (8) (8) (8)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(2) (2) (2)	> 500 mm (9) (9) (9) (9) (9)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)	SEGREGATIONS	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)	Soil Water Status (1 each per layer)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)	1 2 3 4 5	
	(6) (6) (6) (6)		(6) (6) (6)	(6) (6) (6)	(6) (6) (6)	dry (1) (1) (1) (1) (1)	
	(7) (7) (7) (7)		(7) (7) (7)	(7) (7) (7)	(7) (7) (7)	mod. moist (2) (2) (2) (2) (2)	
	(8) (8) (8) (8)		(8) (8) (8)	(8) (8) (8)	(8) (8) (8)	moist (3) (3) (3) (3) (3)	
ESTIMATED EFFECTIVE ROOTING DEPTH (m)	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (R) (B) (17) (10)	(2.5) (R) (B) (17) (10)	(1) (1) (1)	wet (4) (4) (4) (4) (4)	
	(1) (1) (1) (1)	(3) (B) (F) (2) (2)	(5) (Y) (B) (2) (2)	(5) (Y) (B) (2) (2)	(1) (1) (1)	TEXTURE	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(2) (2) (2)	(1 each per layer)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)	Texture Grade 1 2 3 4 5	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)	sand (1) (1) (1) (1) (1)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)	loamy sand (2) (2) (2) (2) (2)	
	(6) (6) (6) (6)		(6) (6) (6)	(6) (6) (6)	(6) (6) (6)	clayey sand (3) (3) (3) (3) (3)	
	(7) (7) (7) (7)		(7) (7) (7)	(7) (7) (7)	(7) (7) (7)	sandy loam (4) (4) (4) (4) (4)	
	(8) (8) (8) (8)		(8) (8) (8)	(8) (8) (8)	(8) (8) (8)	loam (5) (5) (5) (5) (5)	
DOMINANT (1)	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (R) (B) (17) (10)	(2.5) (R) (B) (17) (10)	(1) (1) (1)	silty loam (6) (6) (6) (6) (6)	
	(1) (1) (1) (1)	(3) (B) (F) (2) (2)	(5) (Y) (B) (2) (2)	(5) (Y) (B) (2) (2)	(1) (1) (1)	sandy clay loam (7) (7) (7) (7) (7)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(2) (2) (2)	clay loam (8) (8) (8) (8) (8)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)	clay loam sandy (9) (9) (9) (9) (9)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)	silty clay loam (10) (10) (10) (10) (10)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)	sandy clay (11) (11) (11) (11) (11)	
	(6) (6) (6) (6)		(6) (6) (6)	(6) (6) (6)	(6) (6) (6)	silty clay (12) (12) (12) (12) (12)	
	(7) (7) (7) (7)		(7) (7) (7)	(7) (7) (7)	(7) (7) (7)	clay (13) (13) (13) (13) (13)	
	(8) (8) (8) (8)		(8) (8) (8)	(8) (8) (8)	(8) (8) (8)	fibric peat (14) (14) (14) (14) (14)	
MOTTLES	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (R) (B) (17) (10)	(2.5) (R) (B) (17) (10)	(1) (1) (1)	hemic peat (15) (15) (15) (15) (15)	
	(1) (1) (1) (1)	(3) (B) (F) (2) (2)	(5) (Y) (B) (2) (2)	(5) (Y) (B) (2) (2)	(1) (1) (1)	sapric peat (16) (16) (16) (16) (16)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(2) (2) (2)	Sand Fraction 1 2 3 4 5	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)	coarse (1) (1) (1) (1) (1)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)	fine (2) (2) (2) (2) (2)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)	Clay Fraction 1 2 3 4 5	
	(6) (6) (6) (6)		(6) (6) (6)	(6) (6) (6)	(6) (6) (6)	light (1) (1) (1) (1) (1)	
	(7) (7) (7) (7)		(7) (7) (7)	(7) (7) (7)	(7) (7) (7)	light medium (2) (2) (2) (2) (2)	
	(8) (8) (8) (8)		(8) (8) (8)	(8) (8) (8)	(8) (8) (8)	medium (3) (3) (3) (3) (3)	
CONTRAST	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (R) (B) (17) (10)	(2.5) (R) (B) (17) (10)	(1) (1) (1)	medium heavy (4) (4) (4) (4) (4)	
	(1) (1) (1) (1)	(3) (B) (F) (2) (2)	(5) (Y) (B) (2) (2)	(5) (Y) (B) (2) (2)	(1) (1) (1)	heavy (5) (5) (5) (5) (5)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(2) (2) (2)	Size (1 per layer) 1 2 3 4 5	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)	fine (<2 mm) (1) (1) (1) (1) (1)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)	medium (2-6 mm) (2) (2) (2) (2) (2)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)	coarse (6-20 mm) (3) (3) (3) (3) (3)	
	(6) (6) (6) (6)		(6) (6) (6)	(6) (6) (6)	(6) (6) (6)	v coarse (20-60 mm) (4) (4) (4) (4) (4)	
	(7) (7) (7) (7)		(7) (7) (7)	(7) (7) (7)	(7) (7) (7)	ext coarse (>60 mm) (5) (5) (5) (5) (5)	
	(8) (8) (8) (8)		(8) (8) (8)	(8) (8) (8)	(8) (8) (8)	Type (1 per layer) 1 2 3 4 5	
COARSE FRAGMENTS	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (R) (B) (17) (10)	(2.5) (R) (B) (17) (10)	(1) (1) (1)	not evident (1) (1) (1) (1) (1)	
	(1) (1) (1) (1)	(3) (B) (F) (2) (2)	(5) (Y) (B) (2) (2)	(5) (Y) (B) (2) (2)	(1) (1) (1)	calcareous (2) (2) (2) (2) (2)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(2) (2) (2)	gypseous (3) (3) (3) (3) (3)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)	manganiferous (4) (4) (4) (4) (4)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)	ferruginous (5) (5) (5) (5) (5)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)	ferromanganiferous (6) (6) (6) (6) (6)	
	(6) (6) (6) (6)		(6) (6) (6)	(6) (6) (6)	(6) (6) (6)	organic (7) (7) (7) (7) (7)	
	(7) (7) (7) (7)		(7) (7) (7)	(7) (7) (7)	(7) (7) (7)	not identified (8) (8) (8) (8) (8)	
	(8) (8) (8) (8)		(8) (8) (8)	(8) (8) (8)	(8) (8) (8)	other (9) (9) (9) (9) (9)	
Amount (1 per layer)	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (R) (B) (17) (10)	(2.5) (R) (B) (17) (10)	(1) (1) (1)	Amount (1 per layer) 1 2 3 4 5	
	(1) (1) (1) (1)	(3) (B) (F) (2) (2)	(5) (Y) (B) (2) (2)	(5) (Y) (B) (2) (2)	(1) (1) (1)	none (1) (1) (1) (1) (1)	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(2) (2) (2)	very few (<2%) (2) (2) (2) (2) (2)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)	few (2-10%) (3) (3) (3) (3) (3)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)	common (10-20%) (4) (4) (4) (4) (4)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)	many (20-50%) (5) (5) (5) (5) (5)	
	(6) (6) (6) (6)		(6) (6) (6)	(6) (6) (6)	(6) (6) (6)	abundant (>50%) (6) (6) (6) (6) (6)	
	(7) (7) (7) (7)		(7) (7) (7)	(7) (7) (7)	(7) (7) (7)	Strength (1 per layer) 1 2 3 4 5	
	(8) (8) (8) (8)		(8) (8) (8)	(8) (8) (8)	(8) (8) (8)	weak (1) (1) (1) (1) (1)	
Size (1 per layer)	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (R) (B) (17) (10)	(2.5) (R) (B) (17) (10)	(1) (1) (1)	strong (2) (2) (2) (2) (2)	
	(1) (1) (1) (1)	(3) (B) (F) (2) (2)	(5) (Y) (B) (2) (2)	(5) (Y) (B) (2) (2)	(1) (1) (1)	Form (1 per layer) 1 2 3 4 5	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(2) (2) (2)	soft segregations (1) (1) (1) (1) (1)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)	nodules (2) (2) (2) (2) (2)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)	fragments (3) (3) (3) (3) (3)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)	crystals (4) (4) (4) (4) (4)	
	(6) (6) (6) (6)		(6) (6) (6)	(6) (6) (6)	(6) (6) (6)	veins (5) (5) (5) (5) (5)	
	(7) (7) (7) (7)		(7) (7) (7)	(7) (7) (7)	(7) (7) (7)	concretions (6) (6) (6) (6) (6)	
	(8) (8) (8) (8)		(8) (8) (8)	(8) (8) (8)	(8) (8) (8)	root linings (7) (7) (7) (7) (7)	
Form (1 per layer)	(1) (1) (1) (1)	(2) (2) (2) (2)	(2.5) (R) (B) (17) (10)	(2.5) (R) (B) (17) (10)	(1) (1) (1)	tubules (8) (8) (8) (8) (8)	
	(1) (1) (1) (1)	(3) (B) (F) (2) (2)	(5) (Y) (B) (2) (2)	(5) (Y) (B) (2) (2)	(1) (1) (1)	Size (1 per layer) 1 2 3 4 5	
	(2) (2) (2) (2)	(4) (C) (O) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(2) (2) (2)	fine (<2 mm) (1) (1) (1) (1) (1)	
	(3) (3) (3) (3)	AB P	(N) (3) (3)	(10) (N) (3) (3)	(3) (3) (3)	medium (2-6 mm) (2) (2) (2) (2) (2)	
	(4) (4) (4) (4)	AC H	(GY) (4) (4)	(GY) (4) (4)	(4) (4) (4)	coarse (6-20 mm) (3) (3) (3) (3) (3)	
	(5) (5) (5) (5)	BC	(G) (5) (5)	(G) (5) (5)	(5) (5) (5)	v coarse (20-60 mm) (4) (4) (4) (4) (4)	
	(6) (6) (6) (6)		(6) (6) (6)	(6) (6) (6)	(6) (6) (6)	ext coarse (>60 mm) (5) (5) (5) (5) (5)	
	(7) (7) (7) (7)		(7) (7) (7)	(7) (7) (7)	(7) (7) (7)	Type (1 per layer) 1 2 3 4 5	



SURVEY TITLE: WARKWORTH

SITE LOCATION: DS2

PROFILE MAP DETAILS				SURVEY DETAILS				
Profile No.	Map Sheet No.	Easting	Northings	Described By	Profile Date	Photo Taken (1)	No. of Layers	
1	1	1	1	1	1	1	1	
2	2	2	2	2	2	2	2	
3	3	3	3	3	3	3	3	
4	4	4	4	4	4	4	4	
5	5	5	5	5	5	5	5	
6	6	6	6	6	6	6	6	
7	7	7	7	7	7	7	7	
8	8	8	8	8	8	8	8	
9	9	9	9	9	9	9	9	
Potential BSAL? (1)				Site type (1)				
yes 1 no 2				checked 1 detailed 2 exclusion 3				
BIOPHYSICAL STRATEGIC AGRICULTURAL LAND SOIL DATA CARD								
SOIL TYPE		VEGETATION		LANDFORM ELEMENT (1)				
A.S.C.		Vegetation Community (1)		alcove 43 cone 3 footslope 21 ox-bow 57 sink hole/doline 52				
O		unknown 1		backplain 31 crater 51 foredune 12 pan/playa 55 stream channel 45				
SO		rainforest 2		bank 25 cut face 28 gully 42 pediment 22 summit surface 2				
AC		wet sclerophyll forest 3		bar 6 cut-over surface 39 hillcrest 1 pit 60				
FN		dry sclerophyll forest 4		beach 26 dam 16 hillslope 1 plain 30				
GG		woodland grass u'storey 5		beach ridge 7 drainage depression 41 lagoon 54 prior stream 3				
AF		woodland shrub u'storey 6		bench 19 dune 11 lake 55 rock flat 34				
SG		tall shrubland 7		berm 29 embankment 14 landslide 20 rock platform 35				
B		low shrubland 8		blow-out 59 estuary 44 levee 8 scald 36				
E		heath 9		channel bench 33 fan 27 lunette 13 scarp 18				
K		grassland/herbland 10		cirque 50 fill top 40 maar 53 scree 24				
O		swamp complex 11		cliff 5 flood-out 32 mound 15 scroll 10				
W		littoral complex 12						
C		no vegetation 13						
G.S.G.		Growth Forms (4)		LITHOLOGY				
A		tree 1		Substrate (3)				
B		tree mallee 2		not identified 1 limestone 23 coarse-basic 45				
C		shrub 3		unconsolidated 2 tuff 24 fine-acidic 46				
D		mallee shrub 4		gravel 3 breccia 25 fine-intermediate 47				
E		heath shrub 5		sand 4 greywacke 26 fine-basic 48				
F		chenopod shrub 6		silt 5 arkose 27 serpentine 49				
G		hummock grass 7		clay 6 dolomite 28 gabbro 50				
H		tussock grass 8		organic material 7 calcrete 29 dolerite 51				
I		sod grass 9		alluvium 8 aeolianite 30 diorite 52				
J		sedg 10		colluvium 9 chert 31 syenite 53				
K		rush 11		lacustrine 10 jasper 32 granodiorite 54				
L		fern/cycad 12		aeolian 11 metamorphic 33 adamellite 55				
M		moss 13		marine 12 gneiss 34 granite 56				
N		lichen 14		calcareous sand 13 schist/phyllite 35 aplite 57				
O		liverwort 15		fill 14 slate 36 quartz porphyry 58				
P		vine 16		mud 15 hornfels 37 basalt 59				
Q				till 16 quartzite 38 andesite 60				
R				sedimentary 17 greenstone 39 trachyte 61				
S				shale 18 amphibolite 40 rhyolite 62				
T				siltstone/mudstone 19 marble 41 obsidian 63				
U				sandstone-quartz 20 igneous 42 scoria 64				
V				sandstone-lithic 21 coarse-acidic 43 ash 65				
W				conglomerate 22 coarse-intermediate 44 agglomerate 66				
X				other 67				
Y								
Z								
AA								
AB								
AC								
AD								
AE								
AF								
AG								
AH								
AI								
AJ								
AK								
AL								
AM								
AN								
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NQ								
NR								





LAYER STATUS		COLOUR (Munsell, 1994)		Field pH	LAYER NOTES		Field pH Test Method (1)	
Lower	Horizon	Moist Munsell	Dry Munsell	(1 per layer)	1		Raupach <input type="checkbox"/> test strip <input type="checkbox"/>	
1							pH meter <input type="checkbox"/>	
2							HCI (1)	
3							no effervescence <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
4							audible/slight efferv. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
5							strong effervescence <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
6							Boundary Distinctiveness	
7							(1 per layer) 1 2 3 4 5	
8							not evident <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
9							sharp (<5 mm) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
10							abrupt (5-20 mm) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
11							clear (20-50 mm) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
12							gradual (50-100 mm) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
13							diffuse (>100 mm) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
14							STRUCTURE	
15							Grade of Pedality (1) 1 2 3 4 5	
16							single-grained <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
17							massive <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
18							weak pedality <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
19							moderate pedality <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
20							strong pedality <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
21							Fabric (1) 1 2 3 4 5	
22							sandy <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
23							earthy <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
24							rough-faced peds <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
25							smooth-faced peds <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
26							Dominant (1) 1 2 3 4 5	
27							1 2 3 4 5	
28							platy <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
29							lenticular <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
30							prismatic <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
31							columnar <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
32							angular blocky <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
33							sub-ang. blocky <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
34							polyhedral <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
35							granular <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
36							crumb <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
37							round <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
38							Dominant (1) 1 2 3 4 5	
39							1 2 3 4 5	
40							<2 mm <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
41							2-5 mm <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
42							5-10 mm <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
43							10-20 mm <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
44							20-50 mm <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
45							50-100 mm <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
46							100-200 mm <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
47							200-500 mm <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
48							> 500 mm <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
49							Soil Water Status (1 each per layer)	
50							1 2 3 4 5	
51							dry <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
52							mod. moist <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
53							moist <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
54							wet <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
55							TEXTURE (1 each per layer)	
56							Texture Grade 1 2 3 4 5	
57							1 2 3 4 5	
58							sand <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
59							loamy sand <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
60							clayey sand <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
61							sandy loam <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
62							loam <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
63							silty loam <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
64							sandy clay loam <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
65							clay loam <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
66							clay loam sandy <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
67							silty clay loam <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
68							sandy clay <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
69							silty clay <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
70							clay <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
71							Form (1 per layer) 1 2 3 4 5	
72							1 2 3 4 5	
73							soft segregations <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
74							nodules <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
75							fragments <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
76							crystals <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
77							veins <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
78							concretions <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
79							root linings <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
80							tubules <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
81							Size (1 per layer) 1 2 3 4 5	
82							1 2 3 4 5	
83							fine gravel (2-6 mm) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
84							gravel (6-20 mm) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
85							coarse gravel (20-60 mm) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
86							cobbles (60-200 mm) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
87							stones (200-600 mm) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
88							boulders (>600 mm) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
89							ext coarse (>60 mm) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
90							SEGREGATIONS	
91							Type (1 per layer) 1 2 3 4 5	
92							1 2 3 4 5	
93							not evident <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
94							calcareous <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
95							gypseous <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
96							manganiferous <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
97							ferruginous <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
98							ferromanganiferous <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
99							organic <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
100							not identified <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
101							other <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
102							Amount (1 per layer) 1 2 3 4 5	
103							1 2 3 4 5	
104							very few (<2%) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
105							few (2-10%) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
106							common (10-20%) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
107							many (20-50%) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
108							abundant (>50%) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
109							Strength (1 per layer) 1 2 3 4 5	
110							1 2 3 4 5	
111							weak <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
112							strong <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
113							Form (1 per layer) 1 2 3 4 5	
114							1 2 3 4 5	
115							soft segregations <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
116							nodules <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
117							fragments <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
118							crystals <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
119							veins <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
120							concretions <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
121							root linings <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
122							tubules <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
123							Size (1 per layer) 1 2 3 4 5	
124							1 2 3 4 5	
125							fine (<2 mm) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
126							medium (2-6 mm) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
127							coarse (6-20 mm) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
128							v coarse (20-60 mm) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
129							ext coarse (>60 mm) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
130							Soil Water Status (1 each per layer)	
131							1 2 3 4 5	
132							dry <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
133							mod. moist <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
134							moist <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
135							wet <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
136							TEXTURE (1 each per layer)	
137							Texture Grade 1 2 3 4 5	
138							1 2 3 4 5	
139							sand <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
140							loamy sand <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
141							clayey sand <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
142							sandy loam <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
143							loam <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
144							silty loam <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
145							sandy clay loam <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
146							clay loam <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
147							clay loam sandy <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
148							silty clay loam <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
149							sandy clay <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
150							silty clay <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
151							clay <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
152							Form (1 per layer) 1 2 3 4 5	
153							1 2 3 4 5	
154							soft segregations <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
155							nodules <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
156							fragments <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
157							crystals <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
158							veins <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
159							concretions <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
160							root linings <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
161							tubules <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
162							Size (1 per layer) 1 2 3 4 5	
163							1 2 3 4 5	
164							fine (<2 mm) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
165							medium (2-6 mm) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
166							coarse (6-20 mm) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
167							v coarse (20-60 mm) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
168							ext coarse (>60 mm) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
169							Soil Water Status (1 each per layer)	
170							1 2 3 4 5	
171							dry <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
172							mod. moist <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
173							moist <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
174							wet <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
175							TEXTURE (1 each per layer)	
176							Texture Grade 1 2 3 4 5	
177							1 2 3 4 5	
178							sand <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
179							loamy sand <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	



SURVEY TITLE: WARRKNOTH

SITE LOCATION: DS5



NSW SOIL  
AND LAND  
INFORMATION  
SYSTEM

Please MARK  
LIKE THIS ONLY:

- Use 2B pencil
- No pen or biro
- Fully erase mistakes
- Make no stray marks
- Numbers in ( ) show max. entries allowed

PROFILE MAP DETAILS				SURVEY DETAILS			
Profile No.	Map Sheet No.	Eastings	Northings	Described By	Profile Date	Photo Taken (1)	No. of Layers
0 0 0	0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0	0 Jan 00 0 0	profile 1	
1 1 1	1 1 1	1 1 1 1 1 1	1 1 1 1 1 1	1 1 1 1	1 Feb 00 1 1	site 2	00
2 2 2	2 2 2	2 2 2 2 2 2	2 2 2 2 2 2	2 2 2 2	2 Mar 00 2 2	both profile & site	1
3 3 3	3 3 3	3 3 3 3 3 3	3 3 3 3 3 3	3 3 3 3	3 Apr 00 3 3	Nature of Exposure (2)	2
4 4 4	4 4 4	4 4 4 4 4 4	4 4 4 4 4 4	4 4 4 4	4 May 00 4 4	auger 1	3
5 5 5	5 5 5	5 5 5 5 5 5	5 5 5 5 5 5	5 5 5 5	5 Jun 00 5 5	pit 2	15
6 6 6	6 6 6	6 6 6 6 6 6	6 6 6 6 6 6	6 6 6 6	6 Jul 00 6 6	batter 3	5
7 7 7	7 7 7	7 7 7 7 7 7	7 7 7 7 7 7	7 7 7 7	7 Aug 00 7 7	gully 4	
8 8 8	8 8 8	8 8 8 8 8 8	8 8 8 8 8 8	8 8 8 8	8 Sep 00 8 8	core sample 5	
9 9 9	9 9 9	9 9 9 9 9 9	9 9 9 9 9 9	9 9 9 9	9 Oct 00 9 9	other 6	

