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BSAL Site Verification Assessment Drayton South Coal Project

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BSAL Site Verification Assessment

Drayton South Coal Project

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DOCUMENT CONTROL

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1 INTRODUCTION

Hansen Bailey on behalf of Anglo American Pty Limited has engaged SLR Consulting Australia Pty Ltd (SLR) to undertake a Biophysical Strategic Agricultural Land (BSAL) Site Verification Assessment for the Drayton South Coal Project (the Project). The Project is located 10 km north west of the village of Jerrys Plains and approximately 13 km south of the township of Muswellbrook in the Upper Hunter Valley of NSW (**Figure 1**).

This report has been conducted in accordance with *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land* (Interim Protocol) ((Office of Environment & Heritage (OEH) and Department of Primary Industries - Office of Agricultural Sustainability and Food Security (DPI-OASFS), 2013)) and is intended to determine whether the land proposed to be disturbed by the Project is BSAL.

1.1 Study Area

The Study Area for this BSAL Site Verification Assessment was a total of 1,470.9 hectares (ha) of land within Exploration Lease (EL) 5460 as shown on **Figure 1**. This included the land proposed to be subject to high-intensity disturbance activities such as open-cut mining, overburden emplacement areas, mine infrastructure and haul roads as well as non-disturbed land assessed as a 100 m buffer in accordance with the Interim Protocol (**Figure 1**).

1.2 Legislation and Standards

1.2.1 Interim Protocol for Site Verification and Mapping of BSAL

In April 2013, the Interim Protocol was released by the NSW Government. This Interim Protocol outlines the process for seeking verification of whether or not land mapped as BSAL meets the Interim Protocol's BSAL criteria. The State Environment Planning Policy (mining, Petroleum Production and Extractive Industries) Amendment 2013 (the 2013 Mining SEPP amendment) requires certain types of developments to verify whether the proposed site is on BSAL.

The purpose of the Interim Protocol is to assist proponents and landholders to understand what is required to identify the existence of BSAL and outlines the technical requirements for the on-site identification and mapping of BSAL.

1.3 Assessment Standards

The key standards for this assessment include:

- Interim Protocol
- Australian Soil Classification (ASC) system (Isbell, 1996).
- Guidelines for Surveying Soil and Land Resources (NCST, 2008).
- Australian Soil and Land Survey Field Handbook (NCST, 2009).

1.4 Interim Protocol Checklist

The BSAL assessment has been conducted in accordance with the Interim Protocol and other relevant guidelines. This checklist is provided in **Table 1** along with the relevant references to the sections of this report where the information may be found.

Table 1 Interim Protocol Checklist

Checklist Item	Addressed in Section of Report
Ensure that:	
a qualified soil scientist is overseeing the verification assessment and has signed off on the quality and extent of the work;	Section 2.5
laboratories for soil samples are compliant with AS ISO/IEC17025;	Appendix B
results within 15 per cent of threshold levels are analysed in a laboratory;	Appendix B
reporting requirements for site verification criteria as described in Appendix 1;	Section 3 and Section 4
three 1:25,000 maps showing: base level information; soil types and BSAL;	Appendix A
Laboratory report.	Appendix B

2 METHODOLOGY

The site verification and methodology for the Study Area reported in the following sections has been undertaken based on the Interim Protocol; including the following steps:

1. Identify the project area which will be assessed for BSAL;
2. Confirm access to a reliable water supply;
3. Choose the appropriate approach to map the soils information;
4. Risk assessment; and
5. Field Soil Survey and BSAL Assessment.

2.1 Step 1: Identify the project area which will be assessed for BSAL

The Interim Protocol requires that:

"The assessment area should include the entire project area and include at least a 100 m buffer to take into account minor changes in design, surrounding disturbance and minor expansion. If BSAL is part of a larger contiguous mass of BSAL then the boundary of this area must also be identified."

The Study Area for this BSAL Site Verification Assessment as shown on **Figure 1** was 1,470.9 ha of land within EL 5460 and included a 100 m buffer from any disturbance area.

2.2 Step 2: Confirm access to a reliable water supply

The Interim Protocol requires that:

"BSAL lands must have access to a reliable water supply."

Representative rainfall data for the Study Area has been obtained from the nearest Bureau of Meteorology (BOM) weather station located at Jerrys Plains. The Jerrys Plains Post Office BOM Station (No. 061086) has recorded an average annual rainfall of 645.9 mm (based on records from 1884 – present); therefore the Study Area meets the minimum average annual rainfall of 350 mm to have access to reliable water supply.

2.3 Step 3: Choose the appropriate approach to map the soils information

The Interim Protocol states that:

"Access to the project area will define the level of investigation that the proponent can undertake. If the proponent has access to the land then the BSAL verification requirements for on-site soils assessment as described in sections 6 and 9 of the Interim Protocol should be met. If the proponent does not have access then the proponent should develop a model of soils distribution guided by sections 6 and 9 based on landscape characteristics using the information listed in Section 5 of the Interim Protocol."

The Proponent has full access to the Study Area required for the site verification of BSAL as they own all of the land.

2.4 Step 4: Risk assessment

The Interim Protocol states that:

“The proponent should undertake a risk assessment as this will influence the density of soil sampling required as explained in Section 9.6.1. The proposed activity on parts or all of the project area may be of low risk to agriculture and so may only require a sampling density of 1:100 000. Alternatively other areas may be at higher risk of impact and so should have a sampling density of 1:25 000.”

The Project consists of proposed open cut mining activities and overburden emplacement areas. SLR has assessed the following potential impacts of the project activities within the Study Area on agriculture:

- Consequence: Level 2 – Significant and / or long term damage; Long term management implications. Impacts difficult or impractical to reverse.
- Probability: A – Almost Certain. Common or repeating occurrence.

The risk matrix result was A2 which is considered a high risk. The Study Area therefore required an inspection density of 1:25,000 which needed a minimum observation site every 25 ha.

For the purpose of this survey the 100m buffer area is also considered to require an inspection density of 1:25,000.

2.5 Step 5: Field Soil Survey and BSAL Assessment

John Lawrie (CPSS 3) undertook the fieldwork and sampling with assistance from SLR staff. Adele Calandra (CPSS 2) was responsible for technical review with assistance from appropriate SLR staff.

2.6 Field Soil Survey Methodology

For soil to be classified as BSAL it must follow the criteria outlined in the flow chart shown in **Diagram 1**. If any criteria is not met (except step 5 or step 6), the site is not BSAL and there is no need to continue the assessment. The design of the soil survey was developed following a process of applying the BSAL methodology as a desktop exercise to identify any areas that would obviously not meet the criteria. The field survey program was then developed to ensure that areas of relatively higher likelihood of meeting BSAL criteria were targeted for field analysis.

2.6.1 Exclusion Zones

Initially, land greater than 10% slope (**Figure 2**) within the Study Area was identified using topographical data from the LIDAR survey collected in 2011. Areas with slope greater than 10% slope were excluded.

Following exclusion by slope, areas of land less than 20 ha were excluded from the Study Area. To ensure a conservative approach was applied, an Area of Consideration was included in the slope analysis. This ensured that land contiguous to the Study Area was included when classifying areas of land to be less than 20 ha.

In total 433.1 ha was determined not to meet the BSAL methodology criteria within the Study Area. This included 402.2 ha of land with slope greater than 10% and 30.9 ha of land less than 20 ha contiguous. This reduced the land to be assessed by the field soil survey program to 1,037.8 ha. (**Table 2; Figure 3**).

2.6.2 Soil Survey Density

To satisfy the Interim Protocol requirements, the field soil survey program was comprised of 61 observations which consisted of 47 detailed sites and 14 check sites (**Figure 5**).

Table 2 Soil Survey Density

Land Area	Area (ha)	Survey Density	Survey Sites Required	Survey Sites Completed
<10% slope	1,037.8	1 site per 25 ha	42	61
Exclusion Zone >10% Slope	402.2	N/A	-	-
Exclusion Zone <20 ha contiguous	30.9	N/A	-	-
Total	1,470.9	-	42	61

2.6.3 Soil Survey Observation Types

Detailed Sites

Soil profiles were assessed in accordance with the *Australian Soil and Land Survey Field Handbook* (NCST, 2009). Each soil-profile exposure was excavated by a soil corer (8 sites) or backhoe (53 sites) to a depth of 1.2 m, equipment refusal or to bedrock. After assessment, soil cores or pits were backfilled with the remaining soil. Detailed soil profile morphological descriptions recorded information that covered the parameters specified in the Interim Protocol.

Samples were sent to the Scone Research Centre (NSW, Australia) and ALS Brisbane (QLD, Australia) for analysis for the suite of parameters as listed in **Table 3**. These laboratories are National Association of Testing Authority (NATA) accredited.

Table 3 BSAL Soil Laboratory Analysis Parameters

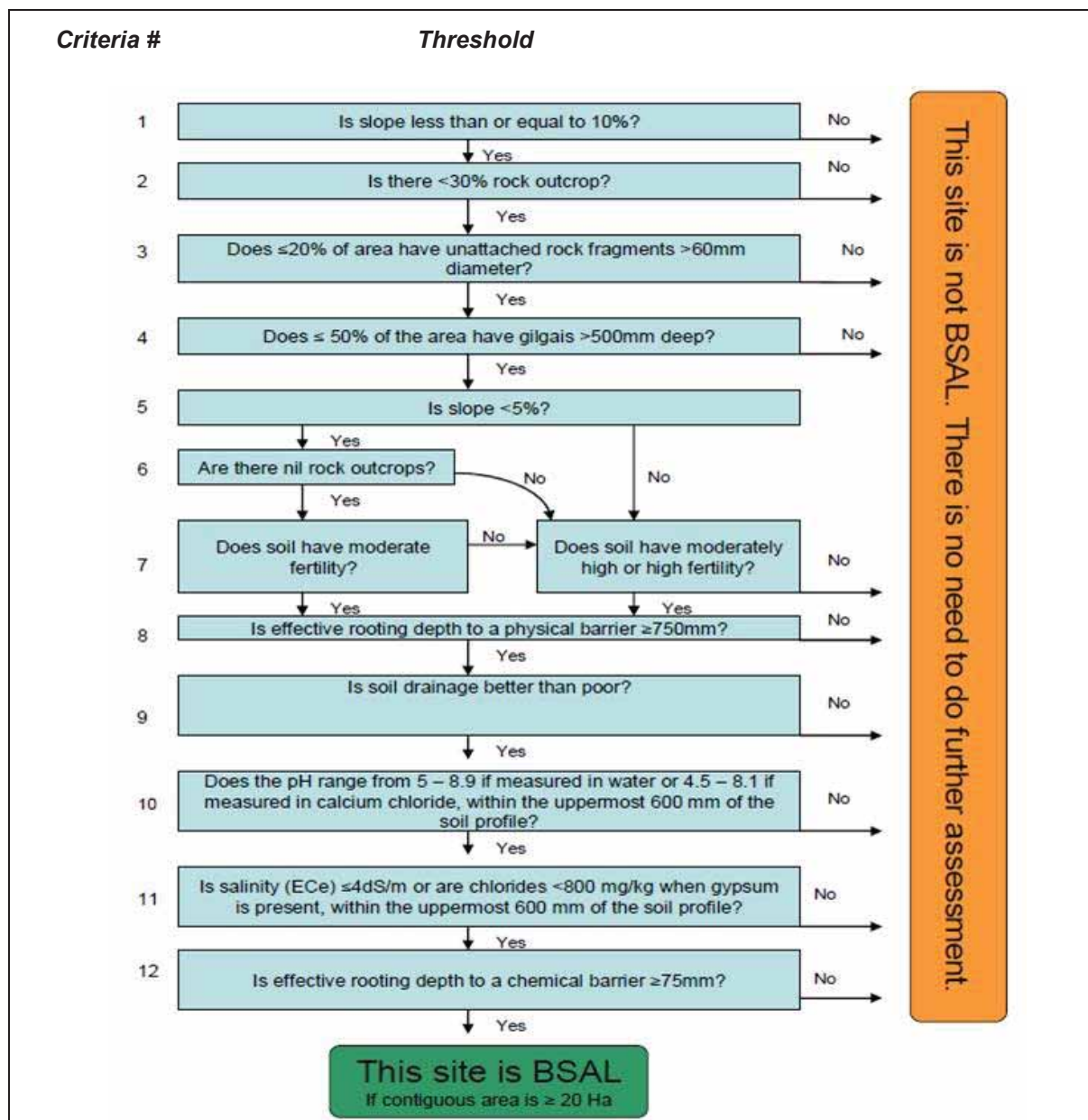
Laboratory Analysis	
- Electrical conductivity (EC) - pH (1:5) - Total cation exchange and exchangeable cations	- Cation exchange capacity (CEC) - Particle size Analysis - Colour[^]