Potential BSAL? (1)	Site type (1)
yes 1 no 2	checked 1 detailed 2 exclusion 3

## BIOPHYSICAL STRATEGIC AGRICULTURAL LAND SOIL DATA CARD

SOIL TYPE	VEGETATION	LANDFORM ELEMENT (1)					
A.S.C.	Vegetation Community (1)	alcove 43	cone 3	footslope 21	ox-bow 57	sink hole/doline 52	
0	unknown 1	backplain 31	crater 31	foredune 12	pan/playa 55	stream channel 45	
SO	rainforest 2	bank 25	cut face 28	gully 42	pediment 22	streambed 45	
AC	wet sclerophyll forest 3	bar 6	cut-over surface 39	hillcrest 1	pit 60	summit surface 2	
SO	dry sclerophyll forest 4	beach 26	dam 15	hillslope 2	plain 30	swale 47	
FN	woodland grass u'storey 5	beach ridge 7	drainage depression 41	lagoon 54	prior stream 3	swamp 58	
GG	woodland shrub u'storey 6	bench 19	dune 11	lake 55	rock flat 34	talus 23	
AF	tall shrubland 7	berm 29	embankment 13	landslide 20	rock platform 35	tidal creek 48	
SG	low shrubland 8	blow-out 59	estuary 44	levee 8	scald 35	tidal flat 37	
AF	heath 9	channel bench 33	fan 27	lunette 13	scarp 18	tor 4	
SG	grassland/herbland 10	cirque 50	fill top 40	maar 53	scree 24	trench 49	
	swamp complex 11	cliff 5	flood-out 32	mound 15	scroll 10	valley flat 38	

LITHOLOGY		TOPOGRAPHY	
Growth Forms (4)	Substrate (3)	Slope Percent	Site Morphology (1)
tree 1	not identified 1	0 0 0	flat 1
tree mallee 2	unconsolidated 2	1 1 1	crest 2
shrub 3	gravel 3	2 2 2	hillock 3
mallee shrub 4	sand 4	3 3 3	ridge 4
heath shrub 5	silt 5	4 4 4	upper slope 5
chenopod shrub 6	clay 6	5 5 5	midslope 6
hummock grass 7	organic material 7	6 6 6	simple slope 7
tussock grass 8	alluvium 8	7 7 7	lower slope 8
sod grass 9	colluvium 9	8 8 8	open depression 9
sedge 10	lacustrine 10	9 9 9	closed depression 10
rush 11	aeolian 11		
forb 12	marine 12		
fern/cycad 13	calcareous sand 13		
moss 14	fill 14		
lichen 15	mud 15		
liverwort 16	till 16		
vine 17	sedimentary 17		
	shale 18		
	siltstone/mudstone 19		
	sandstone-quartz 20		
	sandstone-lithic 21		
	conglomerate 22		
	coarse-acidic 43		
	coarse-intermediate 44		
	limestone 23		
	tuff 24		
	breccia 25		
	greywacke 26		
	arkose 27		
	dolomite 28		
	calcrete 29		
	aeolianite 30		
	chert 31		
	jasper 32		
	metamorphic 33		
	gneiss 34		
	schist/phyllite 35		
	slate 36		
	hornfels 37		
	quartzite 38		
	greenstone 39		
	amphibolite 40		
	marble 41		
	igneous 42		
	coarse-acidic 43		
	coarse-intermediate 44		
	coarse-basic 45		
	fine-acidic 46		
	fine-intermediate 47		
	fine-basic 48		
	serpentine 49		
	gabbro 50		
	dolerite 51		
	diorite 52		
	syenite 53		
	granodiorite 54		
	adamellite 55		
	granite 56		
	aplite 57		
	quartz porphyry 58		
	basalt 59		
	andesite 60		
	trachyte 61		
	rhyolite 62		
	obsidian 63		
	scoria 64		
	ash 65		
	agglomerate 66		
	other 67		

LAND USE (1)		HYDROLOGY	
national/state parks 1	Identification Method (1)	Profile Drainage (1)	Permeability (1)
timber/scrub/unused 2	personal assessment 1	very poorly drained 1	very slowly permeable 1
logged native forest 3	geology map 2	poorly drained 2	slowly permeable 2
hardwood plantation 4	both assessment & map 3	imperfectly drained 3	moderately permeable 3
softwood plantation 5	Rock Outcrop % (1)	mod. well-drained 4	highly permeable 4
volun./native pasture 6	nil 1 >20-30% 5	well-drained 5	
improved pasture 7	<2% 2 >30-50% 6	rapidly drained 6	
cropping 8	2-10% 3 >50% 7		
orchard/vineyard 9	>10-20% 4		
vegetables/flowers 10			
urban 11			
industrial 12			
quarry/mining 13			
other 14			

SITE CONDITION		Surface Condition	
Site Disturbance(s) (2)	Ground Cover %	Current (2)	Expected Wet (2) Dry (2)
natural disturbance 1		cracked 2	2 2
no effective disturbance 2		self-mulched 3	3 3
limited clearing 3	0 0	loose 4	4 4
extensive clearing 4	1 1 1	soft 5	5 5
cleared, no cultivation 5	2 2	firm 6	6 6
occasional cultivation 6	3 3	hardset 7	7 7
rainfed cultivation 7	4 4	surface crust 8	8 8
irrigated cultivation 8	5 5	trampled 9	9 9
highly disturbed 9	6 6	poached 10	10 10
	7 7	recently cultivated 11	
	8 8	water repellent 12	12 12
	9 9	gravelly 13	
		other 13	13 13

## SITE FIELD NOTES

Photo file name/s:

Please do not mark this space.

4053



cm mm 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180

LAYER STATUS		COLOUR (Munsell, 1994)		Field pH	LAYER NOTES		Field pH Test Method (1)	
Lower	Horizon	Moist Munsell	Dry Munsell	(1 per layer)			Raupach (1) test strip (3)	
1							pH meter (3)	
<b>HCI (1)</b>								
no effervescence (1) (1) (1) (1)								
audible/slight efferv. (2) (2) (2) (2)								
strong effervescence (3) (3) (3) (3)								
<b>Boundary Distinctiveness</b>								
(1 per layer) 1 2 3 4 5								
not evident (1) (1) (1) (1)								
sharp (<5 mm) (2) (2) (2) (2)								
abrupt (5-20 mm) (3) (3) (3) (3)								
clear (20-50 mm) (4) (4) (4) (4)								
gradual (50-100 mm) (5) (5) (5) (5)								
diffuse (>100 mm) (6) (6) (6) (6)								
<b>STRUCTURE</b>								
Grade of Pedality (1) 1 2 3 4 5								
single-grained (1) (1) (1) (1)								
massive (2) (2) (2) (2)								
weak pedality (3) (3) (3) (3)								
moderate pedality (4) (4) (4) (4)								
strong pedality (5) (5) (5) (5)								
Fabric (1) 1 2 3 4 5								
sandy (1) (1) (1) (1)								
earthy (2) (2) (2) (2)								
rough-faced peds (3) (3) (3) (3)								
smooth-faced peds (4) (4) (4) (4)								
<b>Dominant (1)</b>								
1 2 3 4 5								
1 (1) (1) (1) (1)								
2 (2) (2) (2) (2)								
3 (3) (3) (3) (3)								
4 (4) (4) (4) (4)								
5 (5) (5) (5) (5)								
<b>Ped Shape</b>								
platy (1) (1) (1) (1)								
lenticular (2) (2) (2) (2)								
prismatic (3) (3) (3) (3)								
columnar (4) (4) (4) (4)								
angular blocky (5) (5) (5) (5)								
sub-ang. blocky (6) (6) (6) (6)								
polyhedral (7) (7) (7) (7)								
granular (8) (8) (8) (8)								
crumb (9) (9) (9) (9)								
round (10) (10) (10) (10)								
<b>Dominant (1)</b>								
1 2 3 4 5								
1 (1) (1) (1) (1)								
2 (2) (2) (2) (2)								
3 (3) (3) (3) (3)								
4 (4) (4) (4) (4)								
5 (5) (5) (5) (5)								
<b>Ped Size</b>								
1 2 3 4 5								
<2 mm (1) (1) (1) (1)								
2-5 mm (2) (2) (2) (2)								
5-10 mm (3) (3) (3) (3)								
10-20 mm (4) (4) (4) (4)								
20-50 mm (5) (5) (5) (5)								
50-100 mm (6) (6) (6) (6)								
100-200 mm (7) (7) (7) (7)								
200-500 mm (8) (8) (8) (8)								
> 500 mm (9) (9) (9) (9)								
<b>SEGREGATIONS</b>								
Type (1 per layer) 1 2 3 4 5								
not evident (1) (1) (1) (1)								
calcareous (2) (2) (2) (2)								
gypseous (3) (3) (3) (3)								
manganiferous (4) (4) (4) (4)								
ferruginous (5) (5) (5) (5)								
ferromanganiferous (6) (6) (6) (6)								
organic (7) (7) (7) (7)								
not identified (8) (8) (8) (8)								
other (9) (9) (9) (9)								
Amount (1 per layer) 1 2 3 4 5								
none (1) (1) (1) (1)								
very few (<2%) (2) (2) (2) (2)								
few (2-10%) (3) (3) (3) (3)								
common (10-20%) (4) (4) (4) (4)								
many (20-50%) (5) (5) (5) (5)								
abundant (>50%) (6) (6) (6) (6)								
Strength (1 per layer) 1 2 3 4 5								
weak (1) (1) (1) (1)								
strong (2) (2) (2) (2)								
Form (1 per layer) 1 2 3 4 5								
soft segregations (1) (1) (1) (1)								
nodules (2) (2) (2) (2)								
fragments (3) (3) (3) (3)								
crystals (4) (4) (4) (4)								
veins (5) (5) (5) (5)								
concretions (6) (6) (6) (6)								
root linings (7) (7) (7) (7)								
tubules (8) (8) (8) (8)								
Size (1 per layer) 1 2 3 4 5								
fine (<2 mm) (1) (1) (1) (1)								
medium (2-6 mm) (2) (2) (2) (2)								
coarse (6-20 mm) (3) (3) (3) (3)								
v coarse (20-60 mm) (4) (4) (4) (4)								
ext coarse (>60 mm) (5) (5) (5) (5)								
<b>Soil Water Status (1 each per layer)</b>								
1 2 3 4 5								
dry (1) (1) (1) (1)								
mod. moist (2) (2) (2) (2)								
moist (3) (3) (3) (3)								
wet (4) (4) (4) (4)								
<b>TEXTURE (1 each per layer)</b>								
Texture Grade 1 2 3 4 5								
sand (1) (1) (1) (1)								
loamy sand (2) (2) (2) (2)								
clayey sand (3) (3) (3) (3)								
sandy loam (4) (4) (4) (4)								
loam (5) (5) (5) (5)								
silty loam (6) (6) (6) (6)								
sandy clay loam (7) (7) (7) (7)								
clay loam (8) (8) (8) (8)								
silty clay loam (9) (9) (9) (9)								
sandy clay (10) (10) (10) (10)								
silty clay (11) (11) (11) (11)								
clay (12) (12) (12) (12)								
fibric peat (13) (13) (13) (13)								
hemic peat (14) (14) (14) (14)								
sapric peat (15) (15) (15) (15)								
<b>Sand Fraction 1 2 3 4 5</b>								
coarse (1) (1) (1) (1)								
fine (2) (2) (2) (2)								
<b>Clay Fraction 1 2 3 4 5</b>								
light (1) (1) (1) (1)								
light medium (2) (2) (2) (2)								
medium (3) (3) (3) (3)								
medium heavy (4) (4) (4) (4)								
heavy (5) (5) (5) (5)								
<b>Estimated Effective Rooting Depth (m)</b>								
1 2 3 4 5								
1 (1) (1) (1) (1)								
2 (2) (2) (2) (2)								
3 (3) (3) (3) (3)								
4 (4) (4) (4) (4)								
5 (5) (5) (5) (5)								
<b>Substrate</b>								
Upper								
(3 per layer) 1 2 3 4 5								
Type (1 per layer) Sur 1 2 3 4 5								
not evident (1) (1) (1) (1)								
not identified (2) (2) (2) (2)								
as substrate (3) (3) (3) (3)								
as rock outcrop (4) (4) (4) (4)								
as parent material (5) (5) (5) (5)								
quartz (6) (6) (6) (6)								
feldspar (7) (7) (7) (7)								
silcrete (8) (8) (8) (8)								
ironstone (9) (9) (9) (9)								
bauxite (10) (10) (10) (10)								
shells (11) (11) (11) (11)								
charcoal (12) (12) (12) (12)								
pumice (13) (13) (13) (13)								
opalised wood (14) (14) (14) (14)								
other (15) (15) (15) (15)								
Amount (1 per layer) Sur. 1 2 3 4 5								
very few (<2%) (1) (1) (1) (1)								
few (2-10%) (2) (2) (2) (2)								
common (10-20%) (3) (3) (3) (3)								
many (20-50%) (4) (4) (4) (4)								
abundant (50-90%) (5) (5) (5) (5)								
very abundant (>90%) (6) (6) (6) (6)								
Size (1 per layer) Sur. 1 2 3 4 5								
fine gravel (2-6 mm) (1) (1) (1) (1)								
gravel (6-20 mm) (2) (2) (2) (2)								
coarse gravel (20-60 mm) (3) (3) (3) (3)								
cobbles (60-200 mm) (4) (4) (4) (4)								
stones (200-600 mm) (5) (5) (5) (5)								
boulders (>600 mm) (6) (6) (6) (6)								
<b>MOTTLES</b>								
Dominant (1) Sub-dominant (1)								
1 2 3 4 5 1 2 3 4 5								
Abundance								
not evident (1) (1) (1) (1)								
<2% (2) (2) (2) (2)								
2-10% (3) (3) (3) (3)								
10-20% (4) (4) (4) (4)								
20-50% (5) (5) (5) (5)								
Colour								
1 2 3 4 5 1 2 3 4 5								
dark (1) (1) (1) (1)								
red (2) (2) (2) (2)								
orange (3) (3) (3) (3)								
yellow (4) (4) (4) (4)								
brown (5) (5) (5) (5)								
pale (6) (6) (6) (6)								
grey (7) (7) (7) (7)								
grey (8) (8) (8) (8)								
Contrast								
1 2 3 4 5 1 2 3 4 5								
faint (1) (1) (1) (1)								
distinct (2) (2) (2) (2)								
prominent (3) (3) (3) (3)								



SURVEY TITLE: WARKWORTH

SITE LOCATION: GPO3

NSW SOIL  
AND LAND  
INFORMATION  
SYSTEMPlease MARK  
LIKE THIS ONLY:

- Use 2B pencil
- No pen or biro
- Fully erase mistakes
- Make no stray marks
- Numbers in ( ) show max. entries allowed

PROFILE MAP DETAILS				SURVEY DETAILS			
Profile No.	Map Sheet No.	Easting	Northings	Described By	Profile Date	Photo Taken (1)	No. of Layers
0000	0000	000000	000000	000000	000000	profile (1)	
1111	1111	111111	111111	111111	111111	site (2)	(1)
2222	2222	222222	222222	222222	222222	both profile & site	(1)
3333	3333	333333	333333	333333	333333	Nature of Exposure (2)	(2)
4444	4444	444444	444444	444444	444444	auger (1)	(3)
5555	5555	555555	555555	555555	555555	pit (2)	(4)
6666	6666	666666	666666	666666	666666	batter (3)	(5)
7777	7777	777777	777777	777777	777777	gully (4)	(6)
8888	8888	888888	888888	888888	888888	core sample (5)	(7)
9999	9999	999999	999999	999999	999999	other (6)	(8)

Potential BSAL? (1)	Site type (1)
yes (1) no (2)	checked (1) detailed (2) exclusion (3)

BIOPHYSICAL STRATEGIC AGRICULTURAL  
LAND SOIL DATA CARD

SOIL TYPE	VEGETATION	LANDFORM ELEMENT (1)									
A.S.C.	Vegetation Community (1)	alcove (43)	cone (3)	footslope (21)	ox-bow (57)	sink hole/doline (52)					
0	unknown (1)	backplain (31)	crater (51)	foredune (12)	pan/playa (56)	stream channel (46)					
SO	rainforest (2)	bank (25)	cut face (28)	gully (42)	pediment (22)	streambed (45)					
AD	wet sclerophyll forest (3)	bar (6)	cut-over surface (39)	hillcrest (1)	pit (60)	summit surface (2)					
SO	dry sclerophyll forest (4)	beach (26)	dam (16)	hillslope (3)	plain (30)	swale (47)					
FN	woodland grass u'storey (5)	beach ridge (7)	drainage depression (41)	lagoon (54)	prior stream (3)	swamp (58)					
GG	woodland shrub u'storey (6)	bench (19)	dune (11)	lake (55)	rock flat (34)	talus (23)					
DB	tall shrubland (7)	berm (29)	embankment (14)	landslide (20)	rock platform (35)	tidal creek (48)					
SG	low shrubland (8)	blow-out (59)	estuary (44)	levee (8)	scald (36)	tidal flat (37)					
DB	heath (9)	channel bench (33)	fan (27)	lunette (13)	scarp (18)	tor (4)					
SG	grassland/herbland (10)	cirque (50)	fill top (40)	maar (53)	scree (24)	trench (49)					
DB	swamp complex (11)	cliff (5)	flood-out (32)	mound (15)	scroll (10)	valley flat (38)					
DB	littoral complex (12)										
DB	no vegetation (13)										
FAMILY	Growth Forms (4)										
W	tree (1)	not identified (1)	limestone (23)	coarse-basic (45)							
C	tree mallee (2)	unconsolidated (2)	tuff (24)	fine-acidic (46)							
	shrub (3)	gravel (3)	breccia (25)	fine-intermediate (47)							
	mallee shrub (4)	sand (4)	greywacke (26)	fine-basic (48)							
	heath shrub (5)	silt (5)	arkose (27)	serpentine (49)							
G.S.G.	chenopod shrub (6)	clay (6)	dolomite (28)	gabbro (50)							
(A)	hummock grass (7)	organic material (7)	calcrete (29)	dolerite (51)							
(B)	tussock grass (8)	alluvium (8)	aeolianite (30)	diorite (52)							
(C)	sod grass (9)	colluvium (9)	chert (31)	syenite (53)							
(D)	sedge (10)	lacustrine (10)	jasper (32)	granodiorite (54)							
(E)	rush (11)	aeolian (11)	metamorphic (33)	adamellite (55)							
(G)	forb (12)	marine (12)	gneiss (34)	granite (56)							
(H)	fern/cycad (13)	calcareous sand (13)	schist/phyllite (35)	aplite (57)							
(K)	moss (14)	fill (14)	slate (36)	quartz porphyry (58)							
(L)	lichen (15)	mud (15)	hornfels (37)	basalt (59)							
(N)	liverwort (16)	till (16)	quartzite (38)	andesite (60)							
(P)	vine (17)	sedimentary (17)	greenstone (39)	trachyte (61)							
(R)		shale (18)	amphibolite (40)	rhyolite (62)							
(S)		siltstone/mudstone (19)	marble (41)	obsidian (63)							
(T)		sandstone-quartz (20)	igneous (42)	scoria (64)							
(W)		sandstone-lithic (21)	coarse-acidic (43)	ash (65)							
(X)		conglomerate (22)	coarse-intermediate (44)	agglomerate (66)							
(Y)				other (67)							
affinity with	national/state parks (1)										
	timber/scrub/unused (2)										
	logged native forest (3)										
	hardwood plantation (4)										
	softwood plantation (5)										
	volun./native pasture (6)										
	improved pasture (7)										
	cropping (8)										
	orchard/vineyard (9)										
	vegetables/flowers (10)										
	urban (11)										
	industrial (12)										
	quarry/mining (13)										
	other (14)										
LAND USE (1)											
Identification Method (1)											
personal assessment (1)											
geology map (2)											
both assessment & map (3)											
Rock Outcrop % (1)											
nil (1) >20-30% (5)											
<2% (2) >30-50% (6)											
2-10% (3) >50% (7)											
>10-20% (4)											
HYDROLOGY											
Profile Drainage (1)											
very poorly drained (1)											
poorly drained (2)											
imperfectly drained (3)											
mod. well-drained (4)											
well-drained (5)											
rapidly drained (6)											
Permeability (1)											
very slowly permeable (1)											
slowly permeable (2)											
moderately permeable (3)											
highly permeable (4)											
Depth (1) & Extent (1)											
< 500 mm depth (1)											
> 500 mm depth (2)											
< 50% area (1)											
> 50% area (2)											
SITE FIELD NOTES											

SITE CONDITION		Surface Condition	
		Current (2)	Expected
			Wet (2) Dry (2)
Site Disturbance(s) (2)	Ground Cover %		
natural disturbance (1)		cracked (2)	(2) (2)
no effective disturbance (2)		self-mulched (3)	(3) (3)
limited clearing (3)	(1) (1)	loose (4)	(4) (4)
extensive clearing (4)	(1) (1)	soft (5)	(5) (5)
cleared, no cultivation (5)	(2) (2)	firm (6)	(6) (6)
occasional cultivation (6)	(3) (3)	hardset (7)	(7) (7)
rainfed cultivation (7)	(4) (4)	surface crust (8)	(8) (8)
irrigated cultivation (8)	(5) (5)	trampled (9)	(9) (9)
highly disturbed (9)	(6) (6)	poached (10)	(10) (10)
	(7) (7)	recently cultivated (11)	(11) (11)
	(8) (8)	water repellent (12)	(12) (12)
	(9) (9)	gravelly (13)	(13) (13)
		other (14)	(14) (14)

Please do not mark this space.

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cm	mm	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180						
1	LAYER STATUS										COLOUR (Munsell, 1994)					Field pH	LAYER NOTES					Field pH Test Method (1)				
	Lower		Horizon		Moist Munsell		Dry Munsell		Field pH		(1 per layer)		1				Raupatch (1)		test strip (3)							
2	(1) (1) (1) (1)		(2) (2) (2) (2)		(2.5) (H) (B) (17) (1)		(2.5) (H) (B) (17) (1)		(1) (1) (1)								pH meter (1)									
3	(1) (1) (1) (1)		(3) (B) (F) (2) (2)		(5) (Y) (P) (25) (1)		(5) (Y) (P) (25) (1)		(1) (1) (1)								HCl (1)									
4	(2) (2) (2) (2)		(4) (C) (O) (3) (3)		(7.5) (Y) (P) (25) (2)		(7.5) (Y) (P) (25) (2)		(2) (2) (2)								no effervescence (1) (1) (1) (1)									
5	(3) (3) (3) (3)		AB P		(N) (3) (3)		(10) (N) (3) (3)		(3) (3) (3)								audible/slight efferv. (2) (2) (2) (2)									
6	(4) (4) (4) (4)		AC R		(GY) (4) (4)		(GY) (4) (4)		(4) (4) (4)								strong effervescence (3) (3) (3) (3)									
7	(5) (5) (5) (5)		BC		(G) (5) (5)		(G) (5) (5)		(5) (5) (5)								Boundary Distinctiveness									
8	(6) (6) (6) (6)								(6) (6) (6)								(1 per layer)		1 2 3 4 5							
9	(7) (7) (7) (7)								(7) (7) (7)								not evident (1) (1) (1) (1)									
10	(8) (8) (8) (8)								(8) (8) (8)								sharp (<5 mm) (2) (2) (2) (2)									
11	(9) (9) (9) (9)								(9) (9) (9)								abrupt (5-20 mm) (3) (3) (3) (3)									
12																	clear (20-50 mm) (4) (4) (4) (4)									
13																	gradual (50-100 mm) (5) (5) (5) (5)									
14																	diffuse (>100 mm) (6) (6) (6) (6)									
15																	STRUCTURE									
16																	Grade of Pedality (1)		1 2 3 4 5							
17																	single-grained (1) (1) (1) (1)									
18																	massive (2) (2) (2) (2)									
19																	weak pedality (3) (3) (3) (3)									
20																	moderate pedality (4) (4) (4) (4)									
21																	strong pedality (5) (5) (5) (5)									
22																	Fabric (1)		1 2 3 4 5							
23																	sandy (1) (1) (1) (1)									
24																	earthy (2) (2) (2) (2)									
25																	rough-faced peds (3) (3) (3) (3)									
26																	smooth-faced peds (4) (4) (4) (4)									
27																	Dominant (1)		Ped Shape							
28																	1 2 3 4 5		Sub-dominant (1)							
29																	1 2 3 4 5		1 2 3 4 5							
30																	platy (1) (1) (1) (1)									
31																	lenticular (2) (2) (2) (2)									
32																	prismatic (3) (3) (3) (3)									
33																	columnar (4) (4) (4) (4)									
34																	angular blocky (5) (5) (5) (5)									
35																	sub-ang. blocky (6) (6) (6) (6)									
36																	polyhedral (7) (7) (7) (7)									
37																	granular (8) (8) (8) (8)									
38																	crumb (9) (9) (9) (9)									
39																	round (10) (10) (10) (10)									
40																	Dominant (1)		Ped Size							
41																	1 2 3 4 5		Sub-dominant (1)							
42																	1 2 3 4 5		1 2 3 4 5							
43																	<2 mm (1) (1) (1) (1)									
44																	2-5 mm (2) (2) (2) (2)									
45																	5-10 mm (3) (3) (3) (3)									
46																	10-20 mm (4) (4) (4) (4)									
47																	20-50 mm (5) (5) (5) (5)									
48																	50-100 mm (6) (6) (6) (6)									
49																	100-200 mm (7) (7) (7) (7)									
50																	200-500 mm (8) (8) (8) (8)									
51																	> 500 mm (9) (9) (9) (9)									
52																	SEGREGATIONS		Soil Water Status							
53																	Type (1 per layer)		(1 each per layer)							
54																	1 2 3 4 5		1 2 3 4 5							
55																	not evident (1) (1) (1) (1)		dry (1) (1) (1) (1)							
56																	calcareous (2) (2) (2) (2)		mod. moist (2) (2) (2) (2)							
57																	gypseous (3) (3) (3) (3)		moist (3) (3) (3) (3)							
58																	manganiferous (4) (4) (4) (4)		wet (4) (4) (4) (4)							
59																	ferruginous (5) (5) (5) (5)									
60																	ferromanganiferous (6) (6) (6) (6)									
61																	organic (7) (7) (7) (7)									
62																	not identified (8) (8) (8) (8)									
63																	other (9) (9) (9) (9)									
64																	Amount (1 per layer)		1 2 3 4 5							
65																	none (1) (1) (1) (1)									
66																	very few (<2%) (2) (2) (2) (2)									
67																	few (2-10%) (3) (3) (3) (3)									
68																	common (10-20%) (4) (4) (4) (4)									
69																	many (20-50%) (5) (5) (5) (5)									
70																	abundant (>50%) (6) (6) (6) (6)									
71																	Strength (1 per layer)		1 2 3 4 5							
72																	weak (1) (1) (1) (1)									
73																	strong (2) (2) (2) (2)									
74																	Form (1 per layer)		1 2 3 4 5							
75																	soft segregations (1) (1) (1) (1)									
76																	nodules (2) (2) (2) (2)									
77																	fragments (3) (3) (3) (3)									
78																	crystals (4) (4) (4) (4)									
79																	veins (5) (5) (5) (5)									
80																	concretions (6) (6) (6) (6)									
81																	root linings (7) (7) (7) (7)									
82																	tubules (8) (8) (8) (8)									
83																	Size (1 per layer)		1 2 3 4 5							
84																	fine (<2 mm) (1) (1) (1) (1)									
85																	medium (2-6 mm) (2) (2) (2) (2)									
86																	coarse (6-20 mm) (3) (3) (3) (3)									
87																	v coarse (20-60 mm) (4) (4) (4) (4)									
88																	ext coarse (>60 mm) (5) (5) (5) (5)									
89																	Sand Fraction		1 2 3 4 5							
90																	coarse (1) (1) (1) (1)									
91																	fine (2) (2) (2) (2)									
92																	Clay Fraction		1 2 3 4 5							
93																	light (1) (1) (1) (1)									
94																	light medium (2) (2) (2) (2)									
95																	medium (3) (3) (3) (3)									
96																	medium heavy (4) (4) (4) (4)									
97																	heavy (5) (5) (5) (5)									
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126																										



SURVEY TITLE: WARKWORTH

SITE LOCATION: GPO1

PROFILE MAP DETAILS				SURVEY DETAILS			
Profile No.	Map Sheet No.	Easting	Northings	Described By	Profile Date	Photo Taken (1)	No. of Layers
01	01	01	01	01	01	profile	01
02	02	02	02	02	02	site	02
03	03	03	03	03	03	both profile & site	03
04	04	04	04	04	04	Nature of Exposure (2)	04
05	05	05	05	05	05	auger	05
06	06	06	06	06	06	pit	06
07	07	07	07	07	07	batter	07
08	08	08	08	08	08	gully	08
09	09	09	09	09	09	core sample	09
10	10	10	10	10	10	other	10

Potential BSAL? (1)	Site type (1)
yes 01 no 02	checked 01 detailed 02 exclusion 03

### BIOPHYSICAL STRATEGIC AGRICULTURAL LAND SOIL DATA CARD

SOIL TYPE	VEGETATION	LANDFORM ELEMENT (1)	
A.S.C.	Vegetation Community (1)	alcove 43	cone 43
O	unknown 1	backplain 31	crater 51
SO	rainforest 2	bank 25	foredune 12
GG	wet sclerophyll forest 3	bar 6	cut face 28
SG	dry sclerophyll forest 4	beach 26	cut-over surface 39
FAMILY	woodland grass u'storey 5	beach ridge 7	dam 16
C	woodland shrub u'storey 6	bench 19	drainage depression 41
G.S.G.	tall shrubland 7	berm 29	dune 11
(A)	low shrubland 8	blow-out 59	embankment 14
(B)	heath 9	channel bench 33	estuary 44
(C)	grassland/herbland 10	cliff 5	fan 27
(D)	swamp complex 11		fill top 40
(E)	littoral complex 12		flood-out 32
(F)	no vegetation 13		lagoon 54
(G)			lake 55
(H)			landslide 20
(I)			levee 8
(J)			lunette 13
(K)			maar 53
(L)			mound 15
(M)			pan/playa 35
(N)			pediment 22
(O)			pit 30
(P)			plain 30
(Q)			prior stream 3
(R)			rock flat 34
(S)			rock platform 35
(T)			scald 36
(U)			scarp 18
(V)			scree 24
(W)			scroll 10
(X)			sink hole/doline 52
(Y)			stream channel 46
(Z)			streambed 45
			summit surface 2
			swale 47
			swamp 58
			talus 23
			tidal creek 48
			tidal flat 37
			tor 4
			trench 49
			valley flat 38

LITHOLOGY		TOPOGRAPHY	
Substrate (3)		Slope Percent	Site Morphology (1)
not identified 1	limestone 23	01 01 01	flat 01
unconsolidated 2	tuff 24	02 02 02	crest 02
gravel 3	breccia 25	03 03 03	hillock 03
sand 4	greywacke 26	04 04 04	ridge 04
silt 5	arkose 27	05 05 05	upper slope 05
clay 6	dolomite 28	06 06 06	midslope 06
organic material 7	calcrete 29	07 07 07	simple slope 07
alluvium 8	aeolianite 30	08 08 08	lower slope 08
colluvium 9	chert 31	09 09 09	open depression 09
lacustrine 10	jasper 32		closed depression 10
aeolian 11	metamorphic 33		
marine 12	gneiss 34	Slope Measurement Method (1)	Slope Morphology (1)
calcareous sand 13	schist/phyllite 35	inclinometer 01	waxing 01
fill 14	slate 36	Abney level 02	waning 02
mud 15	hornfels 37	total station 03	maximal 03
till 16	quartzite 38	RTK GPS 04	minimal 04
sedimentary 17	greenstone 39	LIDAR 05	Aspect (1)
shale 18	amphibolite 40		
siltstone/mudstone 19	marble 41	Microrelief Type (1)	
sandstone-quartz 20	igneous 42	none 01	
sandstone-lithic 21	coarse-acidic 43	normal gilgai 02	
conglomerate 22	coarse-intermediate 44	crabhole gilgai 03	
		linear gilgai 04	
		lattice gilgai 05	
		melonhole gilgai 06	
		other 07	

HYDROLOGY	
Profile Drainage (1)	Permeability (1)
very poorly drained 01	very slowly permeable 01
poorly drained 02	slowly permeable 02
imperfectly drained 03	moderately permeable 03
mod. well-drained 04	highly permeable 04
well-drained 05	
rapidly drained 06	

Depth (1) & Extent (1)	
< 500 mm depth 01	< 50% area 01
> 500 mm depth 02	> 50% area 02

SITE FIELD NOTES	
Photo file name/s:	

SITE CONDITION	
Site Disturbance(s) (2)	Ground Cover %
natural disturbance 01	01
no effective disturbance 02	02
limited clearing 03	03
extensive clearing 04	04
cleared, no cultivation 05	05
occasional cultivation 06	06
rainfed cultivation 07	07
irrigated cultivation 08	08
highly disturbed 09	09

Surface Condition	
Current (2)	Expected Wet (2) Dry (2)
cracked 01	01 01
self-mulched 02	02 02
loose 03	03 03
soft 04	04 04
firm 05	05 05
hardset 06	06 06
surface crust 07	07 07
trampled 08	08 08
poached 09	09 09
recently cultivated 10	10 10
water repellent 11	11 11
gravelly 12	12 12
other 13	13 13



NSW SOIL AND LAND INFORMATION SYSTEM

Please MARK LIKE THIS ONLY:  
01 02 03

- Use 2B pencil
- No pen or biro
- Fully erase mistakes
- Make no stray marks
- Numbers in ( ) show max. entries allowed

Please do not mark this space.

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cm	mm	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180						
1	LAYER STATUS										COLOUR (Munsell, 1994)					Field pH	LAYER NOTES					Field pH Test Method (1)				
	Lower		Horizon		Moist Munsell		Dry Munsell		(1 per layer)							Raupach (1) test strip (3)										
2	1		2		2.5		2.5		1							pH meter										
3	1		2		2.5		2.5		1							HCl (1)										
4	1		2		2.5		2.5		1							no effervescence (1) (1) (1) (1) (1)										
5	1		2		2.5		2.5		1							audible/slight efferv. (2) (2) (2) (2) (2)										
6	1		2		2.5		2.5		1							strong effervescence (3) (3) (3) (3) (3)										
7	1		2		2.5		2.5		1							Boundary Distinctiveness										
8	1		2		2.5		2.5		1							(1 per layer) 1 2 3 4 5										
9	1		2		2.5		2.5		1							not evident (1) (1) (1) (1) (1)										
10	1		2		2.5		2.5		1							sharp (<5 mm) (2) (2) (2) (2) (2)										
11	1		2		2.5		2.5		1							abrupt (5-20 mm) (3) (3) (3) (3) (3)										
12	1		2		2.5		2.5		1							clear (20-50 mm) (4) (4) (4) (4) (4)										
13	1		2		2.5		2.5		1							gradual (50-100 mm) (5) (5) (5) (5) (5)										
14	1		2		2.5		2.5		1							diffuse (>100 mm) (6) (6) (6) (6) (6)										
15	1		2		2.5		2.5		1							STRUCTURE										
16	1		2		2.5		2.5		1							Grade of Pedality (1) 1 2 3 4 5										
17	1		2		2.5		2.5		1							single-grained (1) (1) (1) (1) (1)										
18	1		2		2.5		2.5		1							massive (2) (2) (2) (2) (2)										
19	1		2		2.5		2.5		1							weak pedality (3) (3) (3) (3) (3)										
20	1		2		2.5		2.5		1							moderate pedality (4) (4) (4) (4) (4)										
21	1		2		2.5		2.5		1							strong pedality (5) (5) (5) (5) (5)										
22	1		2		2.5		2.5		1							Fabric (1) 1 2 3 4 5										
23	1		2		2.5		2.5		1							sandy (1) (1) (1) (1) (1)										
24	1		2		2.5		2.5		1							earthy (2) (2) (2) (2) (2)										
25	1		2		2.5		2.5		1							rough-faced peds (3) (3) (3) (3) (3)										
26	1		2		2.5		2.5		1							smooth-faced peds (4) (4) (4) (4) (4)										
27	1		2		2.5		2.5		1							Dominant (1) 1 2 3 4 5										
28	1		2		2.5		2.5		1							1 2 3 4 5										
29	1		2		2.5		2.5		1							1 2 3 4 5										
30	1		2		2.5		2.5		1							1 2 3 4 5										
31	1		2		2.5		2.5		1							1 2 3 4 5										
32	1		2		2.5		2.5		1							1 2 3 4 5										
33	1		2		2.5		2.5		1							1 2 3 4 5										
34	1		2		2.5		2.5		1							1 2 3 4 5										
35	1		2		2.5		2.5		1							1 2 3 4 5										
36	1		2		2.5		2.5		1							1 2 3 4 5										
37	1		2		2.5		2.5		1							1 2 3 4 5										
38	1		2		2.5		2.5		1							1 2 3 4 5										
39	1		2		2.5		2.5		1							1 2 3 4 5										
40	1		2		2.5		2.5		1							1 2 3 4 5										
41	1		2		2.5		2.5		1							1 2 3 4 5										
42	1		2		2.5		2.5		1							1 2 3 4 5										
43	1		2		2.5		2.5		1							1 2 3 4 5										
44	1		2		2.5		2.5		1							1 2 3 4 5										
45	1		2		2.5		2.5		1							1 2 3 4 5										
46	1		2		2.5		2.5		1							1 2 3 4 5										
47	1		2		2.5		2.5		1							1 2 3 4 5										
48	1		2		2.5		2.5		1							1 2 3 4 5										
49	1		2		2.5		2.5		1							1 2 3 4 5										
50	1		2		2.5		2.5		1							1 2 3 4 5										
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52	1		2		2.5		2.5		1							1 2 3 4 5										
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54	1		2		2.5		2.5		1							1 2 3 4 5										
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56	1		2		2.5		2.5		1							1 2 3 4 5										
57	1		2		2.5		2.5		1							1 2 3 4 5										
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60	1		2		2.5		2.5		1							1 2 3 4 5										
61	1		2		2.5		2.5		1							1 2 3 4 5										
62	1		2		2.5		2.5		1							1 2 3 4 5										
63	1		2		2.5		2.5		1							1 2 3 4 5										
64	1		2		2.5		2.5		1							1 2 3 4 5										
65	1		2		2.5		2.5		1							1 2 3 4 5										
66	1		2		2.5		2.5		1							1 2 3 4 5										
67	1		2		2.5		2.5		1							1 2 3 4 5										
68	1		2		2.5		2.5		1							1 2 3 4 5										
69	1		2		2.5		2.5		1							1 2 3 4 5										
70	1		2		2.5		2.5		1							1 2 3 4 5										
71	1		2		2.5		2.5		1							1 2 3 4 5										
72	1		2		2.5		2.5		1							1 2 3 4 5										
73	1		2		2.5		2.5		1							1 2 3 4 5										
74	1		2		2.5		2.5		1							1 2 3 4 5										
75	1		2		2.5		2.5		1							1 2 3 4 5										
76	1		2		2.5		2.5		1							1 2 3 4 5										
77	1		2		2.5		2.5		1							1 2 3 4 5										
78	1		2		2.5		2.5		1							1 2 3 4 5										
79	1		2		2.5		2.5		1							1 2 3 4 5										
80	1		2		2.5		2.5		1							1 2 3 4 5										
81	1		2		2.5		2.5		1							1 2 3 4 5										
82	1		2		2.5		2.5		1							1 2 3 4 5										
83	1		2		2.5		2.5		1							1 2 3 4 5										
84	1		2		2.5		2.5		1							1 2 3 4 5										
85	1		2		2.5		2.5		1							1 2 3 4 5										
86	1		2		2.5		2.5		1							1 2 3 4 5										
87	1		2		2.5		2.5		1							1 2 3 4 5										
88	1		2		2.5		2.5		1							1 2 3 4 5										
89	1		2		2.5		2.5		1							1 2 3 4 5										
90	1		2		2.5		2.5		1							1 2 3 4 5										
91	1		2		2.5		2.5		1							1 2 3 4 5										
92	1		2		2.5		2.5		1							1 2 3 4 5										
93	1		2		2.5		2.5		1							1 2 3 4 5										
94	1		2		2.5		2.5		1							1 2 3 4 5										
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97	1		2		2.5		2.5		1							1 2 3 4 5										
98	1		2		2.5		2.5		1							1 2 3 4 5										
99	1		2		2.5		2.5		1							1 2 3 4 5										
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111	1		2		2.5		2.5		1							1 2 3 4 5										
112	1		2		2.5		2.5		1							1 2 3 4 5										
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116	1		2		2.5		2.5		1							1 2 3 4 5										
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126	1		2		2.5		2.5		1							1 2 3 4 5										
127	1		2		2.5		2.5		1							1 2 3 4 5										
128	1		2		2.5		2.5		1							1 2 3 4 5										
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131	1		2		2.5		2.5		1							1 2 3 4 5										
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136	1		2		2.5		2.5		1							1 2 3 4 5										
137	1		2		2.5		2.5		1							1 2 3 4 5										
138	1		2		2.5		2.5		1							1 2 3 4 5										
139	1		2		2.5		2.5		1							1 2 3 4 5										
140	1		2		2.5		2.5		1							1 2 3 4 5										
141	1		2		2.5		2.5		1							1 2 3 4 5										
142	1		2		2.5		2.5		1																	