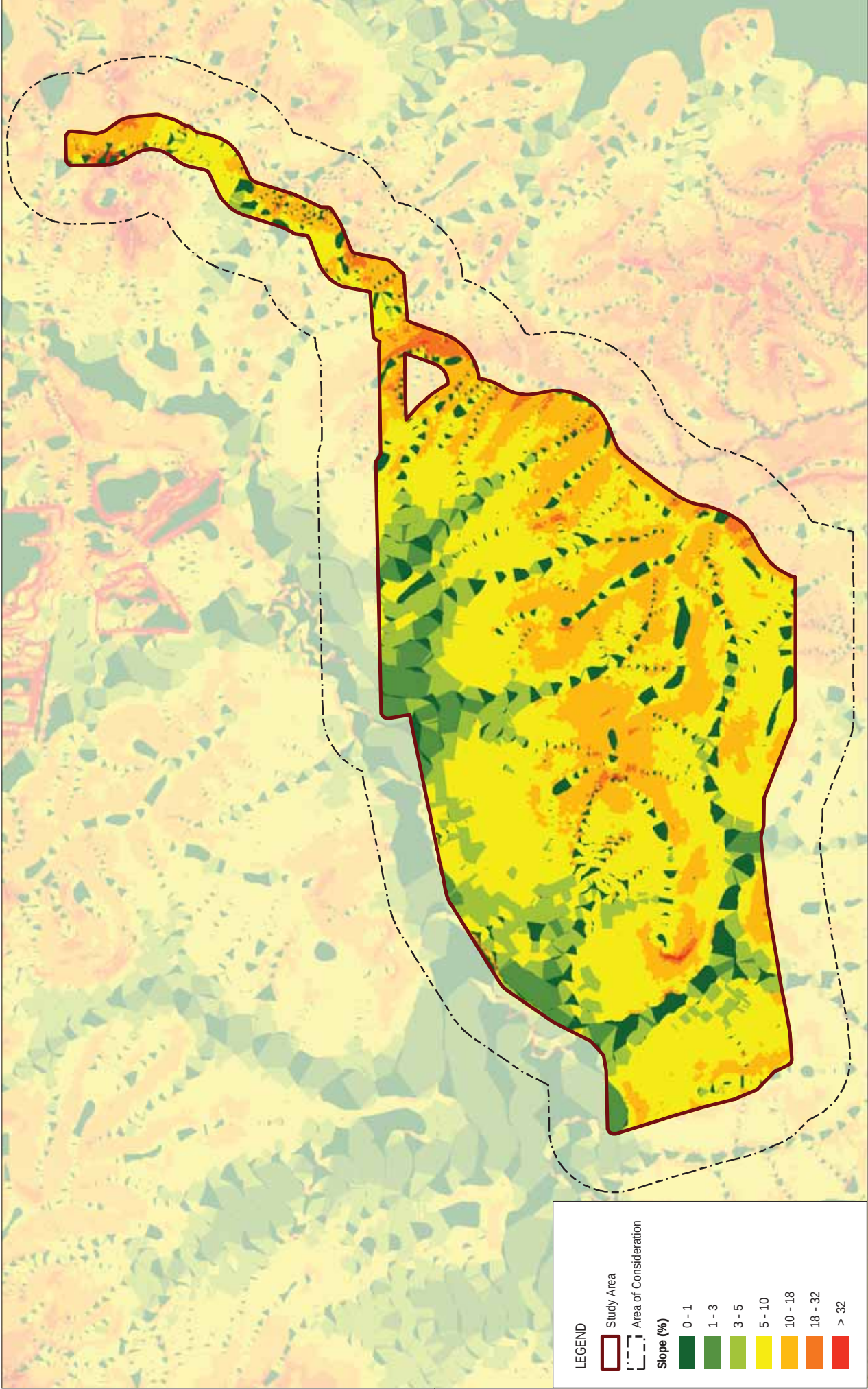
[^] Laboratory colour has been used except when mottling was greater than 20% as field colour more accurately assesses primary colour and dominant mottle colour.

Check Sites

Check sites are mapping observations examined in sufficient detail to allocate the site to a specific soil type and map unit.

Diagram 1 BSAL Soil Laboratory Analysis Parameters





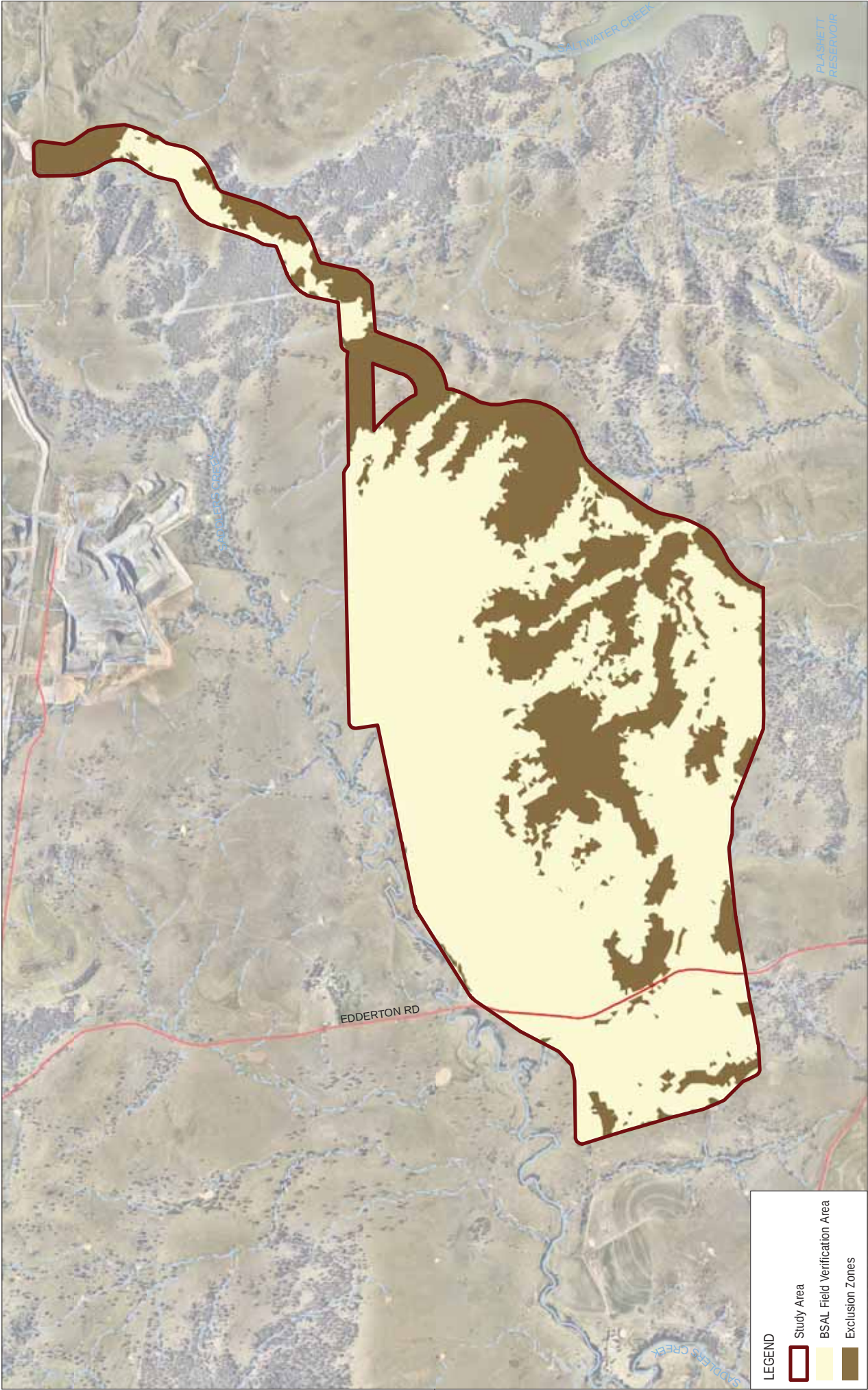
LEGEND

Study Area

Area of Consideration

Slope (%)

	0 - 1
	1 - 3
	3 - 5
	5 - 10
	10 - 18
	18 - 32
	> 32

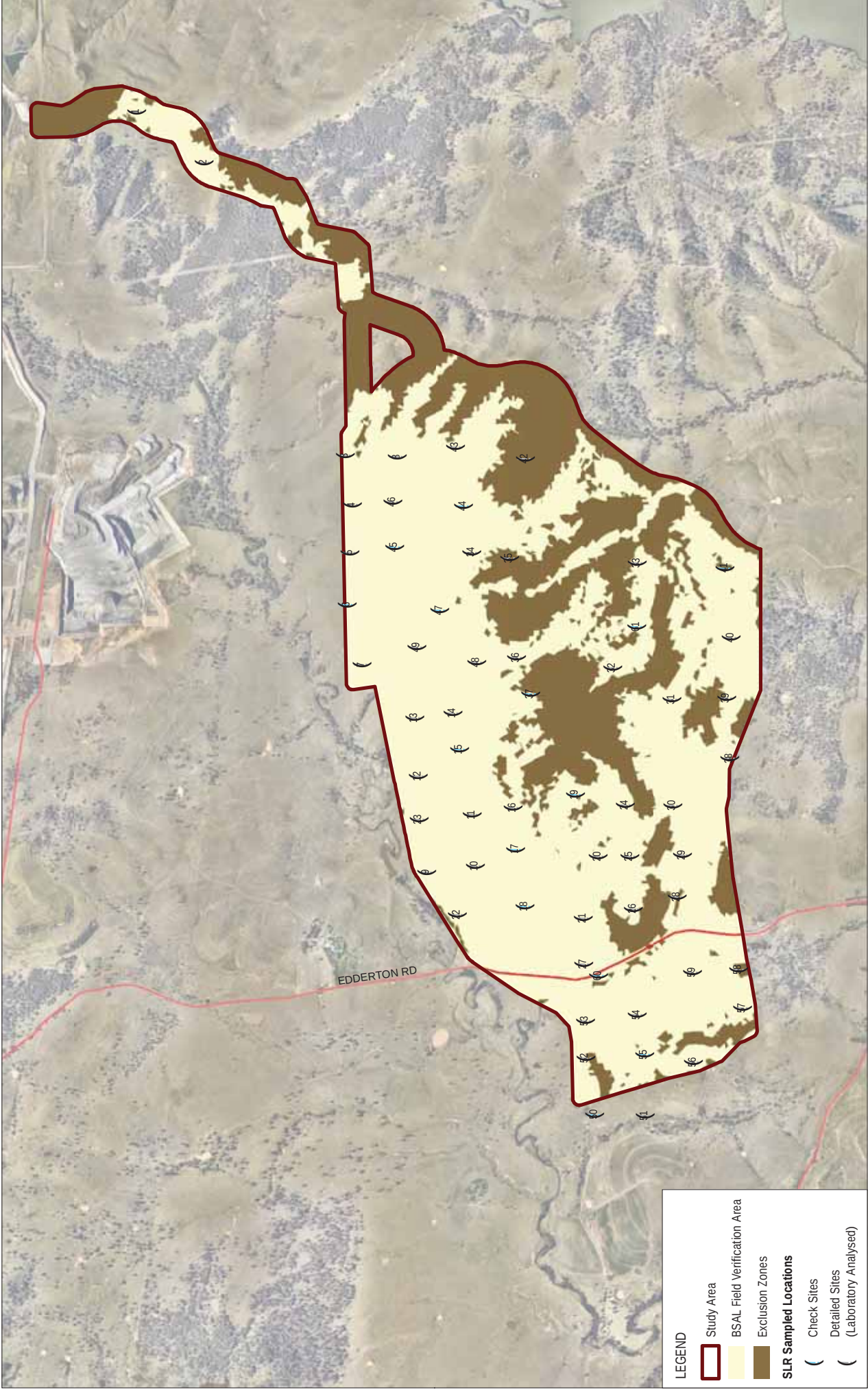


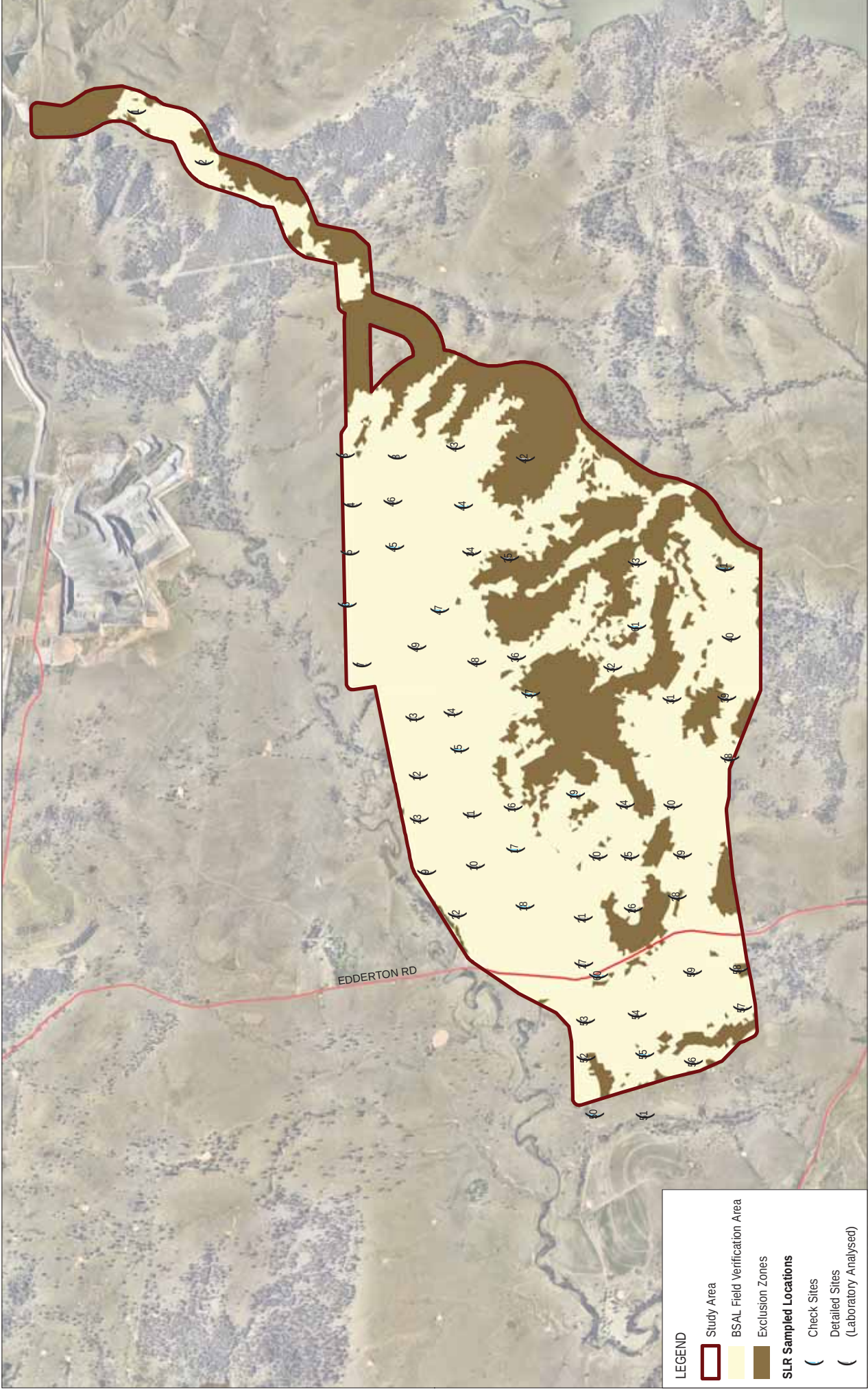
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Projection:	GDA 1994 MGA Zone 56



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		Drawn by: NT	SLR Sampled Locations	
		Scale: 1:40,000	FIGURE 5	
		Sheet Size: A4		
		Projection: GDA 1994 MGA Zone 56		

3 SOIL ASSESSMENT

In accordance with the Interim Protocol, a soil mapping unit (Soil Unit) may contain some soil variation, but will typically only contain a single dominant soil type. The dominant soil type will comprise greater than 70% of the Soil Unit. Therefore, a Soil Unit may contain a dominant soil type as well as subdominant and/or soil variants. When a Soil Unit does not have a clear dominant soil type soil variation must be accepted. Within the Study Area a total of 12 Soil Units have been identified based on the dominant soil type(s) (**Table 4; Figure 6**). Each Soil Unit contains a minimum of three detailed sites in accordance with the Interim Protocol, with the exception of Soil Unit 11; all soil sample sites within Soil Unit 11 fail BSAL criteria regardless of any additional laboratory analysis (refer **Section 4**).

All check sites within each Soil Unit have been correlated with the dominant soil type. Sites 50 and 51 lie outside the Study Area (**Figure 6**) but have been used for this assessment as they form an area of land which is contiguous to Soil Unit 4. Soil Units with the same dominant soil type but are mapped separately due to spatial separation have been designated Unit A or Unit B to distinguish between the two Soil units.

The majority soils within the Study Area were identified as Chromosols and Sodosols, with other soil types identified including Vertosols and Dermosols. A representative soil profile from the dominant soil type of each Soil Unit is described below.

Table 4 Soils Assessment Summary

Soil Unit	Area	Site Type	Site #
1 Eutrophic Brown Chromosol; Deep	93.4	Detailed	21, 27, 54, 59
		Check	60
2 Self-mulching Brown Vertosol; Deep	124.8	Detailed	11, 16, 22
		Check	15, 17, 18
3 Eutrophic Brown Chromosol; Moderate – Unit A	89.6	Detailed	10, 24, 25, 26, 28
		Check	19
4 Subnatric Red Sodosol	35.6	Detailed	51, 52, 53
		Check	50, 55
5 Eutrophic Brown Chromosol; Shallow	30.6	Detailed	56, 57, 58
		Check	-
6 Subnatric Brown Sodosol – Unit A	166.9	Detailed	29, 30, 31, 38, 39, 40
		Check	41
7 Subnatric Brown Sodosols – Unit B	88.6	Detailed	9, 10, 12, 13, 14, 23
		Check	-
8 Eutrophic Grey/Brown Chromosol	93.3	Detailed	35, 36, 48
		Check	37, 47
9 Subnatric/Mesonatric Brown Sodosol	193.1	Detailed	1, 2, 8, 34, 42, 43, 46
		Check	44
10 Eutrophic Brown Chromosol; Moderate – Unit B	45.2	Detailed	3, 4, 5
		Check	6
11 Eutrophic Brown Dermosol	50.8	Detailed	7, 49
		Check	45
12 Self-mulching Brown Vertosol; Moderate	25.9	Detailed	32, 33
		Check	61
Total	1,037.8	-	61

3.1 Soil Unit 1: Eutrophic Brown Chromosol; deep

The dominant soil type of Soil Unit 1 is a Eutrophic Brown Chromosol; deep. Chromosols are soils with strong texture contrast between the A and B horizons, with B horizons that are not strongly acidic and are not sodic. Soil Unit 1 profiles varied from loam or clay loam topsoil overlying light-medium to heavy clay. All profiles were non-sodic; however some displayed slightly saline subsoil.