SURVEY TITLE: WARKWORTH

SITE LOCATION: US1

PROFILE MAP DETAILS				SURVEY DETAILS			
Profile No.	Map Sheet No.	Easting	Northings	Described By	Profile Date	Photo Taken (1)	No. of Layers
01	01	01	01	01	01	01	01
02	02	02	02	02	02	02	02
03	03	03	03	03	03	03	03
04	04	04	04	04	04	04	04
05	05	05	05	05	05	05	05
06	06	06	06	06	06	06	06
07	07	07	07	07	07	07	07
08	08	08	08	08	08	08	08
09	09	09	09	09	09	09	09
Potential BSAL? (1)				Site type (1)			
yes <input type="checkbox"/> no <input checked="" type="checkbox"/>				checked <input type="checkbox"/> detailed <input checked="" type="checkbox"/> exclusion <input type="checkbox"/>			
BIOPHYSICAL STRATEGIC AGRICULTURAL LAND SOIL DATA CARD							
SOIL TYPE		VEGETATION		LANDFORM ELEMENT (1)			
A.S.C.		Vegetation Community (1)		alcove <input type="checkbox"/> cone <input type="checkbox"/> footslope <input type="checkbox"/> ox-bow <input type="checkbox"/> sink hole/doline <input type="checkbox"/>			
O		unknown <input type="checkbox"/>		backplain <input type="checkbox"/> crater <input type="checkbox"/> foredune <input type="checkbox"/> pan/playa <input type="checkbox"/> stream channel <input type="checkbox"/>			
SO		rainforest <input type="checkbox"/>		bank <input type="checkbox"/> cut face <input type="checkbox"/> gully <input type="checkbox"/> pediment <input type="checkbox"/> streambed <input type="checkbox"/>			
GG		wet sclerophyll forest <input type="checkbox"/>		bar <input type="checkbox"/> cut-over surface <input type="checkbox"/> hillcrest <input type="checkbox"/> pit <input type="checkbox"/> summit surface <input type="checkbox"/>			
SG		dry sclerophyll forest <input type="checkbox"/>		beach <input type="checkbox"/> dam <input type="checkbox"/> hillslope <input type="checkbox"/> plain <input type="checkbox"/> swale <input type="checkbox"/>			
F		woodland grass u'storey <input type="checkbox"/>		beach ridge <input type="checkbox"/> drainage depression <input type="checkbox"/> lagoon <input type="checkbox"/> prior stream <input type="checkbox"/> swamp <input type="checkbox"/>			
A		woodland shrub u'storey <input type="checkbox"/>		bench <input type="checkbox"/> dune <input type="checkbox"/> lake <input type="checkbox"/> rock flat <input type="checkbox"/> talus <input type="checkbox"/>			
C		tall shrubland <input type="checkbox"/>		berm <input type="checkbox"/> embankment <input type="checkbox"/> landslide <input type="checkbox"/> rock platform <input type="checkbox"/> tidal creek <input type="checkbox"/>			
G		low shrubland <input type="checkbox"/>		blow-out <input type="checkbox"/> estuary <input type="checkbox"/> levee <input type="checkbox"/> scald <input type="checkbox"/> tidal flat <input type="checkbox"/>			
S		heath <input type="checkbox"/>		channel bench <input type="checkbox"/> fan <input type="checkbox"/> lunette <input type="checkbox"/> scarp <input type="checkbox"/> tor <input type="checkbox"/>			
F		grassland/herbland <input type="checkbox"/>		cirque <input type="checkbox"/> fill top <input type="checkbox"/> maar <input type="checkbox"/> scree <input type="checkbox"/> trench <input type="checkbox"/>			
A		swamp complex <input type="checkbox"/>		cliff <input type="checkbox"/> flood-out <input type="checkbox"/> mound <input type="checkbox"/> scroll <input type="checkbox"/> valley flat <input type="checkbox"/>			
C		littoral complex <input type="checkbox"/>		no vegetation <input type="checkbox"/>			
G		no vegetation <input type="checkbox"/>					
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LAYER STATUS		COLOUR (Munsell, 1994)		Field pH	LAYER NOTES		Field pH Test Method (1)	
Lower	Horizon	Moist Munsell	Dry Munsell	(1 per layer)			Raupach (1) test strip (3)	
1							pH meter	
							HCI (1)	
							no effervescence (1) (1) (1) (1)	
							audible/slight efferv. (2) (2) (2) (2)	
							strong effervescence (3) (3) (3) (3)	
							Boundary Distinctiveness	
							(1 per layer) 1 2 3 4 5	
							not evident (1) (1) (1) (1)	
							sharp (<5 mm) (2) (2) (2) (2)	
							abrupt (5-20 mm) (3) (3) (3) (3)	
							clear (20-50 mm) (4) (4) (4) (4)	
							gradual (50-100 mm) (5) (5) (5) (5)	
							diffuse (>100 mm) (6) (6) (6) (6)	
							STRUCTURE	
							Grade of Pedality (1) 1 2 3 4 5	
							single-grained (1) (1) (1) (1)	
							massive (2) (2) (2) (2)	
							weak pedality (3) (3) (3) (3)	
							moderate pedality (4) (4) (4) (4)	
							strong pedality (5) (5) (5) (5)	
							Fabric (1) 1 2 3 4 5	
							sandy (1) (1) (1) (1)	
							earthy (2) (2) (2) (2)	
							rough-faced peds (3) (3) (3) (3)	
							smooth-faced peds (4) (4) (4) (4)	
							Dominant (1) Ped Shape Sub-dominant (1)	
							1 2 3 4 5 1 2 3 4 5	
							platy (1) (1) (1) (1)	
							lenticular (2) (2) (2) (2)	
							prismatic (3) (3) (3) (3)	
							columnar (4) (4) (4) (4)	
							angular blocky (5) (5) (5) (5)	
							sub-ang. blocky (6) (6) (6) (6)	
							polyhedral (7) (7) (7) (7)	
							granular (8) (8) (8) (8)	
							crumb (9) (9) (9) (9)	
							round (10) (10) (10) (10)	
							Dominant (1) Ped Size Sub-dominant (1)	
							1 2 3 4 5 1 2 3 4 5	
							<2 mm (1) (1) (1) (1)	
							2-5 mm (2) (2) (2) (2)	
							5-10 mm (3) (3) (3) (3)	
							10-20 mm (4) (4) (4) (4)	
							20-50 mm (5) (5) (5) (5)	
							50-100 mm (6) (6) (6) (6)	
							100-200 mm (7) (7) (7) (7)	
							200-500 mm (8) (8) (8) (8)	
							> 500 mm (9) (9) (9) (9)	
							SEGREGATIONS	
							Type (1 per layer) 1 2 3 4 5	
							not evident (1) (1) (1) (1)	
							calcareous (2) (2) (2) (2)	
							gypseous (3) (3) (3) (3)	
							manganiferous (4) (4) (4) (4)	
							ferruginous (5) (5) (5) (5)	
							ferromanganiferous (6) (6) (6) (6)	
							organic (7) (7) (7) (7)	
							not identified (8) (8) (8) (8)	
							other (9) (9) (9) (9)	
							Amount (1 per layer) 1 2 3 4 5	
							none (1) (1) (1) (1)	
							very few (<2%) (2) (2) (2) (2)	
							few (2-10%) (3) (3) (3) (3)	
							common (10-20%) (4) (4) (4) (4)	
							many (20-50%) (5) (5) (5) (5)	
							abundant (>50%) (6) (6) (6) (6)	
							Strength (1 per layer) 1 2 3 4 5	
							weak (1) (1) (1) (1)	
							strong (2) (2) (2) (2)	
							Form (1 per layer) 1 2 3 4 5	
							soft segregations (1) (1) (1) (1)	
							nodules (2) (2) (2) (2)	
							fragments (3) (3) (3) (3)	
							crystals (4) (4) (4) (4)	
							veins (5) (5) (5) (5)	
							concretions (6) (6) (6) (6)	
							root linings (7) (7) (7) (7)	
							tubules (8) (8) (8) (8)	
							Size (1 per layer) 1 2 3 4 5	
							fine (<2 mm) (1) (1) (1) (1)	
							medium (2-6 mm) (2) (2) (2) (2)	
							coarse (6-20 mm) (3) (3) (3) (3)	
							v coarse (20-60 mm) (4) (4) (4) (4)	
							ext coarse (>60 mm) (5) (5) (5) (5)	
							Soil Water Status (1 each per layer)	
							1 2 3 4 5	
							dry (1) (1) (1) (1)	
							mod. moist (2) (2) (2) (2)	
							moist (3) (3) (3) (3)	
							wet (4) (4) (4) (4)	
							TEXTURE (1 each per layer)	
							Texture Grade 1 2 3 4 5	
							sand (1) (1) (1) (1)	
							loamy sand (2) (2) (2) (2)	
							clayey sand (3) (3) (3) (3)	
							sandy loam (4) (4) (4) (4)	
							loam (5) (5) (5) (5)	
							silty loam (6) (6) (6) (6)	
							sandy clay loam (7) (7) (7) (7)	
							clay loam (8) (8) (8) (8)	
							clay loam sandy (9) (9) (9) (9)	
							silty clay loam (10) (10) (10) (10)	
							sandy clay (11) (11) (11) (11)	
							silty clay (12) (12) (12) (12)	
							clay (13) (13) (13) (13)	
							fibric peat (14) (14) (14) (14)	
							hemic peat (15) (15) (15) (15)	
							sapric peat (16) (16) (16) (16)	
							Sand Fraction 1 2 3 4 5	
							coarse (1) (1) (1) (1)	
							fine (2) (2) (2) (2)	
							Clay Fraction 1 2 3 4 5	
							light (1) (1) (1) (1)	
							light medium (2) (2) (2) (2)	
							medium (3) (3) (3) (3)	
							medium heavy (4) (4) (4) (4)	
							heavy (5) (5) (5) (5)	
							Substrate	
							Upper	
							(3 per layer) 1 2 3 4 5	
							disturbed (1) (1) (1) (1)	
							undisturbed (2) (2) (2) (2)	
							bulk density (3) (3) (3) (3)	
							bulk density (4) (4) (4) (4)	
							Base of Observation (1)	
							layer continues (2)	
							soil continues (3)	
							equipment refusal (4)	
							bedrock reached (5)	
							COARSE FRAGMENTS	
							Type (1 per layer) Sur 1 2 3 4 5	
							not evident (1) (1) (1) (1)	
							not identified (2) (2) (2) (2)	
							as substrate (3) (3) (3) (3)	
							as rock outcrop (4) (4) (4) (4)	
							as parent material (5) (5) (5) (5)	
							quartz (6) (6) (6) (6)	
							feldspar (7) (7) (7) (7)	
							silcrete (8) (8) (8) (8)	
							ironstone (9) (9) (9) (9)	
							bauxite (10) (10) (10) (10)	
							shells (11) (11) (11) (11)	
							charcoal (12) (12) (12) (12)	
							pumice (13) (13) (13) (13)	
							opalised wood (14) (14) (14) (14)	
							other (15) (15) (15) (15)	
							Amount (1 per layer) Sur. 1 2 3 4 5	
							very few (<2%) (2) (2) (2) (2)	
							few (2-10%) (3) (3) (3) (3)	
							common (10-20%) (4) (4) (4) (4)	
							many (20-50%) (5) (5) (5) (5)	
							abundant (50-90%) (6) (6) (6) (6)	
							very abundant (>90%) (7) (7) (7) (7)	
							Size (1 per layer) Sur. 1 2 3 4 5	
							fine gravel (2-6 mm) (1) (1) (1) (1)	
							gravel (6-20 mm) (2) (2) (2) (2)	
							coarse gravel (20-60 mm) (3) (3) (3) (3)	
							cobbles (60-200 mm) (4) (4) (4) (4)	
							stones (200-600 mm) (5) (5) (5) (5)	
							boulders (>600 mm) (6) (6) (6) (6)	
							MOTTLES Sub-dominant (1)	
							1 2 3 4 5	
							Abundance 1 2 3 4 5	
							not evident (1) (1) (1) (1)	
							<2% (2) (2) (2) (2)	
							2-10% (3) (3) (3) (3)	
							10-20% (4) (4) (4) (4)	
							20-50% (5) (5) (5) (5)	
							Colour 1 2 3 4 5	
							dark (1) (1) (1) (1)	
							red (2) (2) (2) (2)	
							orange (3) (3) (3) (3)	
							yellow (4) (4) (4) (4)	
							brown (5) (5) (5) (5)	
							pale (6) (6) (6) (6)	
							grey (7) (7) (7) (7)	
							grey (8) (8) (8) (8)	
							Contrast 1 2 3 4 5	
							faint (1) (1) (1) (1)	
							distinct (2) (2) (2) (2)	
							prominent (3) (3) (3) (3)	



SURVEY TITLE: WARKWORTH

SITE LOCATION: U32

PROFILE MAP DETAILS				SURVEY DETAILS			
Profile No.	Map Sheet No.	Easting	Northings	Described By	Profile Date	Photo Taken (1)	No. of Layers
01	01	01	01	01	01	01	01
02	02	02	02	02	02	02	02
03	03	03	03	03	03	03	03
04	04	04	04	04	04	04	04
05	05	05	05	05	05	05	05
06	06	06	06	06	06	06	06
07	07	07	07	07	07	07	07
08	08	08	08	08	08	08	08
09	09	09	09	09	09	09	09
Potential BSAL? (1)				Site type (1)			
yes <input type="checkbox"/> no <input checked="" type="checkbox"/>				checked <input type="checkbox"/> detailed <input checked="" type="checkbox"/> exclusion <input type="checkbox"/>			
BIOPHYSICAL STRATEGIC AGRICULTURAL LAND SOIL DATA CARD							
SOIL TYPE		VEGETATION		LANDFORM ELEMENT (1)			
A.S.C.		Vegetation Community (1)		alcove (43) cone (3) footslope (21) ox-bow (57) sink hole/doline (52)			
O		unknown (1)		backplain (31) crater (51) foredune (12) pan/playa (55) stream channel (46)			
SO		rainforest (2)		bank (25) cut face (28) gully (42) pediment (22) streambed (45)			
GG		wet sclerophyll forest (3)		bar (6) cut-over surface (39) hillcrest (1) pit (60) summit surface (2)			
SG		dry sclerophyll forest (4)		beach (26) dam (16) hillslope (5) plain (30) swale (47)			
F		woodland grass u'storey (5)		beach ridge (7) drainage depression (41) lagoon (54) prior stream (3) swamp (58)			
A		woodland shrub u'storey (6)		bench (19) dune (11) lake (55) rock flat (34) talus (23)			
C		tall shrubland (7)		berm (29) embankment (14) landslide (20) rock platform (35) tidal creek (48)			
G		low shrubland (8)		blow-out (59) estuary (44) levee (8) scald (36) tidal flat (37)			
S		heath (9)		channel bench (33) fan (27) lunette (13) scarp (18) tor (4)			
F		grassland/herbland (10)		cirque (50) fill top (40) maar (53) scree (24) trench (49)			
A		swamp complex (11)		cliff (5) flood-out (32) mound (15) scroll (10) valley flat (38)			
L		littoral complex (12)					
I		no vegetation (13)					
G.S.G.		Growth Forms (4)		LITHOLOGY			
A		tree (1)		Substrate (3)			
B		tree mallee (2)		not identified (1) limestone (23) coarse-basic (45)			
C		shrub (3)		unconsolidated (2) tuff (24) fine-acidic (46)			
D		mallee shrub (4)		gravel (3) breccia (25) fine-intermediate (47)			
E		heath shrub (5)		sand (4) greywacke (26) fine-basic (48)			
F		chenopod shrub (6)		silt (5) arkose (27) serpentine (49)			
G		hummock grass (7)		clay (6) dolomite (28) gabbro (50)			
H		tussock grass (8)		organic material (7) calcrete (29) dolerite (51)			
I		sod grass (9)		alluvium (8) aeolianite (30) diorite (52)			
J		sedge (10)		colluvium (9) chert (31) syenite (53)			
K		rush (11)		lacustrine (10) jasper (32) granodiorite (54)			
L		fern/cycad (12)		aeolian (11) metamorphic (33) adamellite (55)			
M		moss (13)		marine (12) gneiss (34) granite (56)			
N		lichen (14)		calcareous sand (13) schist/phyllite (35) aplite (57)			
O		liverwort (15)		fill (14) slate (36) quartz porphyry (58)			
P		vine (16)		mud (15) hornfels (37) basalt (59)			
Q				till (16) quartzite (38) andesite (60)			
R				sedimentary (17) greenstone (39) trachyte (61)			
S				shale (18) amphibolite (40) rhyolite (62)			
T				siltstone/mudstone (19) marble (41) obsidian (63)			
U				sandstone-quartz (20) igneous (42) scoria (64)			
V				sandstone-lithic (21) coarse-acidic (43) ash (65)			
W				conglomerate (22) coarse-intermediate (44) agglomerate (66)			
X				other (67)			
Y							
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cm mm 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180