Table 5 Summary: Eutrophic Brown Chromosol; deep

Overview	
	
Plate 3.1 – Landscape (Site 21)	
ASC Name	Eutrophic Brown Chromosol; deep
Representative Site	Site 21
Dominant Land Use	Grazing
Inherent Soil Fertility	Moderately High

Table 6 Profile: Eutrophic Brown Chromosol; deep

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.08	Dark brown (7.5YR 3/4) Clay Loam, Strong structure of 20-50 mm angular blocky peds with a strong consistence. Nil mottling; Nil stone content; Nil segregations; abundant fine roots; Well drained with a clear and even boundary.
	B21 0.08 – 0.45	Brown (7.5YR 4/4) Light-medium Clay, Strong structure of 20-50 mm subangular blocky peds with a strong consistence. Nil mottling; Nil stone content; Nil segregations; common fine roots; Well drained with a clear and wavy boundary.
	B22 0.45 – 0.75	Strong brown (7.5YR 4/6) Clay Loam, Strong structure of 20-100 mm subangular blocky peds with a strong consistence. Nil mottling; Nil stone content; 20% < 5 mm soft calcareous segregations; few fine roots; Well drained.

Table 7 Chemical Parameters: Eutrophic Brown Chromosol; deep

Horizon	pH		ESP		EC (1:5)		CEC	
	Unit	rating	%	rating	dS/m	rating	cmol/kg	rating
A1	6.7	Neutral	1.3	Non-sodic	0.9	Non-saline	15.3	Moderate
B21	8.7	Strongly Alkaline	5.8	Non-sodic	2.4	Slightly saline	27.5	High
B22	8.8	Strongly Alkaline	3.0	Non-sodic	3.4	Slightly saline	46	Very High

3.2 Soil Unit 2: Self-mulching Brown Vertosol; deep

The dominant soil type of Soil Unit 2 is a Self-mulching Brown Vertosol; deep. Vertosols are clay soils with shrink-swell properties that exhibit strong cracking when dry and at depth have slickensides and/or lenticular structural aggregates. Soil Unit 2 profiles varied from silty clay loam to light-medium clay topsoil grading to silty or heavy clay. Some profiles displayed sodic and moderately saline subsoil

Table 8 Summary: Self-mulching Brown Vertosol; deep

Overview	
	
Plate 3.2 – Landscape (Site 16)	
ASC Name	Self-mulching Brown Vertosol; deep
Representative Site	Site 16
Dominant Land Use	Grazing
Inherent Soil Fertility	High

Table 9 Profile: Self-mulching Brown Vertisol; deep

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.10	Dark brown (7.5YR 3/4) Clay Loam, Strong structure of 20-50 mm angular blocky peds with a strong consistence. Nil mottling; 5% <5 mm stone content; Nil segregations; abundant fine roots; Well drained with a gradual and even boundary.
	B21 0.10 – 0.45	Dark Yellowish-brown (10YR 4/6) Light-medium Clay, Strong structure of 20-50 mm angular blocky peds with a strong consistence. Nil mottling; Nil stone content; 10% <5 mm soft calcareous segregations; common fine roots; Well drained with a clear and wavy boundary.
	B22 0.45 – 0.90	Dark Yellowish-brown (10YR 4/6) Medium Clay, Strong structure of 20-50 mm angular blocky peds with a strong consistence. 5% faint grey mottling; Nil stone content; 30% <5 mm soft calcareous segregations; few fine roots; Imperfectly drained.

Table 10 Chemical Parameters: Self-mulching Brown Vertisol; deep

Horizon	pH		ESP		EC (1:5)		CEC	
	Unit	rating	%	rating	dS/m	rating	cmol/kg	rating
A1	7.1	Neutral	0.3	Non-sodic	0.7	Non-saline	16.6	Moderate
B21	8.2	Moderately Alkaline	4.3	Non-sodic	0.8	Non-saline	20.7	Moderate
B22	8.9	Strongly Alkaline	2.5	Non-sodic	2.4	Slightly saline	47.6	Very High

3.3 Soil Unit 3: Eutrophic Brown Chromosol; moderate - Unit A

The dominant soil type of Soil Unit 3 is a Eutrophic Brown Chromosol; moderate. Soil Unit 3 profiles varied from loam or loamy sand topsoil overlying light-medium to heavy clay. All profiles were non-sodic; however some displayed slightly saline subsoil.

Table 11 Summary: Eutrophic Brown Chromosol; moderate - Unit A

Overview	
	
Plate 3.3 – Landscape (Site 26)	
ASC Name	Eutrophic Brown Chromosol; moderate
Representative Site	Site 26
Dominant Land Use	Grazing
Inherent Soil Fertility	Moderately High

Table 12 Profile: Eutrophic Brown Chromosol; moderate - Unit A

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.15	Dark brown (10YR 3/3) Loamy Sand, Single-grained structure. Nil mottling; Nil stone content; Nil segregations; abundant fine roots; Moderately drained with a clear and wavy boundary.
	A2 0.15 – 0.45	Brown (7.5YR 4/4) Sandy Loam, Massive structure. Nil mottling; Nil stone content; Nil segregations; common fine roots; Imperfectly drained with a clear and wavy boundary.
	B2 0.45 – 0.65	Strong brown (7.5YR 5/6) Light-medium Clay, Strong structure of 100-200 mm subangular blocky peds with a strong consistence. Nil mottling; 10% <5 mm stone content; Nil segregations; few fine roots; Well drained.
	C 0.65+	Bedrock

Table 13 Chemical Parameters: Eutrophic Brown Chromosol; moderate - Unit A

Horizon	pH		ESP		EC (1:5)		CEC	
	Unit	rating	%	rating	dS/m	rating	cmol/kg	rating
A1	6.1	Slightly Acidic	1.0	Non-sodic	0.9	Non-saline	5.2	Very Low
A2	7.2	Neutral	1.5	Non-sodic	0.3	Non-saline	3.3	Very Low
B2	7.3	Neutral	0.4	Non-sodic	0.4	Non-saline	11.7	Low

3.4 Soil Unit 4: Subnatric Red Sodosol

The dominant soil type of Soil Unit 4 is a Subnatric Red Sodosol. Sodosols are soils with strong texture contrast between the A and B horizons, with B horizons that are not strongly acidic and are sodic. Soil Unit 4 profiles varied from loam or loamy sand topsoil overlying medium to heavy clay. All profiles had sodic, and slightly to moderately saline subsoils.

Table 14 Summary: Subnatric Red Sodosol

Overview	
	
Plate 3.4 – Landscape (Site 53)	
ASC Name	Subnatric Red Sodosol
Representative Site	Site 53
Dominant Land Use	Grazing
Inherent Soil Fertility	Moderately Low

Table 15 Profile: Subnatric Red Sodosol

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.10	Dark Yellowish-brown (10YR 4/4) Loam, Single-grained structure. Nil mottling; Nil stone content; Nil segregations; abundant fine roots; Well drained with a clear and wavy boundary.
	A2 0.10 – 0.20	Pale brown (10YR 6/3; dry) Loam, Massive structure. Bleached layer. Nil mottling; Nil stone content; Nil segregations; common fine roots; Imperfectly drained with an abrupt and wavy boundary.
	B1 0.20 – 0.50	Yellowish-red (5YR 4/6) Heavy Clay, Strong structure of 10-50 mm columnar peds with a strong consistence. Nil mottling; Nil stone content; Nil segregations; common fine roots; Imperfectly drained with a gradual and even boundary.
	B21 0.50 – 0.90	Yellowish-red (5YR 4/6) Heavy Clay, Strong structure of 100-200 mm subangular blocky peds with a strong consistence. Nil mottling; Nil stone content; Nil segregations; few fine roots; Well drained with a clear and wavy boundary.
	B22 0.90 – 1.30	Dark Yellowish-brown (10YR 4/6) Medium Clay, Strong structure of 100-200 mm subangular blocky peds with a strong consistence. 15% faint red mottling; Nil stone content; 5% < 2mm soft calcareous segregations; nil roots; Imperfectly drained.

Table 16 Chemical Parameters: Subnatric Red Sodosol

Horizon	pH		ESP		EC (1:5)		CEC	
	Unit	rating	%	rating	dS/m	rating	cmol/kg	rating
A1	6.2	Slightly Acidic	0.6	Non-sodic	0.8	Non-saline	7.8	Low
A2	6.9	Neutral	3.1	Non-sodic	0.3	Non-saline	3.2	Very Low
B1	7.4	Mildly Alkaline	11.7	Sodic	0.9	Non-saline	10.3	Low
B21	8.0	Moderately Alkaline	19.1	Strongly Sodic	3.3	Slightly Saline	11.5	Low
B22	8.7	Strongly Alkaline	7.5	Marginally Sodic	7.7	Moderately Saline	26.6	High

3.5 Soil Unit 5: Eutrophic Brown Chromosol; shallow

The dominant soil type of Soil Unit 5 is a Eutrophic Brown Chromosol; shallow. Soil Unit 5 profiles varied from loam or clay loam topsoil overlying heavy clay. All profiles were non-sodic and non-saline.

Table 17 Summary: Eutrophic Brown Chromosol; shallow

Overview	
	
Plate 3.5 – Landscape (Site 58)	
ASC Name	Eutrophic Brown Chromosol
Representative Site	Site 58
Dominant Land Use	Grazing
Inherent Soil Fertility	Moderately High

Table 18 Profile: Eutrophic Brown Chromosol; shallow

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.10	Dark brown (10YR 3/3) Loam, Moderate structure of 20-50 mm subangular blocky peds with a strong consistence. Nil mottling; Nil stone content; Nil segregations; abundant fine roots; Well drained with a clear and wavy boundary.
	B2 0.10 – 0.40	Dark Yellowish-brown (10YR 4/4) Heavy Clay, Strong structure of 20-100 mm angular blocky peds with a strong consistence. Nil mottling; 5% <5 mm stone content; Nil segregations; common fine roots; Well drained with a clear and wavy boundary.
	BC 0.40 – 0.80	Weathering bedrock
	C 0.80	Bedrock

Table 19 Chemical Parameters: Eutrophic Brown Chromosol; shallow

Horizon	pH		ESP		EC (1:5)		CEC	
	Unit	rating	%	rating	dS/m	rating	cmol/kg	rating
A1	6.8	Neutral	0.3	Non-sodic	0.8	Non-saline	15.0	Moderate
B2	8.1	Moderately Alkaline	4.6	Non-sodic	0.5	Non-saline	24.0	Moderate

3.6 Soil Unit 6: Subnatric Brown Sodosol - Unit A

The dominant soil type of Soil Unit 6 is a Subnatric Brown Sodosol. Soil Unit 6 profiles varied from loam or clay loam topsoil overlying heavy clay. All profiles had sodic and moderately saline subsoils.

Table 20 Summary: Subnatric Brown Sodosol - Unit A

Overview	
	
Plate 3.6 – Landscape (Site 40)	
ASC Name	Subnatric Brown Sodosol
Representative Site	Site 40
Dominant Land Use	Woodland / Grazing
Inherent Soil Fertility	Moderately Low

Table 21 Profile: Subnatric Brown Sodosol - Unit A

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.10	Dark brown (7.5YR 3/3) Loam, Moderate structure of 20-50 mm platy peds with a moderate consistence. Nil mottling; Nil stone content; Nil segregations; abundant fine roots; Moderately drained with an abrupt and even boundary.
	B21 0.10 – 0.35	Brown (7.5YR 4/4) Heavy Clay, Strong structure of 20-50 mm angular blocky peds with a strong consistence. Nil mottling; Nil stone content; Nil segregations; common fine roots; Moderately drained with a clear and wavy boundary.
	B22 0.35 – 0.70	Reddish-brown (5YR 4/4) Heavy Clay, Strong structure of 20-50 mm angular blocky peds with a strong consistence. Nil mottling; Nil stone content; 10% < 2mm soft calcareous segregations; few fine roots; Well drained with a clear and wavy boundary.
	BC 0.70 – 1.10	Weathering bedrock

Table 22 Chemical Parameters: Subnatric Brown Sodosol - Unit A

Horizon	pH		ESP		EC (1:5)		CEC	
	Unit	rating	%	rating	dS/m	rating	cmol/kg	rating
A1	6.9	Neutral	0.4	Non-sodic	0.5	Non-saline	12.7	Moderate
B21	8.3	Moderately Alkaline	10.1	Sodic	1.5	Non-saline	26.7	High
B22	8.8	Strongly Alkaline	6.7	Marginally Sodic	5.6	Moderately saline	49.2	Very High

3.7 Soil Unit 7: Subnatric Brown Sodosol - Unit B

The dominant soil type of Soil Unit 7 is a Subnatric Brown Sodosol. Soil Unit 7 profiles varied from loam or clay loam topsoil overlying light-medium to heavy clay. All profiles had sodic and slightly to moderately saline subsoils.

Table 23 Summary: Subnatric Brown Sodosol - Unit B

Overview	
	
Plate 3.7 – Landscape (Site 13)	
ASC Name	Subnatric Brown Sodosol
Representative Site	Site 13
Dominant Land Use	Grazing
Inherent Soil Fertility	Moderately Low

Table 24 Profile: Subnatric Brown Sodosol - Unit B

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.08	Dark brown (10YR 3/3) Clay Loam, Moderate structure of 20-50 mm subangular blocky peds with a strong consistence. Nil mottling; Nil stone content; Nil segregations; abundant fine roots; Moderately drained with a clear and even boundary.
	B21 0.08 – 0.50	Dark brown (10YR 3/3) Heavy Clay, Strong structure of 20-50 mm angular blocky peds with a strong consistence. Nil mottling; 10% <5 mm ironstone stone content; Nil segregations; common fine roots; Moderately drained with a clear and wavy boundary.
	B22 0.50 – 0.60	Strong brown (7.5YR 4/6) Heavy Clay, Strong structure of 20-50 mm angular blocky peds with a strong consistence. Nil mottling; 5% 5-10 mm ironstone stone content; 30% <5 mm soft calcareous segregations; few fine roots; Moderately drained with a clear and wavy boundary.
	B23 0.60 – 1.00	Strong brown (7.5YR 4/6) Heavy Clay, Strong structure of 50-100 mm angular blocky peds with a strong consistence. Nil mottling; 5% 5-10 mm ironstone stone content; 5% <5 mm manganiferous segregations; nil roots; Moderately drained.

Table 25 Chemical Parameters: Subnatric Brown Sodosol - Unit B

Horizon	pH		ESP		EC (1:5)		CEC	
	Unit	rating	%	rating	dS/m	rating	cmol/kg	rating
A1	6.5	Slightly Acidic	1.1	Non-sodic	1.0	Non-saline	17.4	Moderate
B21	8.2	Moderately Alkaline	8.5	Marginally Sodic	1.3	Non-saline	32.8	High
B22	8.5	Strongly Alkaline	6.4	Marginally Sodic	5.7	Moderately Saline	58	Very High
B23	8.8	Strongly Alkaline	8.5	Marginally Sodic	6.7	Moderately Saline	57.8	Very High

3.8 Soil Unit 8: Eutrophic Grey/Brown Chromosol

The dominant soil types of Soil Unit 7 are Eutrophic Grey or Brown Chromosols. Soil Unit 7 profiles varied from clay loam or loamy sand topsoil overlying light to heavy clay. All profiles were non-sodic; however some displayed moderately saline subsoil.

Table 26 Summary: Eutrophic Grey/Brown Chromosol

Overview	
	
Plate 3.8 – Landscape (Site 36)	
ASC Name	Eutrophic Grey/Brown Chromosol
Representative Site	Site 36
Dominant Land Use	Woodland
Inherent Soil Fertility	Moderately High

Table 27 Profile: Eutrophic Grey/Brown Chromosol

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.25	Dark brown (7.5YR 3/2) Loamy Sand, Single-grained structure. Nil mottling; Nil stone content; Nil segregations; abundant coarse roots; Well drained with a clear and wavy boundary.
	A2 0.25 – 0.45	Pinkish-grey (7.5YR 7/2; dry) Loamy Sand, Single-grained structure. Nil mottling; Nil stone content; 20% 5-10 mm manganiferous segregations; few coarse and common fine roots; Poorly drained with a clear and wavy boundary.
	B1 0.45 – 0.65	Yellowish-brown (10YR 5/4) Light Clay, Strong structure of 50-100 mm subangular blocky peds with a strong consistence. 1 0% distinct grey mottling; 10% <5 mm stone content; Nil segregations; few coarse and fine roots; Imperfectly drained with a gradual and wavy boundary.
	B2 0.65 – 0.90	Brown (10YR 5/3) Medium Clay, Strong structure of 50-100 mm angular blocky peds with a strong consistence. 10% distinct grey mottling; 10% <2 mm stone content; Nil segregations; few fine roots; Imperfectly drained with a clear and boundary.
	B3 0.90 – 1.30	Yellowish-red (5YR 4/6) Sandy Clay [^] , Massive structure. 15% distinct grey mottling; Nil stone content; Nil segregations; nil roots; Well drained.

[^] Field Munsell Colour and texture

Table 28 Chemical Parameters: Eutrophic Grey/Brown Chromosol

Horizon	pH		ESP		EC (1:5)		CEC	
	Unit	rating	%	rating	dS/m	rating	cmol/kg	rating
A1	6.0	Moderately Acidic	1.0	Non-sodic	0.5	Non-saline	4.8	Very Low
A2	6.9	Neutral	1.6	Non-sodic	0.2	Non-saline	3.2	Very Low
B1	7.4	Mildly Alkaline	1.2	Non-sodic	0.3	Non-saline	16.9	Moderate
B2	7.8	Mildly Alkaline	1.6	Non-sodic	0.4	Non-saline	24.6	Moderate

3.9 Soil Unit 9: Subnatric/Mesonatric Brown Sodosol

The dominant soil types of Soil Unit 9 are Subnatric or Mesonatric Brown Sodosols. Soil Unit 9 profiles varied greatly from loam, clay loam, silty loam or silty clay loam topsoil overlying light to heavy clay. All profiles had sodic to strongly sodic subsoils; and most displayed slightly to moderately saline subsoil.

Table 29 Summary: Subnatric/Mesonatric Brown Sodosol

Overview	
	
Plate 3.9 – Landscape (Site 1)	
ASC Name	Subnatric/Mesonatric Brown Sodosol
Representative Site	Site 1
Dominant Land Use	Grazing
Inherent Soil Fertility	Moderately Low

Table 30 Profile: Subnatric/Mesonatric Brown Sodosol

Profile	Horizon / Depth (m)	Description
	A11 0.0 – 0.10	Dark brown (7.5YR 3/3) Loam, Strong structure of 5-10 mm subangular blocky peds with a moderate consistence. Nil mottling; Nil stone content; Nil segregations; many coarse and few fine roots; Well drained with a clear and wavy boundary.
	A12 0.10 – 0.35	Brown (7.5YR 4/2) Loam, Weak structure of 2-10 mm subangular blocky peds with a weak consistence. Nil mottling; Nil stone content; <5% 5 mm manganiferous segregations; many coarse and few fine roots; Moderately drained with a gradual and wavy boundary.
	B21 0.35 – 0.65	Dark brown (7.5YR 3/4) Heavy Clay, Strong structure of 20-50 mm angular blocky peds with a strong consistence. Nil mottling; Nil stone content; Nil segregations; common coarse and few fine roots; Moderately drained with a gradual and wavy boundary.
	B22 0.65 – 0.95	Dark brown (7.5YR 3/4) Heavy Clay, Strong structure of 50+ mm angular blocky peds with a strong consistence. Nil mottling; 10% <5 mm stone content; <5% 5 mm manganiferous segregations; few coarse and fine roots; Well drained.

Table 31 Chemical Parameters: Subnatric/Mesonatric Brown Sodosol

Horizon	pH		ESP		EC (1:5)		CEC	
	Unit	rating	%	rating	dS/m	rating	cmol/kg	rating
A11	5.8	Moderately Acidic	0.7	Non-sodic	0.6	Non-saline	7.3	Low
A12	6.8	Neutral	2.5	Non-sodic	0.3	Non-saline	7.9	Low
B21	8.1	Moderately Alkaline	10.2	Sodic	0.9	Non-saline	22.6	Moderate
B22	8.7	Strongly Alkaline	11.9	Sodic	2.9	Slightly saline	28.5	High

3.10 Soil Unit 10: Eutrophic Brown Chromosol; moderate - Unit B

The dominant soil type of Soil Unit 10 is a Eutrophic Brown Chromosol; moderate. Soil Unit 10 profiles varied from loam or silty clay loam topsoil overlying light-medium or heavy clay. All profiles were non-sodic; however some displayed slightly saline subsoil

Table 32 Summary: Eutrophic Brown Chromosol; moderate - Unit B

Overview	
	
Plate 3.10 – Landscape (Site 5)	
ASC Name	Eutrophic Brown Chromosol; moderate
Representative Site	Site 5
Dominant Land Use	Grazing
Inherent Soil Fertility	Moderately High

Table 33 Profile: Eutrophic Brown Chromosol; moderate - Unit B

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.05	Dark brown (7.5YR 3/2) Loam, Moderate structure of 10-50 mm angular blocky peds with a strong consistence. Nil mottling; Nil stone content; Nil segregations; common fine roots; Moderately drained with an abrupt and wavy boundary.
	B21 0.05 – 0.30	Dark Yellowish-brown (10YR 4/4) Light-medium Clay, Strong structure of 10-50 mm angular blocky peds with a strong consistence. Nil mottling; Nil stone content; Nil segregations; few fine roots; Moderately drained with a gradual and wavy boundary.
	B22 0.30 – 0.50	Dark Yellowish-brown (10YR 4/4) Light-medium Clay, Strong structure of 50-100 mm angular blocky peds with a strong consistence. 15% faint grey mottling; Nil stone content; 20% <5 mm soft calcareous segregations; few fine roots; Imperfectly drained.
	BC 0.50 – 1.00	Weathering bedrock