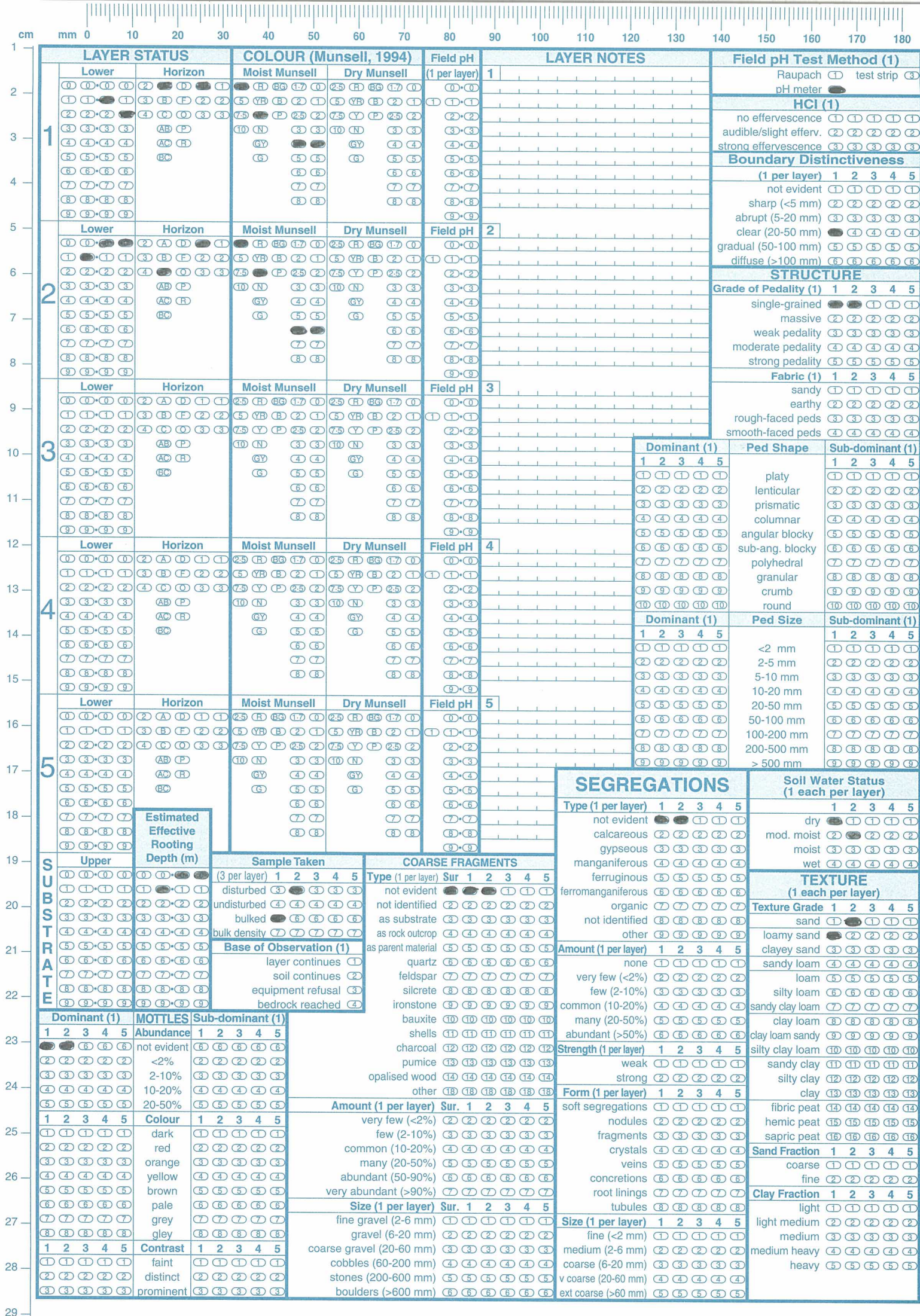
LAYER STATUS		COLOUR (Munsell, 1994)		Field pH	LAYER NOTES		Field pH Test Method (1)	
Lower	Horizon	Moist Munsell	Dry Munsell	(1 per layer)	1		Raupach (1) test strip (3)	
1	1	10 YR 5/6	10 YR 5/6	10	1		pH meter (1)	
2	2	10 YR 5/6	10 YR 5/6	10	2		HCI (1)	
3	3	10 YR 5/6	10 YR 5/6	10	3		no effervescence (1) (1) (1) (1)	
4	4	10 YR 5/6	10 YR 5/6	10	4		audible/slight efferv. (2) (2) (2) (2)	
5	5	10 YR 5/6	10 YR 5/6	10	5		strong effervescence (3) (3) (3) (3)	
6	6	10 YR 5/6	10 YR 5/6	10	6		Boundary Distinctiveness	
7	7	10 YR 5/6	10 YR 5/6	10	7		(1 per layer) 1 2 3 4 5	
8	8	10 YR 5/6	10 YR 5/6	10	8		not evident (1) (1) (1) (1)	
9	9	10 YR 5/6	10 YR 5/6	10	9		sharp (<5 mm) (2) (2) (2) (2)	
10	10	10 YR 5/6	10 YR 5/6	10	10		abrupt (5-20 mm) (3) (3) (3) (3)	
11	11	10 YR 5/6	10 YR 5/6	10	11		clear (20-50 mm) (4) (4) (4) (4)	
12	12	10 YR 5/6	10 YR 5/6	10	12		gradual (50-100 mm) (5) (5) (5) (5)	
13	13	10 YR 5/6	10 YR 5/6	10	13		diffuse (>100 mm) (6) (6) (6) (6)	
14	14	10 YR 5/6	10 YR 5/6	10	14		STRUCTURE	
15	15	10 YR 5/6	10 YR 5/6	10	15		Grade of Pedality (1) 1 2 3 4 5	
16	16	10 YR 5/6	10 YR 5/6	10	16		single-grained (1) (1) (1) (1)	
17	17	10 YR 5/6	10 YR 5/6	10	17		massive (2) (2) (2) (2)	
18	18	10 YR 5/6	10 YR 5/6	10	18		weak pedality (3) (3) (3) (3)	
19	19	10 YR 5/6	10 YR 5/6	10	19		moderate pedality (4) (4) (4) (4)	
20	20	10 YR 5/6	10 YR 5/6	10	20		strong pedality (5) (5) (5) (5)	
21	21	10 YR 5/6	10 YR 5/6	10	21		Fabric (1) 1 2 3 4 5	
22	22	10 YR 5/6	10 YR 5/6	10	22		sandy (1) (1) (1) (1)	
23	23	10 YR 5/6	10 YR 5/6	10	23		earthy (2) (2) (2) (2)	
24	24	10 YR 5/6	10 YR 5/6	10	24		rough-faced peds (3) (3) (3) (3)	
25	25	10 YR 5/6	10 YR 5/6	10	25		smooth-faced peds (4) (4) (4) (4)	
26	26	10 YR 5/6	10 YR 5/6	10	26		Dominant (1) 1 2 3 4 5	
27	27	10 YR 5/6	10 YR 5/6	10	27		1 2 3 4 5	
28	28	10 YR 5/6	10 YR 5/6	10	28		platy (1) (1) (1) (1)	
29	29	10 YR 5/6	10 YR 5/6	10	29		lenticular (2) (2) (2) (2)	
30	30	10 YR 5/6	10 YR 5/6	10	30		prismatic (3) (3) (3) (3)	
31	31	10 YR 5/6	10 YR 5/6	10	31		columnar (4) (4) (4) (4)	
32	32	10 YR 5/6	10 YR 5/6	10	32		angular blocky (5) (5) (5) (5)	
33	33	10 YR 5/6	10 YR 5/6	10	33		sub-ang. blocky (6) (6) (6) (6)	
34	34	10 YR 5/6	10 YR 5/6	10	34		polyhedral (7) (7) (7) (7)	
35	35	10 YR 5/6	10 YR 5/6	10	35		granular (8) (8) (8) (8)	
36	36	10 YR 5/6	10 YR 5/6	10	36		crumb (9) (9) (9) (9)	
37	37	10 YR 5/6	10 YR 5/6	10	37		round (10) (10) (10) (10)	
38	38	10 YR 5/6	10 YR 5/6	10	38		Dominant (1) 1 2 3 4 5	
39	39	10 YR 5/6	10 YR 5/6	10	39		1 2 3 4 5	
40	40	10 YR 5/6	10 YR 5/6	10	40		Ped Size	
41	41	10 YR 5/6	10 YR 5/6	10	41		Sub-dominant (1) 1 2 3 4 5	
42	42	10 YR 5/6	10 YR 5/6	10	42		1 2 3 4 5	
43	43	10 YR 5/6	10 YR 5/6	10	43		<2 mm (1) (1) (1) (1)	
44	44	10 YR 5/6	10 YR 5/6	10	44		2-5 mm (2) (2) (2) (2)	
45	45	10 YR 5/6	10 YR 5/6	10	45		5-10 mm (3) (3) (3) (3)	
46	46	10 YR 5/6	10 YR 5/6	10	46		10-20 mm (4) (4) (4) (4)	
47	47	10 YR 5/6	10 YR 5/6	10	47		20-50 mm (5) (5) (5) (5)	
48	48	10 YR 5/6	10 YR 5/6	10	48		50-100 mm (6) (6) (6) (6)	
49	49	10 YR 5/6	10 YR 5/6	10	49		100-200 mm (7) (7) (7) (7)	
50	50	10 YR 5/6	10 YR 5/6	10	50		200-500 mm (8) (8) (8) (8)	
51	51	10 YR 5/6	10 YR 5/6	10	51		> 500 mm (9) (9) (9) (9)	
52	52	10 YR 5/6	10 YR 5/6	10	52		SEGREGATIONS	
53	53	10 YR 5/6	10 YR 5/6	10	53		Type (1 per layer) 1 2 3 4 5	
54	54	10 YR 5/6	10 YR 5/6	10	54		not evident (1) (1) (1) (1)	
55	55	10 YR 5/6	10 YR 5/6	10	55		calcareous (2) (2) (2) (2)	
56	56	10 YR 5/6	10 YR 5/6	10	56		gypseous (3) (3) (3) (3)	
57	57	10 YR 5/6	10 YR 5/6	10	57		manganiferous (4) (4) (4) (4)	
58	58	10 YR 5/6	10 YR 5/6	10	58		ferruginous (5) (5) (5) (5)	
59	59	10 YR 5/6	10 YR 5/6	10	59		ferromanganiferous (6) (6) (6) (6)	
60	60	10 YR 5/6	10 YR 5/6	10	60		organic (7) (7) (7) (7)	
61	61	10 YR 5/6	10 YR 5/6	10	61		not identified (8) (8) (8) (8)	
62	62	10 YR 5/6	10 YR 5/6	10	62		other (9) (9) (9) (9)	
63	63	10 YR 5/6	10 YR 5/6	10	63		Amount (1 per layer) 1 2 3 4 5	
64	64	10 YR 5/6	10 YR 5/6	10	64		1 2 3 4 5	
65	65	10 YR 5/6	10 YR 5/6	10	65		very few (<2%) (1) (1) (1) (1)	
66	66	10 YR 5/6	10 YR 5/6	10	66		few (2-10%) (2) (2) (2) (2)	
67	67	10 YR 5/6	10 YR 5/6	10	67		common (10-20%) (3) (3) (3) (3)	
68	68	10 YR 5/6	10 YR 5/6	10	68		many (20-50%) (4) (4) (4) (4)	
69	69	10 YR 5/6	10 YR 5/6	10	69		abundant (>50%) (5) (5) (5) (5)	
70	70	10 YR 5/6	10 YR 5/6	10	70		Strength (1 per layer) 1 2 3 4 5	
71	71	10 YR 5/6	10 YR 5/6	10	71		1 2 3 4 5	
72	72	10 YR 5/6	10 YR 5/6	10	72		weak (1) (1) (1) (1)	
73	73	10 YR 5/6	10 YR 5/6	10	73		strong (2) (2) (2) (2)	
74	74	10 YR 5/6	10 YR 5/6	10	74		Form (1 per layer) 1 2 3 4 5	
75	75	10 YR 5/6	10 YR 5/6	10	75		1 2 3 4 5	
76	76	10 YR 5/6	10 YR 5/6	10	76		soft segregations (1) (1) (1) (1)	
77	77	10 YR 5/6	10 YR 5/6	10	77		nodules (2) (2) (2) (2)	
78	78	10 YR 5/6	10 YR 5/6	10	78		fragments (3) (3) (3) (3)	
79	79	10 YR 5/6	10 YR 5/6	10	79		crystals (4) (4) (4) (4)	
80	80	10 YR 5/6	10 YR 5/6	10	80		veins (5) (5) (5) (5)	
81	81	10 YR 5/6	10 YR 5/6	10	81		concretions (6) (6) (6) (6)	
82	82	10 YR 5/6	10 YR 5/6	10	82		root linings (7) (7) (7) (7)	
83	83	10 YR 5/6	10 YR 5/6	10	83		tubules (8) (8) (8) (8)	
84	84	10 YR 5/6	10 YR 5/6	10	84		Size (1 per layer) 1 2 3 4 5	
85	85	10 YR 5/6	10 YR 5/6	10	85		1 2 3 4 5	
86	86	10 YR 5/6	10 YR 5/6	10	86		fine (<2 mm) (1) (1) (1) (1)	
87	87	10 YR 5/6	10 YR 5/6	10	87		medium (2-6 mm) (2) (2) (2) (2)	
88	88	10 YR 5/6	10 YR 5/6	10	88		coarse (6-20 mm) (3) (3) (3) (3)	
89	89	10 YR 5/6	10 YR 5/6	10	89		v coarse (20-60 mm) (4) (4) (4) (4)	
90	90	10 YR 5/6	10 YR 5/6	10	90		ext coarse (>60 mm) (5) (5) (5) (5)	
91	91	10 YR 5/6	10 YR 5/6	10	91		Soil Water Status (1 each per layer)	
92	92	10 YR 5/6	10 YR 5/6	10	92		1 2 3 4 5	
93	93	10 YR 5/6	10 YR 5/6	10	93		dry (1) (1) (1) (1)	
94	94	10 YR 5/6	10 YR 5/6	10	94		mod. moist (2) (2) (2) (2)	
95	95	10 YR 5/6	10 YR 5/6	10	95		moist (3) (3) (3) (3)	
96	96	10 YR 5/6	10 YR 5/6	10	96		wet (4) (4) (4) (4)	
97	97	10 YR 5/6	10 YR 5/6	10	97		TEXTURE	
98	98	10 YR 5/6	10 YR 5/6	10	98		(1 each per layer)	
99	99	10 YR 5/6	10 YR 5/6	10	99		Texture Grade 1 2 3 4 5	
100	100	10 YR 5/6	10 YR 5/6	10	100		1 2 3 4 5	
101	101	10 YR 5/6	10 YR 5/6	10	101		sand (1) (1) (1) (1)	
102	102	10 YR 5/6	10 YR 5/6	10	102		loamy sand (2) (2) (2) (2)	
103	103	10 YR 5/6	10 YR 5/6	10	103		clayey sand (3) (3) (3) (3)	
104	104	10 YR 5/6	10 YR 5/6	10	104		sandy loam (4) (4) (4) (4)	
105	105	10 YR 5/6	10 YR 5/6	10	105		loam (5) (5) (5) (5)	
106	106	10 YR 5/6	10 YR 5/6	10	106		silty loam (6) (6) (6) (6)	
107	107	10 YR 5/6	10 YR 5/6	10	107		sandy clay loam (7) (7) (7) (7)	
108	108	10 YR 5/6	10 YR 5/6	10	108		clay loam (8) (8) (8) (8)	
109	109	10 YR 5/6	10 YR 5/6	10	109		clay loam sandy (9) (9) (9) (9)	
110	110	10 YR 5/6	10 YR 5/6	10	110		silty clay loam (10) (10) (10) (10)	
111	111	10 YR 5/6	10 YR 5/6	10	111		sandy clay (11) (11) (11) (11)	
112	112	10 YR 5/6	10 YR 5/6	10	112		silty clay (12) (12) (12) (12)	
113	113	10 YR 5/6	10 YR 5/6	10	113		clay (13) (13) (13) (13)	
114	114	10 YR 5/6	10 YR 5/6	10	114		fibric peat (14) (14) (14) (14)	
115	115	10 YR 5/6	10 YR 5/6	10	115		hemic peat (15) (15) (15) (15)	
116	116	10 YR 5/6	10 YR 5/6	10	116		sapric peat (16) (16) (16) (16)	
117	117	10 YR 5/6	10 YR 5/6	10	117		Sand Fraction 1 2 3 4 5	
118	118	10 YR 5/6	10 YR 5/6	10	118		1 2 3 4 5	
119	119	10 YR 5/6	10 YR 5/6	10	119		coarse (1) (1) (1) (1)	
120	120	10 YR 5/6	10 YR 5/6	10	120		fine (2) (2) (2) (2)	
121	121	10 YR 5/6	10 YR 5/6	10	121		Clay Fraction 1 2 3 4 5	
122	122	10 YR 5/6	10 YR 5/6	10	122		1 2 3 4 5	
123	123	10 YR 5/6	10 YR 5/6	10	123		light (1) (1) (1) (1)	
124	124	10 YR 5/6	10 YR 5/6	10	124		light medium (2) (2) (2) (2)	
125	125	10 YR 5/6	10 YR 5/6	10	125		medium (3) (3) (3) (3)	
126	126	10 YR 5/6	10 YR 5/6	10	126		medium heavy (4) (4) (4) (4)	
127	127	10 YR 5/6	10 YR 5/6	10	127		heavy (5) (5) (5) (5)	



**SITE LOCATION:** US3

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**SITE LOCATION:** D53

NSW SOIL  
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INFORMATION  
SYSTEM

Please MARK  
LIKE THIS ONLY:

- Use 2B pencil
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- Fully erase mistakes
- Make no stray marks
- Numbers in ( ) show max. entries allowed



[illegible]



SURVEY TITLE: WARKWORTH

SITE LOCATION: D54

PROFILE MAP DETAILS				SURVEY DETAILS			
Profile No.	Map Sheet No.	Eastings	Northings	Described By	Profile Date	Photo Taken (1)	No. of Layers
01	01	01	01	01	01	01	01
02	02	02	02	02	02	02	02
03	03	03	03	03	03	03	03
04	04	04	04	04	04	04	04
05	05	05	05	05	05	05	05
06	06	06	06	06	06	06	06
07	07	07	07	07	07	07	07
08	08	08	08	08	08	08	08
09	09	09	09	09	09	09	09
Potential BSAL? (1)				Site type (1)			
yes <input type="checkbox"/> no <input checked="" type="checkbox"/>				checked <input type="checkbox"/> detailed <input checked="" type="checkbox"/> exclusion <input type="checkbox"/>			
BIOPHYSICAL STRATEGIC AGRICULTURAL LAND SOIL DATA CARD							
SOIL TYPE		VEGETATION		LANDFORM ELEMENT (1)			
A.S.C.		Vegetation Community (1)		alcove (43) cone (3) footslope (21) ox-bow (57) sink hole/doline (52)			
O		unknown (1)		backplain (31) crater (51) foredune (12) pan/playa (55) stream channel (46)			
SO		rainforest (2)		bank (25) cut face (28) gully (42) pediment (22) streambed (45)			
		wet sclerophyll forest (3)		bar (6) cut-over surface (39) hillcrest (1) pit (60) summit surface (2)			
		dry sclerophyll forest (4)		beach (26) dam (16) hillslope (1) plain (30) swale (47)			
		woodland grass u'stoery (5)		beach ridge (7) drainage depression (41) lagoon (54) prior stream (9) swamp (58)			
		woodland shrub u'stoery (6)		bench (19) dune (11) lake (55) rock flat (34) talus (23)			
GG		tall shrubland (7)		berm (29) embankment (14) landslide (20) rock platform (35) tidal creek (48)			
		low shrubland (8)		blow-out (59) estuary (44) levee (8) scald (36) tidal flat (37)			
		heath (9)		channel bench (33) fan (27) lunette (13) scarp (18) tor (4)			
SG		grassland/herbland (10)		cirque (50) fill top (40) maar (53) scree (24) trench (49)			
		swamp complex (11)		cliff (5) flood-out (32) mound (15) scroll (10) valley flat (38)			
		littoral complex (12)					
FAMILY		no vegetation (13)					
C		Growth Forms (4)		LITHOLOGY			
		tree (1)		Substrate (3)			
		tree mallee (2)		not identified (1) limestone (23) coarse-basic (45)			
		shrub (3)		unconsolidated (2) tuff (24) fine-acidic (46)			
		mallee shrub (4)		gravel (3) breccia (25) fine-intermediate (47)			
		heath shrub (5)		sand (4) greywacke (26) fine-basic (48)			
G.S.G.		chenopod shrub (6)		silt (5) arkose (27) serpentine (49)			
		hummock grass (7)		clay (6) dolomite (28) gabbro (50)			
		tussock grass (8)		organic material (7) calcrete (29) dolerite (51)			
		sod grass (9)		alluvium (8) aeolianite (30) diorite (52)			
		sedg (10)		colluvium (9) chert (31) syenite (53)			
		rush (11)		lacustrine (10) jasper (32) granodiorite (54)			
		fern/cycad (12)		aeolian (11) metamorphic (33) adamellite (55)			
		moss (13)		marine (12) gneiss (34) granite (56)			
		lichen (14)		calcareous sand (13) schist/phyllite (35) aplite (57)			
		liverwort (15)		fill (14) slate (36) quartz porphyry (58)			
		vine (16)		mud (15) hornfels (37) basalt (59)			
				till (16) quartzite (38) andesite (60)			
				sedimentary (17) greenstone (39) trachyte (61)			
				shale (18) amphibolite (40) rhyolite (62)			
				siltstone/mudstone (19) marble (41) obsidian (63)			
				sandstone-quartz (20) igneous (42) scoria (64)			
				sandstone-lithic (21) coarse-acidic (43) ash (65)			
				conglomerate (22) coarse-intermediate (44) agglomerate (66)			
				other (67)			
		LAND USE (1)		HYDROLOGY			
		national/state parks (1)		Profile Drainage (1)			
		timber/scrub/unused (2)		very poorly drained (1)			
		logged native forest (3)		poorly drained (2)			
		hardwood plantation (4)		imperfectly drained (3)			
		softwood plantation (5)		mod. well-drained (4)			
		volun./native pasture (6)		well-drained (5)			
		improved pasture (7)		rapidly drained (6)			
		cropping (8)		Permeability (1)			
		orchard/vineyard (9)		very slowly permeable (1)			
		vegetables/flowers (10)		slowly permeable (2)			
		urban (11)		moderately permeable (3)			
		industrial (12)		highly permeable (4)			
		quarry/mining (13)					
		other (14)					
		Identification Method (1)		Depth (1) & Extent (1)			
		personal assessment (1)		≤ 500 mm depth (1)			
		geology map (2)		> 500 mm depth (2)			
		both assessment & map (3)		≤ 50% area (1)			
		Rock Outcrop % (1)		> 50% area (2)			
		nil (1) >20-30% (5)					
		<2% (2) >30-50% (6)					
		2-10% (3) >50% (7)					
		>10-20% (4)					
		Surface Condition		SITE FIELD NOTES			
		Current (2)					
		Expected					
		Wet (2) Dry (2)					
		cracked (2)					
		self-mulched (3)					
		loose (4)					
		soft (5)					
		firm (6)					
		hardset (7)					
		surface crust (8)					
		trampled (9)					
		poached (10)					
		recently cultivated (11)					
		water repellent (12)					
		gravelly (1)					
		other (13)					
		Ground Cover %					
		natural disturbance (1)					
		no effective disturbance (2)					
		limited clearing (3)					
		extensive clearing (4)					
		cleared, no cultivation (5)					
		occasional cultivation (6)					
		rainfed cultivation (7)					
		irrigated cultivation (8)					
		highly disturbed (9)					
		Photo file name/s:					

NSW SOIL  
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INFORMATION  
SYSTEMPlease MARK  
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4068



cm	mm	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180						
1	LAYER STATUS										COLOUR (Munsell, 1994)					Field pH	LAYER NOTES					Field pH Test Method (1)				
	Lower		Horizon		Moist Munsell		Dry Munsell		(1 per layer)							Raupach (1) test strip (3)										
2	1		2		3		4		5							pH meter (3)										
3	1		2		3		4		5							HCl (1)										
4	1		2		3		4		5							no effervescence (1) (1) (1) (1)										
5	1		2		3		4		5							audible/slight efferv. (2) (2) (2) (2)										
6	1		2		3		4		5							strong effervescence (3) (3) (3) (3)										
7	1		2		3		4		5							Boundary Distinctiveness										
8	1		2		3		4		5							(1 per layer) 1 2 3 4 5										
9	1		2		3		4		5							not evident (1) (1) (1) (1)										
10	1		2		3		4		5							sharp (<5 mm) (2) (2) (2) (2)										
11	1		2		3		4		5							abrupt (5-20 mm) (3) (3) (3) (3)										
12	1		2		3		4		5							clear (20-50 mm) (4) (4) (4) (4)										
13	1		2		3		4		5							gradual (50-100 mm) (5) (5) (5) (5)										
14	1		2		3		4		5							diffuse (>100 mm) (6) (6) (6) (6)										
15	1		2		3		4		5							STRUCTURE										
16	1		2		3		4		5							Grade of Pedality (1) 1 2 3 4 5										
17	1		2		3		4		5							single-grained (1) (1) (1) (1)										
18	1		2		3		4		5							massive (2) (2) (2) (2)										
19	1		2		3		4		5							weak pedality (3) (3) (3) (3)										
20	1		2		3		4		5							moderate pedality (4) (4) (4) (4)										
21	1		2		3		4		5							strong pedality (5) (5) (5) (5)										
22	1		2		3		4		5							Fabric (1) 1 2 3 4 5										
23	1		2		3		4		5							sandy (1) (1) (1) (1)										
24	1		2		3		4		5							earthy (2) (2) (2) (2)										
25	1		2		3		4		5							rough-faced peds (3) (3) (3) (3)										
26	1		2		3		4		5							smooth-faced peds (4) (4) (4) (4)										
27	1		2		3		4		5							Dominant (1)										
28	1		2		3		4		5							1 2 3 4 5										
29	1		2		3		4		5							1 2 3 4 5										
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142	1		2		3		4		5							1 2 3 4 5										
143	1		2		3		4		5							1 2 3 4 5										
144	1		2		3		4		5							1 2 3 4 5										
145	1		2		3		4		5							1 2 3 4 5										
146	1		2		3		4		5							1 2 3 4 5										
147	1		2		3		4		5							1 2 3 4 5										
148	1		2		3		4		5							1 2 3 4 5										
149	1		2		3		4		5							1 2 3 4 5										
150	1		2		3																					



SURVEY TITLE: WARKWORTH

SITE LOCATION: DSC1

NSW SOIL  
AND LAND  
INFORMATION  
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PROFILE MAP DETAILS				SURVEY DETAILS			
Profile No.	Map Sheet No.	Eastings	Northings	Described By	Profile Date	Photo Taken (1)	No. of Layers
000	000	000000	000000	000000	00 Jan 00 00 00	profile 01	
1	1	1111	1111	1111	11 Feb 00 01 01	site 02	00
2	2	2222	2222	2222	22 Mar 00 02 02	both profile & site 03	01
3	3	3333	3333	3333	33 Apr 00 03 03	Nature of Exposure (2)	02
4	4	4444	4444	4444	44 May 00 04 04	auger 04	03
5	5	5555	5555	5555	55 Jun 00 05 05	pit 05	04
6	6	6666	6666	6666	66 Jul 00 06 06	batter 06	05
7	7	7777	7777	7777	77 Aug 00 07 07	gully 07	
8	8	8888	8888	8888	88 Sep 00 08 08	core sample 08	
9	9	9999	9999	9999	99 Oct 00 09 09	other 09	

Potential BSAL? (1)	Site type (1)
yes 01 no 02	checked 01 detailed 02 exclusion 03

BIOPHYSICAL STRATEGIC AGRICULTURAL  
LAND SOIL DATA CARD

SOIL TYPE	VEGETATION	LANDFORM ELEMENT (1)									
A.S.C.	Vegetation Community (1)	alcove 03	cone 03	footslope 01	ox-bow 07	sink hole/doline 02					
O	unknown 01	backplain 01	crater 01	foredune 02	pan/playa 05	stream channel 06					
SO	rainforest 02	bank 02	cut face 02	gully 02	pediment 02	streambed 02					
	wet sclerophyll forest 03	bar 06	cut-over surface 03	hillcrest 01	pit 06	summit surface 02					
	dry sclerophyll forest 04	beach 06	dam 06	hillslope 01	plain 03	swale 07					
GG	woodland grass u'storey 05	beach ridge 07	drainage depression 01	lagoon 04	prior stream 03	swamp 08					
	woodland shrub u'storey 06	bench 09	dune 01	lake 05	rock flat 04	talus 09					
	tall shrubland 07	berm 09	embankment 04	landslide 02	scald 06	tidal creek 08					
	low shrubland 08	blow-out 09	estuary 04	levee 08	scarp 08	tidal flat 07					
SG	heath 09	channel bench 03	fan 07	lunette 03	scree 04	tor 04					
	grassland/herbland 10	cliff 05	fill top 04	maar 05	scroll 01	trench 09					
	swamp complex 11		flood-out 02	mound 05		valley flat 08					
	littoral complex 12										
	no vegetation 13										
FAMILY	Growth Forms (4)	LITHOLOGY									
	tree 01	not identified 01	limestone 03	coarse-basic 05							
	tree mallee 02	unconsolidated 02	tuff 04	fine-acidic 06							
	shrub 03	gravel 03	breccia 05	fine-intermediate 07							
	mallee shrub 04	sand 04	greywacke 06	fine-basic 08							
C	heath shrub 05	silt 05	arkose 07	serpentine 09							
	chenopod shrub 06	clay 06	dolomite 08	gabbro 10							
	hummock grass 07	organic material 07	calcrete 09	dolerite 11							
	tussock grass 08	alluvium 08	aeolianite 10	diorite 12							
	sod grass 09	colluvium 09	chert 11	syenite 13							
	sedge 10	lacustrine 10	jasper 12	granodiorite 14							
	rush 11	aeolian 11	metamorphic 13	adamellite 15							
	forb 12	marine 12	gneiss 14	granite 16							
	fern/cycad 13	calcareous sand 13	schist/phyllite 15	aplite 17							
	moss 14	fill 14	slate 16	quartz porphyry 18							
	lichen 15	mud 15	hornfels 17	basalt 19							
	liverwort 16	till 16	quartzite 18	andesite 20							
	vine 17	sedimentary 17	greenstone 19	trachyte 21							
		shale 18	amphibolite 20	rhyolite 22							
		siltstone/mudstone 19	marble 21	obsidian 23							
		sandstone-quartz 20	igneous 22	scoria 24							
		sandstone-lithic 21	coarse-acidic 23	ash 25							
		conglomerate 22	coarse-intermediate 24	agglomerate 26							
				other 27							
	LAND USE (1)	HYDROLOGY									
	national/state parks 01	Identification Method (1)		Profile Drainage (1)		Permeability (1)		Depth (1) & Extent (1)			
	timber/scrub/unused 02	personal assessment 01		very poorly drained 01		very slowly permeable 01		< 500 mm depth 01			
	logged native forest 03	geology map 02		poorly drained 02		slowly permeable 02		> 500 mm depth 02			
	hardwood plantation 04	both assessment & map 03		imperfectly drained 03		moderately permeable 03		< 50% area 01			
	softwood plantation 05	Rock Outcrop % (1)		mod. well-drained 04		highly permeable 04		> 50% area 02			
	volun./native pasture 06	nil 01 >20-30% 05		well-drained 05							
	improved pasture 07	<2% 02 >30-50% 06		rapidly drained 06							
	cropping 08	2-10% 03 >50% 07									
	orchard/vineyard 09	>10-20% 04									
	vegetables/flowers 10										
	urban 11										
	industrial 12										
	quarry/mining 13										
	other 14										

SITE CONDITION		Surface Condition		Expected	
Site Disturbance(s) (2)		Current (2)	Wet (2)	Dry (2)	
natural disturbance 01	Ground Cover %	cracked 02	02	02	
no effective disturbance 02		self-mulched 03	03	03	
limited clearing 03		loose 04	04	04	
extensive clearing 04		soft 05	05	05	
cleared, no cultivation 05		firm 06	06	06	
occasional cultivation 06		hardset 07	07	07	
rainfed cultivation 07		surface crust 08	08	08	
irrigated cultivation 08		trampled 09	09	09	
highly disturbed 09		poached 10	10	10	
		recently cultivated 11			
	water repellent 12				
	gravelly 13				
	other 14				

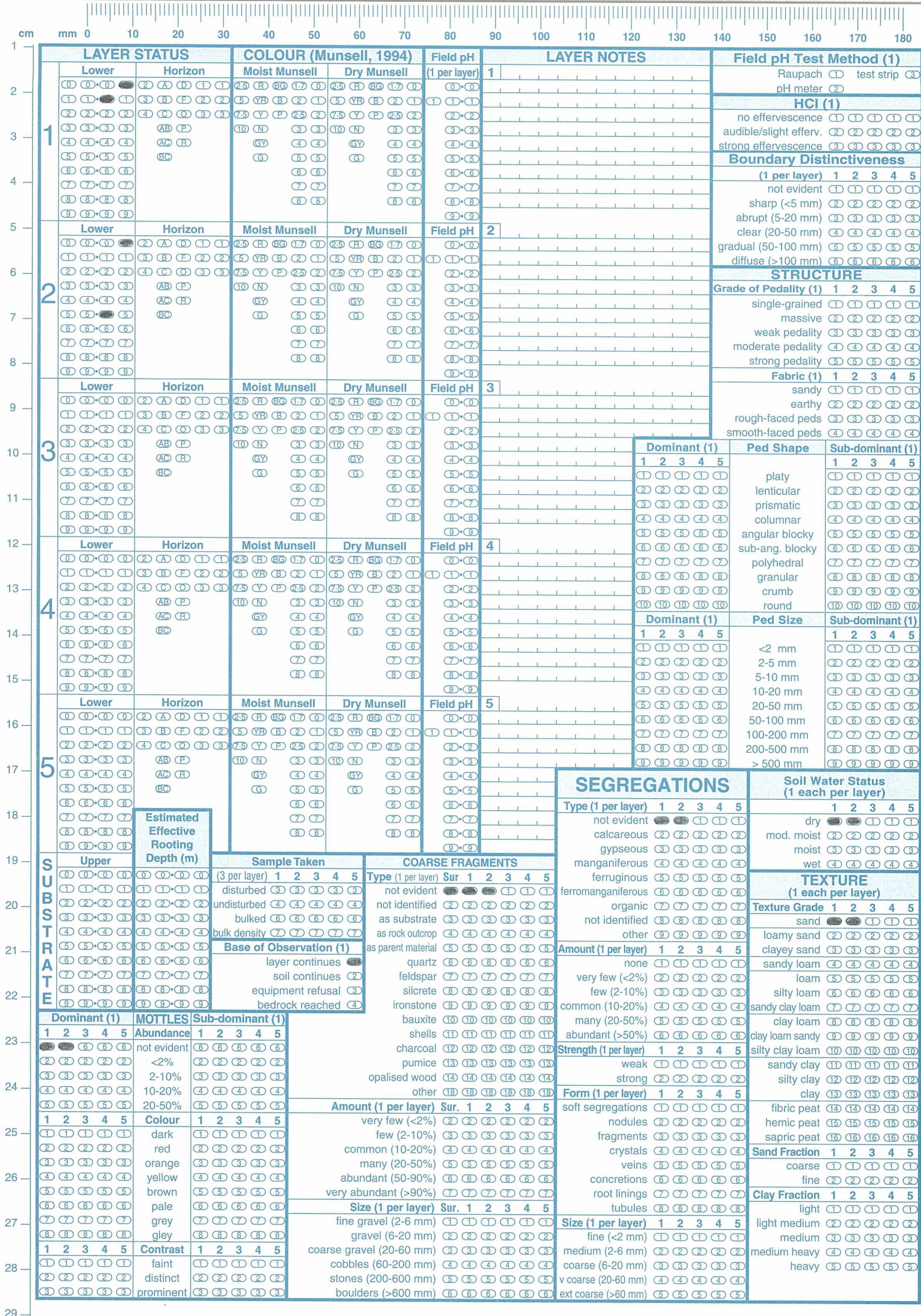
Photo file name/s:

Please do not mark this space.



4064







SURVEY TITLE: WARKWORTHSITE LOCATION: D.S.C.2NSW SOIL  
AND LAND  
INFORMATION  
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- Make no stray marks
- Numbers in ( ) show max. entries allowed

PROFILE MAP DETAILS				SURVEY DETAILS			
Profile No.	Map Sheet No.	Easting	Northings	Described By	Profile Date	Photo Taken (1)	No. of Layers
00 00 00	00 00 00	00 00 00	00 00 00	00 00 00	00 00 00	profile 01	
01 01 01	01 01 01	01 01 01	01 01 01	01 01 01	01 01 01	site 02	00
02 02 02	02 02 02	02 02 02	02 02 02	02 02 02	02 02 02	both profile & site	01
03 03 03	03 03 03	03 03 03	03 03 03	03 03 03	03 03 03	Nature of Exposure (2)	
04 04 04	04 04 04	04 04 04	04 04 04	04 04 04	04 04 04	auger 01	03
05 05 05	05 05 05	05 05 05	05 05 05	05 05 05	05 05 05	pit 02	04
06 06 06	06 06 06	06 06 06	06 06 06	06 06 06	06 06 06	batter 03	05
07 07 07	07 07 07	07 07 07	07 07 07	07 07 07	07 07 07	gully 04	
08 08 08	08 08 08	08 08 08	08 08 08	08 08 08	08 08 08	core sample 05	
09 09 09	09 09 09	09 09 09	09 09 09	09 09 09	09 09 09	other 06	

Potential BSAL? (1)	Site type (1)
yes 01 no 02	checked 01 detailed 02 exclusion 03

BIOPHYSICAL STRATEGIC AGRICULTURAL  
LAND SOIL DATA CARD

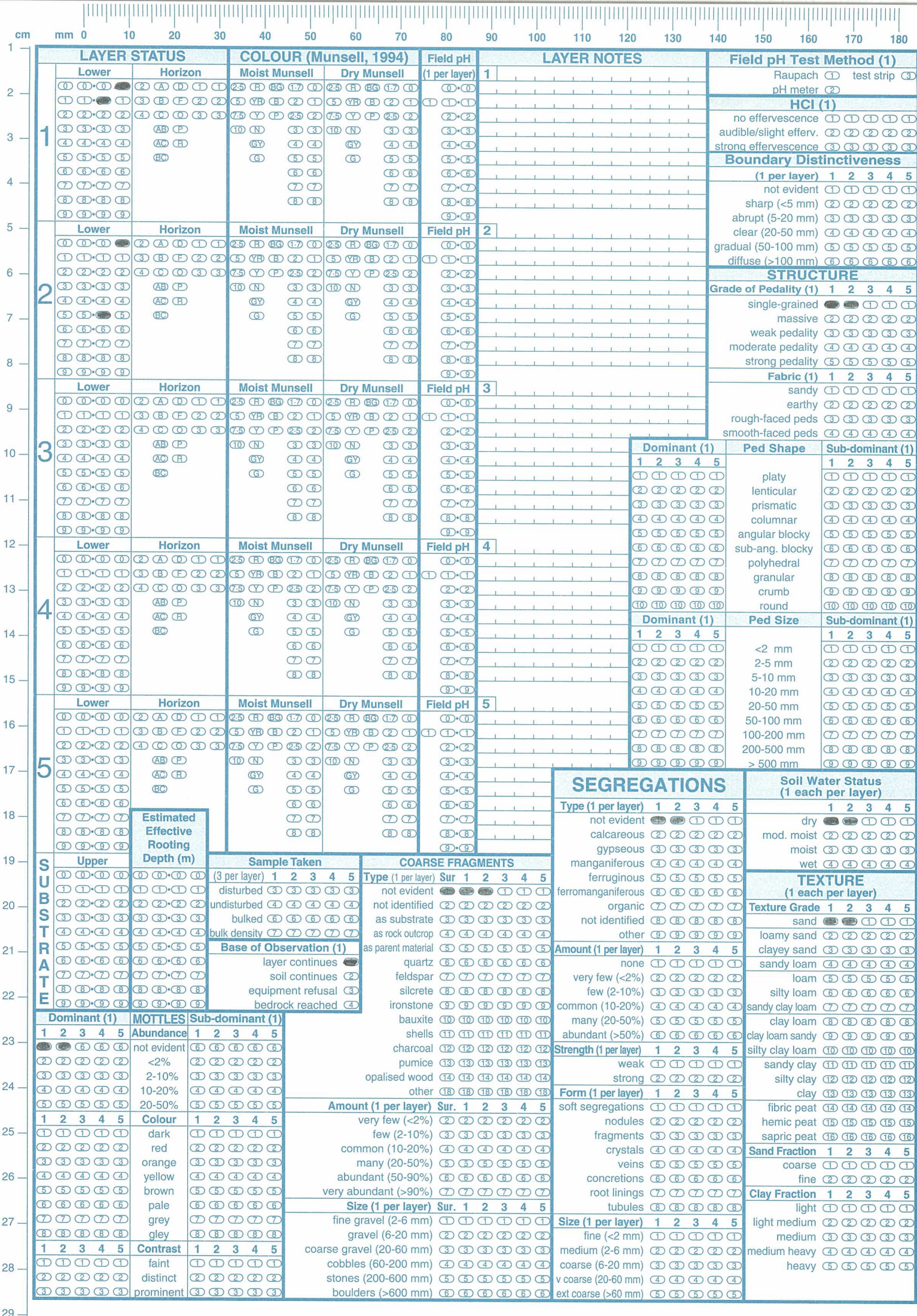
SOIL TYPE	VEGETATION	LANDFORM ELEMENT (1)			
A.S.C.	Vegetation Community (1)	alcove 03	cone 03	footslope 01	ox-bow 07
O	unknown 01	backplain 01	crater 01	foredune 02	sink hole/doline 02
	rainforest 02	bank 02	cut face 02	gully 02	stream channel 03
SO	wet sclerophyll forest 03	bar 03	cut-over surface 03	hillcrest 03	streambed 04
	dry sclerophyll forest 04	beach 04	dam 04	hillslope 04	summit surface 05
	woodland grass u'storey 05	beach ridge 05	drainage depression 05	lagoon 05	swale 06
GG	woodland shrub u'storey 06	bench 06	dune 06	lake 06	swamp 07
	tall shrubland 07	berm 07	embankment 07	landslide 07	talus 08
	low shrubland 08	blow-out 08	estuary 08	levee 08	tidal creek 09
SG	heath 09	channel bench 09	fan 09	lunette 09	tidal flat 10
	grassland/herbland 10	cirque 10	fill top 10	maar 10	tor 11
	swamp complex 11	cliff 11	flood-out 11	mound 11	trench 12
	littoral complex 12				valley flat 13
	no vegetation 13				
		LITHOLOGY			
		Substrate (3)			
	Growth Forms (4)	not identified 01	limestone 02	coarse-basic 03	
	tree 01	unconsolidated 02	tuff 03	fine-acidic 04	
	tree mallee 02	gravel 03	breccia 04	fine-intermediate 05	
	shrub 03	sand 04	greywacke 05	fine-basic 06	
	mallee shrub 04	silt 05	arkose 06	serpentine 07	
	heath shrub 05	clay 06	dolomite 07	gabbro 08	
	chenopod shrub 06	organic material 07	calcrete 08	dolerite 09	
	hummock grass 07	alluvium 08	aeolianite 09	diorite 10	
	tussock grass 08	colluvium 09	chert 10	syenite 11	
	sod grass 09	lacustrine 10	jasper 11	granodiorite 12	
	sedge 10	aeolian 11	metamorphic 12	adamellite 13	
	rush 11	marine 12	gneiss 13	granite 14	
	forb 12	calcareous sand 13	schist/phyllite 14	aplite 15	
	fern/cycad 13	fill 14	slate 15	quartz porphyry 16	
	moss 14	mud 15	hornfels 16	basalt 17	
	lichen 15	till 16	quartzite 17	andesite 18	
	liverwort 16	sedimentary 17	greenstone 18	trachyte 19	
	vine 17	shale 18	amphibolite 19	rhyolite 20	
		siltstone/mudstone 19	marble 20	obsidian 21	
		sandstone-quartz 20	igneous 21	scoria 22	
		sandstone-lithic 21	coarse-acidic 22	ash 23	
		conglomerate 22	coarse-intermediate 23	agglomerate 24	
				other 25	
		TOPOGRAPHY			
		Slope Percent		Site Morphology (1)	
		00 00 00		flat 01	
		01 01 01		crest 02	
		02 02 02		hillock 03	
		03 03 03		ridge 04	
		04 04 04		upper slope 05	
		05 05 05		midslope 06	
		06 06 06		simple slope 07	
		07 07 07		lower slope 08	
		08 08 08		open depression 09	
		09 09 09		closed depression 10	
		Slope Measurement Method (1)		Slope Morphology (1)	
		inclinometer 01		waxing 01	
		Abney level 02		waning 02	
		total station 03		maximal 03	
		RTK GPS 04		minimal 04	
		LIDAR 05			
		Microrelief Type (1)		Aspect (1)	
		none 01		NE 01	
		normal gilgai 02		SE 02	
		crabhole gilgai 03		SW 03	
		linear gilgai 04		W 04	
		lattice gilgai 05		E 05	
		melonhole gilgai 06			
		other 07			
		HYDROLOGY		Depth (1) & Extent (1)	
		Profile Drainage (1)	Permeability (1)	≤ 500 mm depth 01	
		very poorly drained 01	very slowly permeable 01	> 500 mm depth 02	
		poorly drained 02	slowly permeable 02	≤ 50% area 01	
		imperfectly drained 03	moderately permeable 03	> 50% area 02	
		mod. well-drained 04	highly permeable 04		
		well-drained 05			
		rapidly drained 06			
		SITE FIELD NOTES			

SITE CONDITION		Surface Condition		
		Current (2)	Expected Wet (2) Dry (2)	
Site Disturbance(s) (2)		cracked 02	02 02	
natural disturbance 01		self-mulched 03	03 03	
no effective disturbance 02		loose 04	04 04	
limited clearing 03		soft 05	05 05	
extensive clearing 04		firm 06	06 06	
cleared, no cultivation 05		hardset 07	07 07	
occasional cultivation 06		surface crust 08	08 08	
rainfed cultivation 07		trampled 09	09 09	
irrigated cultivation 08		poached 10	10 10	
highly disturbed 09		recently cultivated 11		
	Ground Cover %	water repellent 12	12 12	
		gravelly 13		
		other 14	14 14	

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4065







SURVEY TITLE: W.A.R.K.N.O.R.T.H.