Table 34 Chemical Parameters: Eutrophic Brown Chromosol; moderate - Unit B

Horizon	pH		ESP		EC (1:5)		CEC	
	Unit	rating	%	rating	dS/m	rating	cmol/kg	rating
A1	6.7	Neutral	0.3	Non-sodic	1.0	Non-saline	14.7	Moderate
B21	7.2	Neutral	3.3	Non-sodic	0.4	Non-saline	24.5	Moderate
B22	7.9	Moderately Alkaline	1.4	Non-sodic	2.0	Slightly Saline	21.7	Moderate

3.11 Soil Unit 11: Eutrophic Brown Dermosol

The dominant soil type of Soil Unit 11 is a Eutrophic Brown Dermosol. Dermosols are soils with structured B2 horizons and lacking strong texture contrast between A and B horizons. Soil Unit 11 profiles were typically loamy sand grading to loam and clay loam. All profiles displayed marginally sodic to strongly sodic and moderately saline subsoil

Table 35 Summary: Eutrophic Brown Dermosol

Overview	
	
Plate 3.11 – Landscape (Site 7)	
ASC Name	Eutrophic Brown Dermosol
Representative Site	Site 7
Dominant Land Use	Grazing
Inherent Soil Fertility	Moderately High

Table 36 Profile: Eutrophic Brown Dermosol

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.05	Dark brown (10YR 3/3) Loamy Sand, Strong structure of 5-30 mm platy peds with a weak consistence. Nil mottling; Nil stone content; Nil segregations; abundant fine and few coarse roots; Poorly drained with a clear and even boundary.
	A2 0.05 – 0.20	Weak red (10R 4/3) Loam, Single-grained structure. Nil mottling; 10% 5-20 mm stone content; <5% 5 mm manganiferous segregations; few fine roots; Imperfectly drained with an abrupt and even boundary.
	B21 0.20 – 0.60	Yellowish-brown (10YR 5/4) Clay Loam, Strong structure of 30-50 mm angular blocky peds with a strong consistence. 15% faint red mottling; Nil stone content; Nil segregations; few fine roots; Poorly drained with a gradual and wavy boundary.
	B22 0.60 – 1.00	Dark Yellowish-brown (10YR 4/4) Clay Loam, Strong structure of 10-50 mm angular blocky peds with a moderate consistence. Nil mottling; 10% <5 mm stone content; Nil segregations; nil roots; Moderately drained.

Table 37 Chemical Parameters: Eutrophic Brown Dermosol

Horizon	pH		ESP		EC (1:5)		CEC	
	Unit	rating	%	rating	dS/m	rating	cmol/kg	rating
A1	5.6	Moderately Acidic	1.8	Non-sodic	1.2	Non-saline	2.8	Very Low
A2	6.6	Neutral	9.1	Marginally Sodic	0.8	Non-saline	3.3	Very Low
B21	8.6	Strongly Alkaline	18.6	Strongly Sodic	4.2	Moderately saline	17.2	Moderate
B22	8.6	Strongly Alkaline	21.5	Strongly Sodic	4.5	Moderately saline	15.8	Moderate

3.12 Soil Unit 12: Self-mulching Brown Vertosol; moderate

The dominant soil type of Soil Unit 12 is a Self-mulching Brown Vertosol; moderate. Soil Unit 12 profiles varied from silty clay loam to light-medium clay topsoil grading to silty or heavy clay. All profiles were non-sodic and non-saline.

Table 38 Summary: Self-mulching Brown Vertosol; moderate

Overview	
	
Plate 3.12 – Landscape (Site 33)	
ASC Name	Self-mulching Brown Vertosol; moderate
Representative Site	Site 33
Dominant Land Use	Grazing
Inherent Soil Fertility	High

Table 39 Profile: Self-mulching Brown Vertisol; moderate

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.10	Dark brown (7.5YR 3/4) Clay Loam, Strong structure of 20-50 mm angular blocky peds with a strong consistence. Nil mottling; 10% 20-50 mm stone content; Nil segregations; abundant fine roots; Well drained with a gradual and even boundary.
	B2 0.10 – 0.60	Dark Yellowish-brown (10YR 4/6) Light-medium Clay, Strong structure of 20-50 mm angular blocky peds with a strong consistence. Nil mottling; 5% 10 mm stone content; 10% Nil segregations; common fine roots; Well drained with a clear and wavy boundary.
	BC 0.60 – 0.90	Weathering bedrock

Table 40 Chemical Parameters: Self-mulching Brown Vertisol; moderate

Horizon	pH		ESP		EC (1:5)		CEC	
	Unit	rating	%	rating	dS/m	rating	cmol/kg	rating
A1	7.0	Neutral	2.0	Non-sodic	0.4	Non-saline	19.9	Moderate
B2	8.8	Strongly Alkaline	3.8	Non-sodic	2.0	Non-saline	36.7	High

4 BIOPHYSICAL STRATEGIC AGRICULTURAL LAND SITE VERIFICATION ASSESSMENT

This BSAL assessment has been conducted in accordance with Interim Protocol. The BSAL status was determined on the dominant soil type within each Soil Unit. The BSAL assessment and limitations for each soil sample sites is shown in **Table 42** and displayed in **Figure 7**.

In Summary:

- A total of 12 Soil Units were mapped with the Study Area, with only two Soil Units verified as BSAL (**Figure 8**): Soil Unit 1: Eutrophic Brown Chromosol; deep and Soil Unit 2: Self-mulching Brown Vertosol.
- Soil Units 4, 6, 7 and 9 failed BSAL Criteria 7 (inherent soil fertility) due the moderately low inherent fertility associated with the dominant soil type, Sodosols.
- Soil Units 3, 5, 10 and 12 failed BSAL Criteria 8 (physical barrier to effective rooting depth).
- The dominant soil type within Soil Units 8 and 11 both failed a combination of BSAL criteria, including Criteria 8 and Criteria 11 (salinity).

Overall, there are 218.2 ha of land verified as BSAL within the study area (**Table 41**; **Figure 6**).

Table 41 BSAL Assessment Summary

BSAL Assessment	Area (ha)
Verified BSAL	218.2
Verified Non-BSAL	819.6
Sub Total	1,037.8
Exclusion Zone	433.1
Study Area Total	1,470.9

Table 42 BSAL Assessment

Site #	Inspection Site Type	Soil Type: Australian Soil Classification (to ASC Great Group for detailed sites)	1. Is slope < 10%?	2. Is there < 30% Rock Outcrop?	3. < 20% unattached Rock Fragments > 60mm?	4. Does < 50% have Gilgais >500mm deep?	5. Is Slope <5%?	6. Are there nil rock outcrops?	7a. Does Soil Have Moderate Fertility?	7b. Does soil have moderately high or high fertility?	8. Is ERD to a physical barrier >750mm?	9. Is drainage better than poor?	10. Is pH between 5.0 and 8.9?	11. Is salinity (Ece) < 4 dS/m	12. Is ERD to a chemical barrier >750mm?	Is the Soil Unit BSAL?
Soil Unit 1: Eutrophic Brown Chromosol; Deep																
21	Detailed	Eutrophic Brown Chromosol	✓	✓	✓	✓	✗	N/A	✓	✓	✓	✓	✓	✓	✓	Yes
27	Detailed	Eutrophic Brown Chromosol	✓	✓	✓	✓	✗	N/A	✓	✓	✓	✓	✓	✓	✓	Yes
54	Detailed	Eutrophic Brown Chromosol	✓	✓	✓	✓	✗	N/A	✓	✓	✓	✓	✓	✓	✓	Yes
59	Detailed	Eutrophic Brown Chromosol	✓	✓	✓	✓	✗	N/A	✓	✓	✓	✓	✓	✓	✓	Yes
60	Check	Brown Chromosol	✓	✓	✓	✓	✗	N/A	✓	✓	✓	✓	✓	✓	✓	Yes
Soil Unit 2: Self-mulching Brown Vertosol; Deep																
11	Detailed	Self-mulching Brown Vertosol	✓	✓	✓	✓	✗	N/A	✓	✓	✓	✓	✓	✓	✓	Yes
17	Check	Brown Vertosol	✓	✓	✓	✓	✗	N/A	✓	✓	✗	-	-	-	-	Yes
15	Check	Brown Vertosol	✓	✓	✓	✓	✗	N/A	✓	✓	✓	✓	✓	✓	✓	Yes
18	Check	Brown Vertosol	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Yes
16	Detailed	Eutrophic Brown Dermosol	✓	✓	✓	✓	✗	N/A	✓	✓	✓	✓	✓	✓	✓	Yes
22	Detailed	Paralithic Hypercalcic Calcarasol	✓	✓	✓	✓	✓	✓	✗	✗	-	-	-	-	-	Yes
Soil Unit 3: Eutrophic Brown Chromosol; Moderate Unit A																
20	Detailed	Eutrophic Brown Chromosol	✓	✓	✓	✓	✗	N/A	✓	✓	✓	✓	✓	✗	-	-
25	Detailed	Eutrophic Brown Chromosol	✓	✓	✓	✓	✗	N/A	✓	✓	✗	-	-	-	-	-
26	Detailed	Eutrophic Brown Chromosol	✓	✓	✓	✓	✗	N/A	✓	✓	✗	-	-	-	-	-
19	Check	Brown Chromosol	✓	✓	✓	✓	✗	N/A	✓	✓	✗	-	-	-	-	-

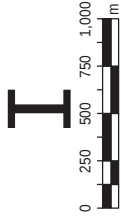
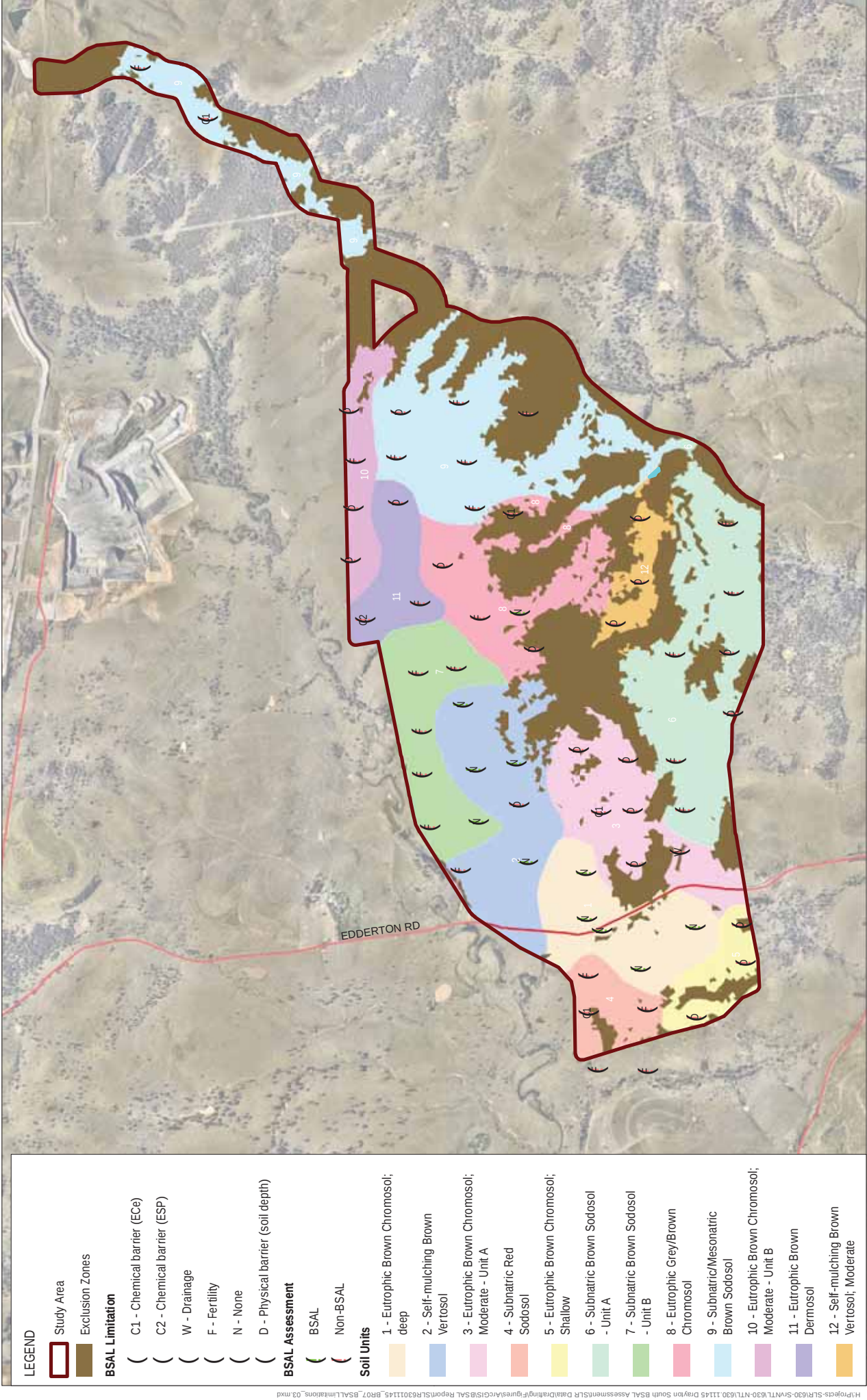
Site #	Inspection Site Type	Soil Type: Australian Soil Classification (to ASC Great Group for detailed sites)	1. Is slope < 10%?	2. Is there < 30% Rock Outcrop?	3. < 20% unattached Rock Fragments > 60mm?	4. Does < 50% have Gilgais >500mm deep?	5. Is Slope <5%?	6. Are there nil rock outcrops?	7a. Does Soil Have Moderate Fertility?	7b. Does soil have moderately high or high fertility?	8. Is ERD to a physical barrier >750mm?	9. Is drainage better than poor?	10. Is pH between 5.0 and 8.9?	11. Is salinity (Ece) < 4 dS/m	12. Is ERD to a chemical barrier >750mm?	Is the Soil Unit BSAL?
24	Detailed	Eutrophic Red Chromosol	✓	✓	✓	✓	✓	✓	✓	✓	✗	-	-	-	-	
28	Detailed	Eutrophic Yellow Chromosol	✓	✓	✓	✓	✗	N/A	N/A	✓	✓	✗	-	-	-	
Soil Unit 4: Subnatric Red Sodosol																
51	Detailed	Subnatric Red Sodosol	✓	✓	✓	✓	✗	N/A	N/A	✗	-	-	-	-	-	No
53	Detailed	Subnatric Red Sodosol	✓	✓	✓	✓	✓	✓	✗	✗	-	-	-	-	-	
50	Check	Red Sodosol*	✓	✓	✓	✓	✓	✓	✗	✗	-	-	-	-	-	
55	Check	Red Sodosol*	✓	✓	✓	✓	✗	N/A	N/A	✗	-	-	-	-	-	
52	Detailed	Eutrophic Brown Chromosol	✓	✓	✓	✓	✗	N/A	N/A	✓	✓	✓	✓	✗	-	
Soil Unit 5: Eutrophic Brown Chromosol; Shallow																
56	Detailed	Eutrophic Brown Chromosol	✓	✓	✓	✓	✗	N/A	N/A	✓	✗	-	-	-	-	No
57	Detailed	Eutrophic Brown Chromosol	✓	✓	✓	✓	✗	N/A	N/A	✓	✗	-	-	-	-	
58	Detailed	Eutrophic Brown Chromosol	✓	✓	✓	✓	✗	N/A	N/A	✓	✗	-	-	-	-	
Soil Unit 6: Subnatric Brown Sodosol; Unit A																
30	Detailed	Subnatric Brown Sodosol	✓	✓	✓	✓	✗	N/A	N/A	✗	-	-	-	-	-	No
31	Detailed	Subnatric Brown Sodosol	✓	✓	✓	✓	✓	✓	✗	✗	-	-	-	-	-	
40	Detailed	Subnatric Brown Sodosol	✓	✓	✓	✓	✗	N/A	N/A	✗	-	-	-	-	-	
41	Check	Brown Sodosol*	✓	✓	✓	✓	✗	N/A	N/A	✗	-	-	-	-	-	
29	Detailed	Hypernatric Grey Sodosol	✓	✓	✓	✓	✗	N/A	N/A	✗	-	-	-	-	-	
38	Detailed	Eutrophic Red Chromosol	✓	✓	✓	✓	✗	N/A	N/A	✓	✗	-	-	-	-	
39	Detailed	Eutrophic Red Chromosol	✓	✓	✓	✓	✗	N/A	N/A	✓	✗	-	-	-	-	

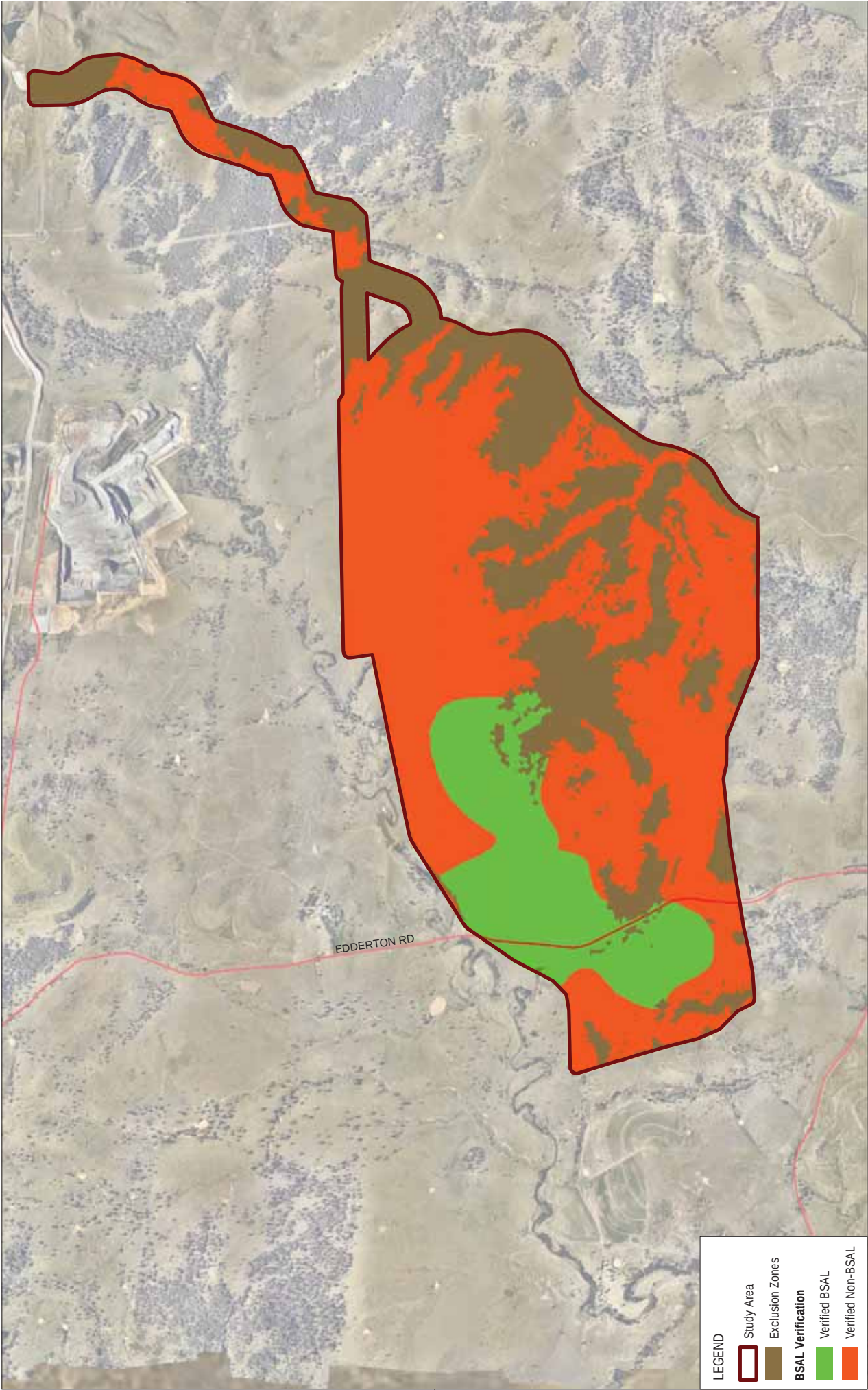
Site #	Inspection Site Type	Soil Type: Australian Soil Classification (to ASC Great Group for detailed sites)	1. Is slope < 10%?	2. Is there < 30% Rock Outcrop?	3. < 20% unattached Rock Fragments > 60mm?	4. Does < 50% have Gilgais >50mm deep?	5. Is Slope <5%?	6. Are there nil rock outcrops?	7a. Does Soil Have Moderate Fertility?	7b. Does soil have moderately high or high fertility?	8. Is ERD to a physical barrier >750mm?	9. Is drainage better than poor?	10. Is pH between 5.0 and 8.9?	11. Is salinity (Ece) < 4 dS/m	12. Is ERD to a chemical barrier >750mm?	Is the Soil Unit BSAL?
Soil Unit 7: Subnatric Brown Sodosol; Unit B																
12	Detailed	Subnatric Brown Sodosol	✓	✓	✓	✓	✓	✓	✗	✗	-	-	-	-	-	No
13	Detailed	Subnatric Brown Sodosol	✓	✓	✓	✓	✓	✓	✗	✗	-	-	-	-	-	
14	Detailed	Subnatric Brown Sodosol	✓	✓	✓	✓	✓	✓	✗	✗	-	-	-	-	-	
23	Detailed	Subnatric Brown Sodosol	✓	✓	✓	✓	✗	N/A	✗	✗	-	-	-	-	-	
9	Detailed	Mesonatric Brown Sodosol	✓	✓	✓	✓	✓	✓	✗	✗	-	-	-	-	-	
10	Detailed	Eutrophic Brown Chromosol	✓	✓	✓	✓	✗	N/A	N/A	✓	✓	✓	✓	✓	✓	
Soil Unit 8: Eutrophic Grey/Brown Chromosol																
35	Detailed	Eutrophic Grey Chromosol	✓	✓	✓	✓	✗	N/A	N/A	✓	✓	✓	✓	✗	-	No
36	Detailed	Eutrophic Brown Chromosol	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
37	Check	Brown Chromosol	✓	✓	✓	✓	✗	N/A	N/A	✓	✗	-	-	-	-	
47	Check	Brown Chromosol	✓	✓	✓	✓	✗	N/A	N/A	✓	✗	-	-	-	-	
48	Detailed	Natric Yellow Kurosol	✓	✓	✓	✓	✓	✓	✗	✗	-	-	-	-	-	
Soil Unit 9: Subnatric/Mesonatric Brown Sodosol																
1	Detailed	Subnatric Brown Sodosol	✓	✓	✓	✓	✗	N/A	N/A	✗	-	-	-	-	-	No
34	Detailed	Mesonatric Brown Sodosol	✓	✓	✓	✓	✗	N/A	N/A	✗	-	-	-	-	-	
43	Detailed	Mesonatric Brown Sodosol	✓	✓	✓	✓	✗	N/A	N/A	✗	-	-	-	-	-	
46	Detailed	Subnatric Brown Sodosol	✓	✓	✓	✓	✓	✓	✗	✗	-	-	-	-	-	
44	Check	Brown Sodosol	✓	✓	✓	✓	✗	N/A	N/A	✗	-	-	-	-	-	
42	Detailed	Subnatric Grey Sodosol	✓	✓	✓	✓	✗	N/A	N/A	✗	-	-	-	-	-	