SITE LOCATION: D.S.C.3

NSW SOIL  
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INFORMATION  
SYSTEMPlease MARK  
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PROFILE MAP DETAILS				SURVEY DETAILS			
Profile No.	Map Sheet No.	Eastings	Northings	Described By	Profile Date	Photo Taken (1)	No. of Layers
00 00 00	00 00 00	00 00 00	00 00 00	00 00 00	00 00 00	profile 01	
01 01 01	01 01 01	01 01 01	01 01 01	01 01 01	01 01 01	site 02	00
02 02 02	02 02 02	02 02 02	02 02 02	02 02 02	02 02 02	both profile & site 03	01
03 03 03	03 03 03	03 03 03	03 03 03	03 03 03	03 03 03	Nature of Exposure (2)	02
04 04 04	04 04 04	04 04 04	04 04 04	04 04 04	04 04 04	auger 04	03
05 05 05	05 05 05	05 05 05	05 05 05	05 05 05	05 05 05	pit 05	04
06 06 06	06 06 06	06 06 06	06 06 06	06 06 06	06 06 06	batter 06	05
07 07 07	07 07 07	07 07 07	07 07 07	07 07 07	07 07 07	gully 07	
08 08 08	08 08 08	08 08 08	08 08 08	08 08 08	08 08 08	core sample 08	
09 09 09	09 09 09	09 09 09	09 09 09	09 09 09	09 09 09	other 09	

Potential BSAL? (1)	Site type (1)
yes 01 no 02	checked 01 detailed 02 exclusion 03

BIOPHYSICAL STRATEGIC AGRICULTURAL  
LAND SOIL DATA CARD

SOIL TYPE	VEGETATION	LANDFORM ELEMENT (1)					
A.S.C.	Vegetation Community (1)	alcove 03	cone 03	footslope 01	ox-bow 07	sink hole/doline 02	
0	unknown 01	backplain 01	crater 01	foredune 02	pan/playa 03	stream channel 04	
	rainforest 02	bank 02	cut face 02	gully 02	pediment 02	streambed 05	
	wet sclerophyll forest 03	bar 03	cut-over surface 03	hillcrest 03	pit 03	summit surface 06	
SO	dry sclerophyll forest 04	beach 04	dam 04	hillslope 04	plain 04	swale 07	
	woodland grass u'storey 05	beach ridge 05	drainage depression 05	lagoon 05	prior stream 05	swamp 08	
	woodland shrub u'storey 06	bench 06	dune 06	lake 06	rock flat 06	talus 09	
GG	tall shrubland 07	berm 07	embankment 07	landslide 07	rock platform 07	tidal creek 10	
	low shrubland 08	blow-out 08	estuary 08	levee 08	scald 08	tidal flat 11	
	heath 09	channel bench 09	fan 09	lunette 09	scarp 09	tor 12	
SG	grassland/herbland 10	cirque 10	fill top 10	maar 10	scree 10	trench 13	
	swamp complex 11	cliff 11	flood-out 11	mound 11	scroll 11	valley flat 14	
	littoral complex 12						
	no vegetation 13						

FAMILY		littoral complex (1)	LITHOLOGY						TOPOGRAPHY	
		no vegetation (3)								
		Growth Forms (4)	Substrate (3)						Slope Percent	
		tree (1)	not identified (1)	limestone (23)	coarse-basic (45)	(0 0 0)				
		tree mallee (2)	unconsolidated (2)	tuff (24)	fine-acidic (46)	(1 1 1)				
		shrub (3)	gravel (3)	breccia (25)	fine-intermediate (47)	(2 2 2)				
		mallee shrub (4)	sand (4)	greywacke (26)	fine-basic (48)	(3 3 3)				
		heath shrub (5)	silt (5)	arkose (27)	serpentine (49)	(4 4 4)				
		chenopod shrub (6)	clay (6)	dolomite (28)	gabbro (50)	(5 5 5)				
		hummock grass (7)	organic material (7)	calcrete (29)	dolerite (51)	(6 6 6)				
C		tussock grass (8)	alluvium (8)	aeolianite (30)	diorite (52)	(7 7 7)				
	G.S.G.	sod grass (9)	colluvium (9)	chert (31)	syenite (53)	(8 8 8)				
(A)		sedge (10)	lacustrine (10)	jasper (32)	granodiorite (54)	(9 9 9)				
(B) (B) (B)		rush (11)	aeolian (11)	metamorphic (33)	adamellite (55)	Slope Measurement				
(C) (C) (C)		forb (12)	marine (12)	gneiss (34)	granite (56)	Method (1)				
(D) (D) (D)		fern/cycad (13)	calcareous sand (13)	schist/phyllite (35)	aplite (57)	inclinometer (1)				
(E) (E) (E)		moss (14)	fill (14)	slate (36)	quartz porphyry (58)	Abney level (4)				
(F) (F) (F)		lichen (15)	mud (15)	hornfels (37)	basalt (59)	total station (5)				
(G) (G) (G)		liverwort (16)	till (16)	quartzite (38)	andesite (60)	RTK GPS (6)				
(H) (H) (H)		vine (17)	sedimentary (17)	greenstone (39)	trachyte (61)	LIDAR (7)				
(I) (I) (I)			shale (18)	amphibolite (40)	rhyolite (62)	Microrelief Type (1)				
(J) (J) (J)		LAND USE (1)	siltstone/mudstone (19)	marble (41)	obsidian (63)	none (1)				
(K) (K) (K)		national/state parks (1)	sandstone-quartz (20)	igneous (42)	scoria (64)	normal gilgai (2)				
(L) (L) (L)		timber/scrub/unused (2)	sandstone-lithic (21)	coarse-acidic (43)	ash (65)	crabhole gilgai (3)				
(M) (M) (M)		logged native forest (3)	conglomerate (22)	coarse-intermediate (44)	agglomerate (66)	linear gilgai (4)				
(N) (N) (N)		hardwood plantation (4)			other (67)	lattice gilgai (5)				

LAND USE (1)	Identification Method (1)	HYDROLOGY	
		Profile Drainage (1)	Permeability (1)
national/state parks 01	personal assessment 01	very poorly drained 01	very slowly permeable 01
timber/scrub/unused 02	geology map 02	poorly drained 02	slowly permeable 02
logged native forest 03	both assessment & map 03	imperfectly drained 03	moderately permeable 03
hardwood plantation 04	Rock Outcrop % (1)	mod. well-drained 04	highly permeable 04
softwood plantation 05	nil 01 >20-30% 05	well-drained 05	
volun./native pasture 06	<2% 02 >30-50% 06	rapidly drained 06	
improved pasture 07	2-10% 03 >50% 07		
cropping 08	>10-20% 04		
orchard/vineyard 09			
vegetables/flowers 10			
urban 11			
industrial 12			
quarry/mining 13			
other 14			

SITE CONDITION		Surface Condition	
Site Disturbance(s) (2)	Ground Cover %	Current (2)	Expected
		Wet (2)	Dry (2)
natural disturbance 01		cracked 02	02
no effective disturbance 02		self-mulched 03	03
limited clearing 03	01 01	loose 04	04
extensive clearing 04	02 02	soft 05	05
cleared, no cultivation 05	03 03	firm 06	06
occasional cultivation 06	04 04	hardset 07	07
rainfed cultivation 07	05 05	surface crust 08	08
irrigated cultivation 08	06 06	trampled 09	09
highly disturbed 09	07 07	poached 10	10
	08 08	recently cultivated 11	
	09 09	water repellent 12	12
		gravelly 13	
		other 14	14

## SITE FIELD NOTES

Photo file name/s:

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4066



LAYER STATUS		COLOUR (Munsell, 1994)				Field pH	LAYER NOTES					Field pH Test Method (1)				
Lower	Horizon	Moist Munsell		Dry Munsell		(1 per layer)						Raupach (1) test strip (3) pH meter (2)				
1	(0) (0) (0) (0)	(2) (A) (0) (1) (1)	(2.5) (R) (6.5) (17) (0)	(2.5) (R) (6.5) (17) (0)	(0) (0) (0)	1						no effervescence (1) (1) (1) (1) (1) audible/slight efferv. (2) (2) (2) (2) (2) strong effervescence (3) (3) (3) (3) (3)				
	(1) (1) (1) (1)	(3) (B) (F) (2) (2)	(5) (YR) (B) (2) (1)	(5) (YR) (B) (2) (1)	(1) (1) (1)							Boundary Distinctiveness				
	(2) (2) (2) (2)	(4) (C) (0) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(2) (2) (2)							(1 per layer) 1 2 3 4 5				
	(3) (3) (3) (3)	(AB) (P)	(10) (N) (3) (3) (3)	(10) (N) (3) (3) (3)	(3) (3) (3)							not evident (1) (1) (1) (1) (1)				
	(4) (4) (4) (4)	(AC) (R)	(6Y) (4) (4) (4)	(6Y) (4) (4) (4)	(4) (4) (4)							sharp (<5 mm) (2) (2) (2) (2) (2)				
	(5) (5) (5) (5)	(BC)	(6) (5) (5) (5)	(6) (5) (5) (5)	(5) (5) (5)							abrupt (5-20 mm) (3) (3) (3) (3) (3)				
	(6) (6) (6) (6)		(6) (6) (6) (6)	(6) (6) (6) (6)	(6) (6) (6)							clear (20-50 mm) (4) (4) (4) (4) (4)				
	(7) (7) (7) (7)		(7) (7) (7) (7)	(7) (7) (7) (7)	(7) (7) (7)							gradual (50-100 mm) (5) (5) (5) (5) (5)				
	(8) (8) (8) (8)		(8) (8) (8) (8)	(8) (8) (8) (8)	(8) (8) (8)							diffuse (>100 mm) (6) (6) (6) (6) (6)				
2	(0) (0) (0) (0)	(2) (A) (0) (1) (1)	(2.5) (R) (6.5) (17) (0)	(2.5) (R) (6.5) (17) (0)	(0) (0) (0)	2						STRUCTURE				
	(1) (1) (1) (1)	(3) (B) (F) (2) (2)	(5) (YR) (B) (2) (1)	(5) (YR) (B) (2) (1)	(1) (1) (1)							Grade of Pedality (1) 1 2 3 4 5				
	(2) (2) (2) (2)	(4) (C) (0) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(2) (2) (2)							single-grained (1) (1) (1) (1) (1)				
	(3) (3) (3) (3)	(AB) (P)	(10) (N) (3) (3) (3)	(10) (N) (3) (3) (3)	(3) (3) (3)							massive (2) (2) (2) (2) (2)				
	(4) (4) (4) (4)	(AC) (R)	(6Y) (4) (4) (4)	(6Y) (4) (4) (4)	(4) (4) (4)							weak pedality (3) (3) (3) (3) (3)				
	(5) (5) (5) (5)	(BC)	(6) (5) (5) (5)	(6) (5) (5) (5)	(5) (5) (5)							moderate pedality (4) (4) (4) (4) (4)				
	(6) (6) (6) (6)		(6) (6) (6) (6)	(6) (6) (6) (6)	(6) (6) (6)							strong pedality (5) (5) (5) (5) (5)				
	(7) (7) (7) (7)		(7) (7) (7) (7)	(7) (7) (7) (7)	(7) (7) (7)							Fabric (1) 1 2 3 4 5				
	(8) (8) (8) (8)		(8) (8) (8) (8)	(8) (8) (8) (8)	(8) (8) (8)							sandy (1) (1) (1) (1) (1)				
3	(0) (0) (0) (0)	(2) (A) (0) (1) (1)	(2.5) (R) (6.5) (17) (0)	(2.5) (R) (6.5) (17) (0)	(0) (0) (0)	3						earthy (2) (2) (2) (2) (2)				
	(1) (1) (1) (1)	(3) (B) (F) (2) (2)	(5) (YR) (B) (2) (1)	(5) (YR) (B) (2) (1)	(1) (1) (1)							rough-faced peds (3) (3) (3) (3) (3)				
	(2) (2) (2) (2)	(4) (C) (0) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(2) (2) (2)							smooth-faced peds (4) (4) (4) (4) (4)				
	(3) (3) (3) (3)	(AB) (P)	(10) (N) (3) (3) (3)	(10) (N) (3) (3) (3)	(3) (3) (3)							Dominant (1) 1 2 3 4 5				
	(4) (4) (4) (4)	(AC) (R)	(6Y) (4) (4) (4)	(6Y) (4) (4) (4)	(4) (4) (4)							Ped Shape				
	(5) (5) (5) (5)	(BC)	(6) (5) (5) (5)	(6) (5) (5) (5)	(5) (5) (5)							Sub-dominant (1) 1 2 3 4 5				
	(6) (6) (6) (6)		(6) (6) (6) (6)	(6) (6) (6) (6)	(6) (6) (6)							platy (1) (1) (1) (1) (1)				
	(7) (7) (7) (7)		(7) (7) (7) (7)	(7) (7) (7) (7)	(7) (7) (7)							lenticular (2) (2) (2) (2) (2)				
	(8) (8) (8) (8)		(8) (8) (8) (8)	(8) (8) (8) (8)	(8) (8) (8)							prismatic (3) (3) (3) (3) (3)				
4	(0) (0) (0) (0)	(2) (A) (0) (1) (1)	(2.5) (R) (6.5) (17) (0)	(2.5) (R) (6.5) (17) (0)	(0) (0) (0)	4						columnar (4) (4) (4) (4) (4)				
	(1) (1) (1) (1)	(3) (B) (F) (2) (2)	(5) (YR) (B) (2) (1)	(5) (YR) (B) (2) (1)	(1) (1) (1)							angular blocky (5) (5) (5) (5) (5)				
	(2) (2) (2) (2)	(4) (C) (0) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(2) (2) (2)							sub-ang. blocky (6) (6) (6) (6) (6)				
	(3) (3) (3) (3)	(AB) (P)	(10) (N) (3) (3) (3)	(10) (N) (3) (3) (3)	(3) (3) (3)							polyhedral (7) (7) (7) (7) (7)				
	(4) (4) (4) (4)	(AC) (R)	(6Y) (4) (4) (4)	(6Y) (4) (4) (4)	(4) (4) (4)							granular (8) (8) (8) (8) (8)				
	(5) (5) (5) (5)	(BC)	(6) (5) (5) (5)	(6) (5) (5) (5)	(5) (5) (5)							crumb (9) (9) (9) (9) (9)				
	(6) (6) (6) (6)		(6) (6) (6) (6)	(6) (6) (6) (6)	(6) (6) (6)							round (10) (10) (10) (10) (10)				
	(7) (7) (7) (7)		(7) (7) (7) (7)	(7) (7) (7) (7)	(7) (7) (7)							Dominant (1) 1 2 3 4 5				
	(8) (8) (8) (8)		(8) (8) (8) (8)	(8) (8) (8) (8)	(8) (8) (8)							Ped Size				
5	(0) (0) (0) (0)	(2) (A) (0) (1) (1)	(2.5) (R) (6.5) (17) (0)	(2.5) (R) (6.5) (17) (0)	(0) (0) (0)	5						Sub-dominant (1) 1 2 3 4 5				
	(1) (1) (1) (1)	(3) (B) (F) (2) (2)	(5) (YR) (B) (2) (1)	(5) (YR) (B) (2) (1)	(1) (1) (1)							<2 mm (1) (1) (1) (1) (1)				
	(2) (2) (2) (2)	(4) (C) (0) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(2) (2) (2)							2-5 mm (2) (2) (2) (2) (2)				
	(3) (3) (3) (3)	(AB) (P)	(10) (N) (3) (3) (3)	(10) (N) (3) (3) (3)	(3) (3) (3)							5-10 mm (3) (3) (3) (3) (3)				
	(4) (4) (4) (4)	(AC) (R)	(6Y) (4) (4) (4)	(6Y) (4) (4) (4)	(4) (4) (4)							10-20 mm (4) (4) (4) (4) (4)				
	(5) (5) (5) (5)	(BC)	(6) (5) (5) (5)	(6) (5) (5) (5)	(5) (5) (5)							20-50 mm (5) (5) (5) (5) (5)				
	(6) (6) (6) (6)		(6) (6) (6) (6)	(6) (6) (6) (6)	(6) (6) (6)							50-100 mm (6) (6) (6) (6) (6)				
	(7) (7) (7) (7)		(7) (7) (7) (7)	(7) (7) (7) (7)	(7) (7) (7)							100-200 mm (7) (7) (7) (7) (7)				
	(8) (8) (8) (8)		(8) (8) (8) (8)	(8) (8) (8) (8)	(8) (8) (8)							200-500 mm (8) (8) (8) (8) (8)				
SUBSTRATE	(0) (0) (0) (0)	(2) (A) (0) (1) (1)	(2.5) (R) (6.5) (17) (0)	(2.5) (R) (6.5) (17) (0)	(0) (0) (0)	5						> 500 mm (9) (9) (9) (9) (9)				
	(1) (1) (1) (1)	(3) (B) (F) (2) (2)	(5) (YR) (B) (2) (1)	(5) (YR) (B) (2) (1)	(1) (1) (1)							SEGREGATIONS				
	(2) (2) (2) (2)	(4) (C) (0) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(2) (2) (2)							Type (1 per layer) 1 2 3 4 5				
	(3) (3) (3) (3)	(AB) (P)	(10) (N) (3) (3) (3)	(10) (N) (3) (3) (3)	(3) (3) (3)							not evident (1) (1) (1) (1) (1)				
	(4) (4) (4) (4)	(AC) (R)	(6Y) (4) (4) (4)	(6Y) (4) (4) (4)	(4) (4) (4)							calcareous (2) (2) (2) (2) (2)				
	(5) (5) (5) (5)	(BC)	(6) (5) (5) (5)	(6) (5) (5) (5)	(5) (5) (5)							gypseous (3) (3) (3) (3) (3)				
	(6) (6) (6) (6)		(6) (6) (6) (6)	(6) (6) (6) (6)	(6) (6) (6)							manganiferous (4) (4) (4) (4) (4)				
	(7) (7) (7) (7)		(7) (7) (7) (7)	(7) (7) (7) (7)	(7) (7) (7)							ferruginous (5) (5) (5) (5) (5)				
	(8) (8) (8) (8)		(8) (8) (8) (8)	(8) (8) (8) (8)	(8) (8) (8)							ferromanganiferous (6) (6) (6) (6) (6)				
ESTIMATED EFFECTIVE ROOTING DEPTH (m)	(0) (0) (0) (0)	(2) (A) (0) (1) (1)	(2.5) (R) (6.5) (17) (0)	(2.5) (R) (6.5) (17) (0)	(0) (0) (0)	5						organic (7) (7) (7) (7) (7)				
	(1) (1) (1) (1)	(3) (B) (F) (2) (2)	(5) (YR) (B) (2) (1)	(5) (YR) (B) (2) (1)	(1) (1) (1)							not identified (8) (8) (8) (8) (8)				
	(2) (2) (2) (2)	(4) (C) (0) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(2) (2) (2)							other (9) (9) (9) (9) (9)				
	(3) (3) (3) (3)	(AB) (P)	(10) (N) (3) (3) (3)	(10) (N) (3) (3) (3)	(3) (3) (3)							Amount (1 per layer) 1 2 3 4 5				
	(4) (4) (4) (4)	(AC) (R)	(6Y) (4) (4) (4)	(6Y) (4) (4) (4)	(4) (4) (4)							none (1) (1) (1) (1) (1)				
	(5) (5) (5) (5)	(BC)	(6) (5) (5) (5)	(6) (5) (5) (5)	(5) (5) (5)							very few (<2%) (2) (2) (2) (2) (2)				
	(6) (6) (6) (6)		(6) (6) (6) (6)	(6) (6) (6) (6)	(6) (6) (6)							few (2-10%) (3) (3) (3) (3) (3)				
	(7) (7) (7) (7)		(7) (7) (7) (7)	(7) (7) (7) (7)	(7) (7) (7)							common (10-20%) (4) (4) (4) (4) (4)				
	(8) (8) (8) (8)		(8) (8) (8) (8)	(8) (8) (8) (8)	(8) (8) (8)							many (20-50%) (5) (5) (5) (5) (5)				
DOMINANT (1)	(0) (0) (0) (0)	(2) (A) (0) (1) (1)	(2.5) (R) (6.5) (17) (0)	(2.5) (R) (6.5) (17) (0)	(0) (0) (0)	5						abundant (>50%) (6) (6) (6) (6) (6)				
	(1) (1) (1) (1)	(3) (B) (F) (2) (2)	(5) (YR) (B) (2) (1)	(5) (YR) (B) (2) (1)	(1) (1) (1)							Strength (1 per layer) 1 2 3 4 5				
	(2) (2) (2) (2)	(4) (C) (0) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(2) (2) (2)							weak (1) (1) (1) (1) (1)				
	(3) (3) (3) (3)	(AB) (P)	(10) (N) (3) (3) (3)	(10) (N) (3) (3) (3)	(3) (3) (3)							strong (2) (2) (2) (2) (2)				
	(4) (4) (4) (4)	(AC) (R)	(6Y) (4) (4) (4)	(6Y) (4) (4) (4)	(4) (4) (4)							Form (1 per layer) 1 2 3 4 5				
	(5) (5) (5) (5)	(BC)	(6) (5) (5) (5)	(6) (5) (5) (5)	(5) (5) (5)							soft segregations (1) (1) (1) (1) (1)				
	(6) (6) (6) (6)		(6) (6) (6) (6)	(6) (6) (6) (6)	(6) (6) (6)							nodules (2) (2) (2) (2) (2)				
	(7) (7) (7) (7)		(7) (7) (7) (7)	(7) (7) (7) (7)	(7) (7) (7)							fragments (3) (3) (3) (3) (3)				
	(8) (8) (8) (8)		(8) (8) (8) (8)	(8) (8) (8) (8)	(8) (8) (8)							crystals (4) (4) (4) (4) (4)				
MOTTLES	(0) (0) (0) (0)	(2) (A) (0) (1) (1)	(2.5) (R) (6.5) (17) (0)	(2.5) (R) (6.5) (17) (0)	(0) (0) (0)	5						veins (5) (5) (5) (5) (5)				
	(1) (1) (1) (1)	(3) (B) (F) (2) (2)	(5) (YR) (B) (2) (1)	(5) (YR) (B) (2) (1)	(1) (1) (1)							concretions (6) (6) (6) (6) (6)				
	(2) (2) (2) (2)	(4) (C) (0) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(2) (2) (2)							root linings (7) (7) (7) (7) (7)				
	(3) (3) (3) (3)	(AB) (P)	(10) (N) (3) (3) (3)	(10) (N) (3) (3) (3)	(3) (3) (3)							tubules (8) (8) (8) (8) (8)				
	(4) (4) (4) (4)	(AC) (R)	(6Y) (4) (4) (4)	(6Y) (4) (4) (4)	(4) (4) (4)							Size (1 per layer) 1 2 3 4 5				
	(5) (5) (5) (5)	(BC)	(6) (5) (5) (5)	(6) (5) (5) (5)	(5) (5) (5)							fine gravel (2-6 mm) (1) (1) (1) (1) (1)				
	(6) (6) (6) (6)		(6) (6) (6) (6)	(6) (6) (6) (6)	(6) (6) (6)							gravel (6-20 mm) (2) (2) (2) (2) (2)				
	(7) (7) (7) (7)		(7) (7) (7) (7)	(7) (7) (7) (7)	(7) (7) (7)							coarse gravel (20-60 mm) (3) (3) (3) (3) (3)				
	(8) (8) (8) (8)		(8) (8) (8) (8)	(8) (8) (8) (8)	(8) (8) (8)							cobbles (60-200 mm) (4) (4) (4) (4) (4)				
ABUNDANCE	(0) (0) (0) (0)	(2) (A) (0) (1) (1)	(2.5) (R) (6.5) (17) (0)	(2.5) (R) (6.5) (17) (0)	(0) (0) (0)	5						stones (200-600 mm) (5) (5) (5) (5) (5)				
	(1) (1) (1) (1)	(3) (B) (F) (2) (2)	(5) (YR) (B) (2) (1)	(5) (YR) (B) (2) (1)	(1) (1) (1)							boulders (>600 mm) (6) (6) (6) (6) (6)				
	(2) (2) (2) (2)	(4) (C) (0) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(2) (2) (2)							ext coarse (>60 mm) (5) (5) (5) (5) (5)				
	(3) (3) (3) (3)	(AB) (P)	(10) (N) (3) (3) (3)	(10) (N) (3) (3) (3)	(3) (3) (3)							Size (1 per layer) 1 2 3 4 5				
	(4) (4) (4) (4)	(AC) (R)	(6Y) (4) (4) (4)	(6Y) (4) (4) (4)	(4) (4) (4)							fine (<2 mm) (1) (1) (1) (1) (1)				
	(5) (5) (5) (5)	(BC)	(6) (5) (5) (5)	(6) (5) (5) (5)	(5) (5) (5)							medium (2-6 mm) (2) (2) (2) (2) (2)				
	(6) (6) (6) (6)		(6) (6) (6) (6)	(6) (6) (6) (6)	(6) (6) (6)							coarse (6-20 mm) (3) (3) (3) (3) (3)				
	(7) (7) (7) (7)		(7) (7) (7) (7)	(7) (7) (7) (7)	(7) (7) (7)							v coarse (20-60 mm) (4) (4) (4) (4) (4)				
	(8) (8) (8) (8)		(8) (8) (8) (8)	(8) (8) (8) (8)	(8) (8) (8)							ext coarse (>60 mm) (5) (5) (5) (5) (5)				
COLOUR	(0) (0) (0) (0)	(2) (A) (0) (1) (1)	(2.5) (R) (6.5) (17) (0)	(2.5) (R) (6.5) (17) (0)	(0) (0) (0)	5						Sand Fraction 1 2 3 4 5				
	(1) (1) (1) (1)	(3) (B) (F) (2) (2)	(5) (YR) (B) (2) (1)	(5) (YR) (B) (2) (1)	(1) (1) (1)							coarse (1) (1) (1) (1) (1)				
	(2) (2) (2) (2)	(4) (C) (0) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(2) (2) (2)							fine (2) (2) (2) (2) (2)				
	(3) (3) (3) (3)	(AB) (P)	(10) (N) (3) (3) (3)	(10) (N) (3) (3) (3)	(3) (3) (3)							Clay Fraction 1 2 3 4 5				
	(4) (4) (4) (4)	(AC) (R)	(6Y) (4) (4) (4)	(6Y) (4) (4) (4)	(4) (4) (4)							light (1) (1) (1) (1) (1)				
	(5) (5) (5) (5)	(BC)	(6) (5) (5) (5)	(6) (5) (5) (5)	(5) (5) (5)							light medium (2) (2) (2) (2) (2)				
	(6) (6) (6) (6)		(6) (6) (6) (6)	(6) (6) (6) (6)	(6) (6) (6)							medium (3) (3) (3) (3) (3)				
	(7) (7) (7) (7)		(7) (7) (7) (7)	(7) (7) (7) (7)	(7) (7) (7)							medium heavy (4) (4) (4) (4) (4)				
	(8) (8) (8) (8)		(8) (8) (8) (8)	(8) (8) (8) (8)	(8) (8) (8)							heavy (5) (5) (5) (5) (5)				
CONTRAST	(0) (0) (0) (0)	(2) (A) (0) (1) (1)	(2.5) (R) (6.5) (17) (0)	(2.5) (R) (6.5) (17) (0)	(0) (0) (0)	5						Texture (1 each per layer)				
	(1) (1) (1) (1)	(3) (B) (F) (2) (2)	(5) (YR) (B) (2) (1)	(5) (YR) (B) (2) (1)	(1) (1) (1)							Texture Grade 1 2 3 4 5				
	(2) (2) (2) (2)	(4) (C) (0) (3) (3)	(7.5) (Y) (P) (2.5) (2)	(7.5) (Y) (P) (2.5) (2)	(2) (2) (2)							sand (1) (1) (1) (1) (1)				
	(3) (3) (3) (3)	(AB) (P)	(10) (N) (3) (3) (3)	(10) (N) (3) (3) (3)	(3) (3) (3)							loamy sand (2) (2) (2) (2) (2)				
	(4) (4) (4) (4)	(AC) (R)	(6Y) (4) (4) (4)	(6Y) (4) (4) (4)	(4) (4) (4)							clayey sand (3) (3) (3) (3) (3)				
	(5) (5) (5) (5)	(BC)	(6) (5) (5) (5)	(6) (5) (5) (5)	(5) (5) (5)							sandy loam (4) (4) (4) (4) (4)				
	(6) (6) (6) (6)		(6) (6) (6) (6)	(6) (6) (6) (												



SURVEY TITLE: WARKWORTH

SITE LOCATION: D.S.C.

NSW SOIL  
AND LAND  
INFORMATION  
SYSTEMPlease MARK  
LIKE THIS ONLY:

- Use 2B pencil
- No pen or biro
- Fully erase mistakes
- Make no stray marks
- Numbers in ( ) show max. entries allowed

PROFILE MAP DETAILS				SURVEY DETAILS			
Profile No.	Map Sheet No.	Eastings	Northings	Described By	Profile Date	Photo Taken (1)	No. of Layers
01	01	01	01	01	01	01	01
02	02	02	02	02	02	02	02
03	03	03	03	03	03	03	03
04	04	04	04	04	04	04	04
05	05	05	05	05	05	05	05
06	06	06	06	06	06	06	06
07	07	07	07	07	07	07	07
08	08	08	08	08	08	08	08
09	09	09	09	09	09	09	09

Potential BSAL? (1)	Site type (1)
yes <input type="checkbox"/> no <input type="checkbox"/>	checked <input type="checkbox"/> detailed <input type="checkbox"/> exclusion <input type="checkbox"/>

BIOPHYSICAL STRATEGIC AGRICULTURAL  
LAND SOIL DATA CARD

SOIL TYPE	VEGETATION	LANDFORM ELEMENT (1)										
A.S.C.	Vegetation Community (1)	alcove (43)	cone (3)	footslope (21)	ox-bow (57)	sink hole/doline (52)						
O	unknown (1)	backplain (31)	crater (51)	foredune (12)	pan/playa (56)	stream channel (46)						
SO	rainforest (2)	bank (25)	cut face (28)	gully (42)	pediment (22)	streambed (45)						
GG	wet sclerophyll forest (3)	bar (6)	cut-over surface (39)	hillcrest (1)	pit (60)	summit surface (2)						
SG	dry sclerophyll forest (4)	beach (26)	dam (16)	hillslope (6)	plain (30)	swale (47)						
	woodland grass u'storey (5)	beach ridge (7)	drainage depression (41)	lagoon (54)	prior stream (9)	swamp (58)						
	woodland shrub u'storey (6)	bench (19)	dune (11)	lake (55)	rock flat (34)	talus (23)						
	tall shrubland (7)	berm (29)	embankment (14)	landslide (20)	rock platform (35)	tidal creek (48)						
	low shrubland (8)	blow-out (59)	estuary (44)	levee (8)	scald (36)	tidal flat (37)						
	heath (9)	channel bench (33)	fan (27)	lunette (13)	scarp (18)	tor (4)						
	grassland/herbland (10)	cirque (50)	fill top (40)	maar (53)	scree (24)	trench (49)						
	swamp complex (11)	cliff (5)	flood-out (32)	mound (15)	scroll (10)	valley flat (38)						
	littoral complex (12)											
	no vegetation (13)											
FAMILY	Growth Forms (4)											
C	tree (1)	not identified (1)	limestone (23)	coarse-basic (45)								
	tree mallee (2)	unconsolidated (2)	tuff (24)	fine-acidic (46)								
	shrub (3)	gravel (3)	breccia (25)	fine-intermediate (47)								
	mallee shrub (4)	sand (4)	greywacke (26)	fine-basic (48)								
	heath shrub (5)	silt (5)	arkose (27)	serpentine (49)								
G.S.G.	chenopod shrub (6)	clay (6)	dolomite (28)	gabbro (50)								
	hummock grass (7)	organic material (7)	calcrete (29)	dolerite (51)								
	tussock grass (8)	alluvium (8)	aeolianite (30)	diorite (52)								
	sod grass (9)	colluvium (9)	chert (31)	syenite (53)								
	sedge (10)	lacustrine (10)	jasper (32)	granodiorite (54)								
	rush (11)	aeolian (11)	metamorphic (33)	adamellite (55)								
	fern/cycad (12)	marine (12)	gneiss (34)	granite (56)								
	moss (13)	calcareous sand (13)	schist/phyllite (35)	aplite (57)								
	lichen (14)	fill (14)	slate (36)	quartz porphyry (58)								
	liverwort (15)	mud (15)	hornfels (37)	basalt (59)								
	vine (16)	till (16)	quartzite (38)	andesite (60)								
		sedimentary (17)	greenstone (39)	trachyte (61)								
		shale (18)	amphibolite (40)	rhyolite (62)								
		siltstone/mudstone (19)	marble (41)	obsidian (63)								
		sandstone-quartz (20)	igneous (42)	scoria (64)								
		sandstone-lithic (21)	coarse-acidic (43)	ash (65)								
		conglomerate (22)	coarse-intermediate (44)	agglomerate (66)								
				other (67)								

LITHOLOGY										TOPOGRAPHY									
Substrate (3)										Slope Percent					Site Morphology (1)				
										01 01 01					flat (1)				
										02 02 02					crest (2)				
										03 03 03					hillock (3)				
										04 04 04					ridge (4)				
										05 05 05					upper slope (5)				
										06 06 06					midslope (6)				
										07 07 07					simple slope (7)				
										08 08 08					lower slope (8)				
										09 09 09					open depression (9)				
										10 10 10					closed depression (10)				

LAND USE (1)										HYDROLOGY									
										Profile Drainage (1)					Permeability (1)				
										very poorly drained (1)					very slowly permeable (1)				
										poorly drained (2)					slowly permeable (2)				
										imperfectly drained (3)					moderately permeable (3)				
										mod. well-drained (4)					highly permeable (4)				
										well-drained (5)									
										rapidly drained (6)									

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										well-drained (5)									
										rapidly drained (6)									

SITE CONDITION										Surface Condition									
										Current (2)					Expected				
															Wet (2) Dry (2)				
										cracked (2)					(2) (2)				
										self-mulched (3)					(3) (3)				
										loose (4)					(4) (4)				
										soft (5)					(5) (5)				
										firm (6)					(6) (6)				
										hardset (7)					(7) (7)				
										surface crust (8)					(8) (8)				
										trampled (9)					(9) (9)				
										poached (10)					(10) (10)				
										recently cultivated (11)					(11) (11)				
										water repellent (12)					(12) (12)				
										gravelly (13)					(13) (13)				
										other (14)					(14) (14)				

SITE CONDITION										Surface Condition									
										Current (2)					Expected				
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										loose (4)					(4) (4)				
										soft (5)					(5) (5)				
										firm (6)					(6) (6)				
										hardset (7)					(7) (7)				
										surface crust (8)					(8) (8)				
										trampled (9)					(9) (9)				
										poached (10)					(10) (10)				
										recently cultivated (11)					(11) (11)				
										water repellent (12)					(12) (12)				
										gravelly (13)					(13) (13)				
										other (14)					(14) (14)				

Please do not mark this space.

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LAYER STATUS		COLOUR (Munsell, 1994)		Field pH	LAYER NOTES		Field pH Test Method (1)	
Lower	Horizon	Moist Munsell	Dry Munsell	(1 per layer)	1		Raupach (1) test strip (3)	
1	1	2.5	2.5	10	1		pH meter (2)	
2	2	5	5	10	2			
3	3	7.5	7.5	10	3			
4	4	10	10	10	4			
5	5	10	10	10	5			
6	6	10	10	10	6			
7	7	10	10	10	7			
8	8	10	10	10	8			
9	9	10	10	10	9			
10	10	10	10	10	10			
11	11	10	10	10	11			
12	12	10	10	10	12			
13	13	10	10	10	13			
14	14	10	10	10	14			
15	15	10	10	10	15			
16	16	10	10	10	16			
17	17	10	10	10	17			
18	18	10	10	10	18			
19	19	10	10	10	19			
20	20	10	10	10	20			
21	21	10	10	10	21			
22	22	10	10	10	22			
23	23	10	10	10	23			
24	24	10	10	10	24			
25	25	10	10	10	25			
26	26	10	10	10	26			
27	27	10	10	10	27			
28	28	10	10	10	28			
29	29	10	10	10	29			

STRUCTURE		Fabric (1)	
Grade of Pedality (1)	1 2 3 4 5	1 2 3 4 5	
single-grained	1	1	1
massive	2	2	2
weak pedality	3	3	3
moderate pedality	4	4	4
strong pedality	5	5	5

Ped Shape		Sub-dominant (1)	
1 2 3 4 5		1 2 3 4 5	
platy	1	1	1
lenticular	2	2	2
prismatic	3	3	3
columnar	4	4	4
angular blocky	5	5	5
sub-ang. blocky	6	6	6
polyhedral	7	7	7
granular	8	8	8
crumb	9	9	9
round	10	10	10

Ped Size		Sub-dominant (1)	
1 2 3 4 5		1 2 3 4 5	
<2 mm	1	1	1
2-5 mm	2	2	2
5-10 mm	3	3	3
10-20 mm	4	4	4
20-50 mm	5	5	5
50-100 mm	6	6	6
100-200 mm	7	7	7
200-500 mm	8	8	8
> 500 mm	9	9	9

SEGREGATIONS		Soil Water Status (1 each per layer)	
Type (1 per layer)	1 2 3 4 5	1 2 3 4 5	
not evident	1	1	1
calcareous	2	2	2
gypseous	3	3	3
manganiferous	4	4	4
ferruginous	5	5	5
ferromanganiferous	6	6	6
organic	7	7	7
not identified	8	8	8
other	9	9	9

TEXTURE		Texture Grade	
(1 each per layer)	1 2 3 4 5	1 2 3 4 5	
sand	1	1	1
loamy sand	2	2	2
clayey sand	3	3	3
sandy loam	4	4	4
loam	5	5	5
silty loam	6	6	6
sandy clay loam	7	7	7
clay loam	8	8	8
clay loam sandy	9	9	9
silty clay loam	10	10	10
sandy clay	11	11	11
silty clay	12	12	12
clay	13	13	13

Form (1 per layer)		Amount (1 per layer)	
1 2 3 4 5		1 2 3 4 5	
soft segregations	1	1	1
nodules	2	2	2
fragments	3	3	3
crystals	4	4	4
veins	5	5	5
concretions	6	6	6
root linings	7	7	7
tubules	8	8	8

Size (1 per layer)		Amount (1 per layer)	
1 2 3 4 5		1 2 3 4 5	
fine (<2 mm)	1	1	1
medium (2-6 mm)	2	2	2
coarse (6-20 mm)	3	3	3
v coarse (20-60 mm)	4	4	4
ext coarse (>60 mm)	5	5	5

COARSE FRAGMENTS		Type (1 per layer)	
1 2 3 4 5		1 2 3 4 5	
not evident	1	1	1
not identified	2	2	2
as substrate	3	3	3
as rock outcrop	4	4	4
as parent material	5	5	5
quartz	6	6	6
feldspar	7	7	7
silcrete	8	8	8
ironstone	9	9	9
bauxite	10	10	10
shells	11	11	11
charcoal	12	12	12
pumice	13	13	13
opalised wood	14	14	14
other	15	15	15

MOTTLES		Sub-dominant (1)	
1 2 3 4 5		1 2 3 4 5	
not evident	1	1	1
<2%	2	2	2
2-10%	3	3	3
10-20%	4	4	4
20-50%	5	5	5

COLOUR		Contrast	
1 2 3 4 5		1 2 3 4 5	
dark	1	1	1
red	2	2	2
orange	3	3	3
yellow	4	4	4
brown	5	5	5
pale	6	6	6
grey	7	7	7
grey	8	8	8

Base of Observation (1)		Sample Taken	
1 2 3 4 5		1 2 3 4 5	
layer continues	1	1	1
soil continues	2	2	2
equipment refusal	3	3	3
bedrock reached	4	4	4

Estimated Effective Rooting Depth (m)		Sample Taken	
1 2 3 4 5		1 2 3 4 5	
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5

SUBSTRATE		Type (1 per layer)	
1 2 3 4 5		1 2 3 4 5	
not evident	1	1	1
undisturbed	2	2	2
disturbed	3	3	3
bulk density	4	4	4
bulk density	5	5	5