Site #	Inspection Site Type	Soil Type: Australian Soil Classification (to ASC Great Group for detailed sites)	1. Is slope < 10%?	2. Is there < 30% Rock Outcrop?	3. < 20% unattached Rock Fragments > 60mm?	4. Does < 50% have Gilgais >50mm deep?	5. Is Slope <5%?	6. Are there nil rock outcrops?	7a. Does Soil Have Moderate Fertility?	7b. Does soil have moderately high or high fertility?	8. Is ERD to a physical barrier >750mm?	9. Is drainage better than poor?	10. Is pH between 5.0 and 8.9?	11. Is salinity (Ece) < 4 dS/m	12. Is ERD to a chemical barrier >750mm?	Is the Soil Unit BSAL?
2	Detailed	Eutrophic Black Dermosol (Sodic)	✓	✓	✓	✓	✗	N/A	N/A	✓	✓	✓	✓	✗	-	
8	Detailed	Self-mulching Brown Vertosol	✓	✓	✓	✓	✗	N/A	N/A	✓	✗	-	-	-	-	
Soil Unit 10: Eutrophic Brown Chromosol; Moderate Unit B																
3	Detailed	Eutrophic Brown Chromosol	✓	✓	✓	✓	✗	N/A	N/A	✓	✗	-	-	-	-	No
6	Detailed	Eutrophic Brown Chromosol	✓	✓	✓	✓	✓	✓	✓	✓	✗	-	-	-	-	No
5	Check	Brown Chromosol	✓	✓	✓	✓	✓	✓	✓	✓	✗	-	-	-	-	No
4	Detailed	Subnatric Grey Sodosol	✓	✓	✓	✓	✓	✓	✗	✗	-	-	-	-	-	No
Soil Unit 11: Eutrophic Brown Dermosol																
7	Detailed	Eutrophic Brown Dermosol	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	-	No
45	Check	Brown Dermosol	✓	✓	✓	✓	✓	✓	✓	✓	✗	-	-	-	-	No
49	Detailed	Hypercalcic Calcarosol	✓	✓	✓	✓	✓	✓	✗	✗	-	-	-	-	-	No
Soil Unit 12: Self-mulching Brown Vertosol; Moderate																
32	Detailed	Self-mulching Brown Vertosol	✓	✓	✓	✓	✗	N/A	N/A	✓	✗	-	-	-	-	No
33	Detailed	Self-mulching Brown Vertosol	✓	✓	✓	✓	✗	N/A	N/A	✓	✗	-	-	-	-	No
61	Check	Self-mulching Brown Vertosol	✓	✓	✓	✓	✗	N/A	N/A	✓	✗	-	-	-	-	No

✓ = passes the BSAL criteria ✗ = fails the criteria but not excluded as BSAL ✗ = fails the BSAL criteria

N/A = criteria is not assessed in accordance with Interim Protocol





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Projection:	GDA 1994 MGA Zone 56

5 CONCLUSION

The Drayton South Coal Project BSAL Site Verification Assessment commenced in November 2014 by SLR Consulting. The Study Area was 1,470.9 ha of land within EL 5460, inclusive of a 100 m buffer from any disturbance activity.

Land greater than 10% slope and areas of land less than 20 ha due to restriction by slope were excluded from the soil survey, totalling 433.1 ha.

Within the Study Area a total of 12 Soil Units have been identified based on the dominant soil type(s). The majority of soils within the Study Area were identified as Chromosols and Sodosols, with other soil types identified including Vertosols and Dermosols.

Only two Soil Units were verified as BSAL within the Study Area, Soil Unit 1: Eutrophic Brown Chromosol; deep and Soil Unit 2: Self-mulching Brown Vertosol.

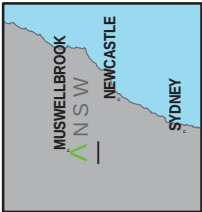
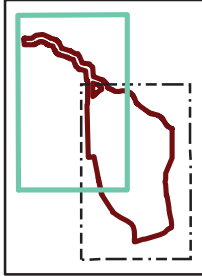
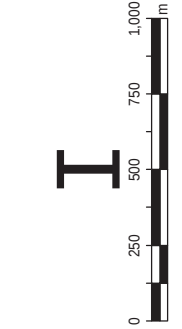
The remaining Soil Units failed either Criteria 7 (inherent soil fertility), Criteria 8 (physical barrier to effective rooting depth) or a combination of BSAL criteria, including Criteria 8 and Criteria 11 (salinity) and were therefore verified as non-BSAL. In total, 819.6 ha was verified as non-BSAL based on field soil survey.

In conclusion, 218.2 ha of land have been verified as BSAL within the Study Area.

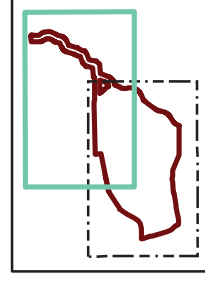
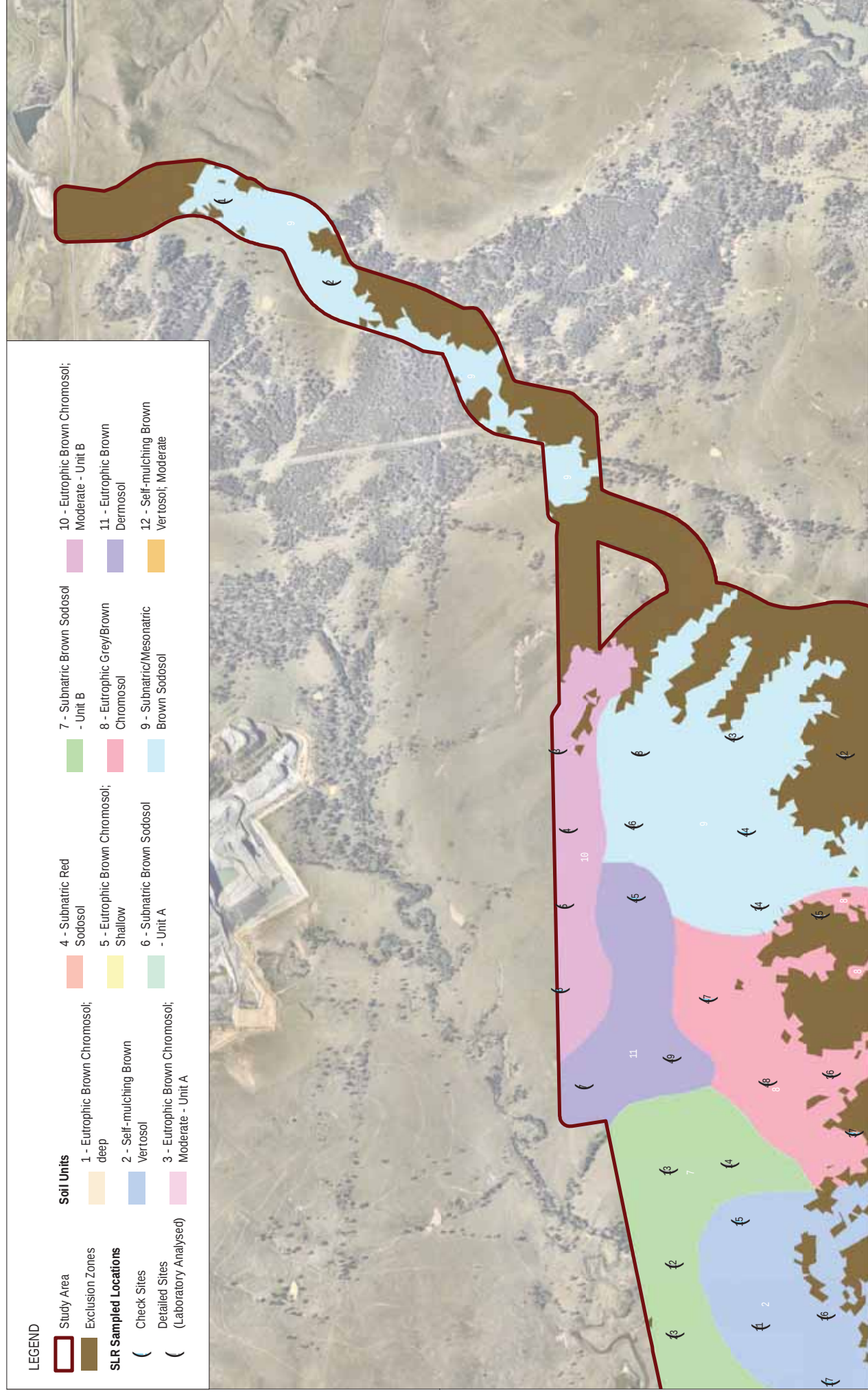
As part of the Project EIS a comprehensive assessment will be completed in order to meet the SEARs and to ensure the precise extent of impacts on BSAL are quantified in detail.

Appendix A

1:25,000 Scale Figures



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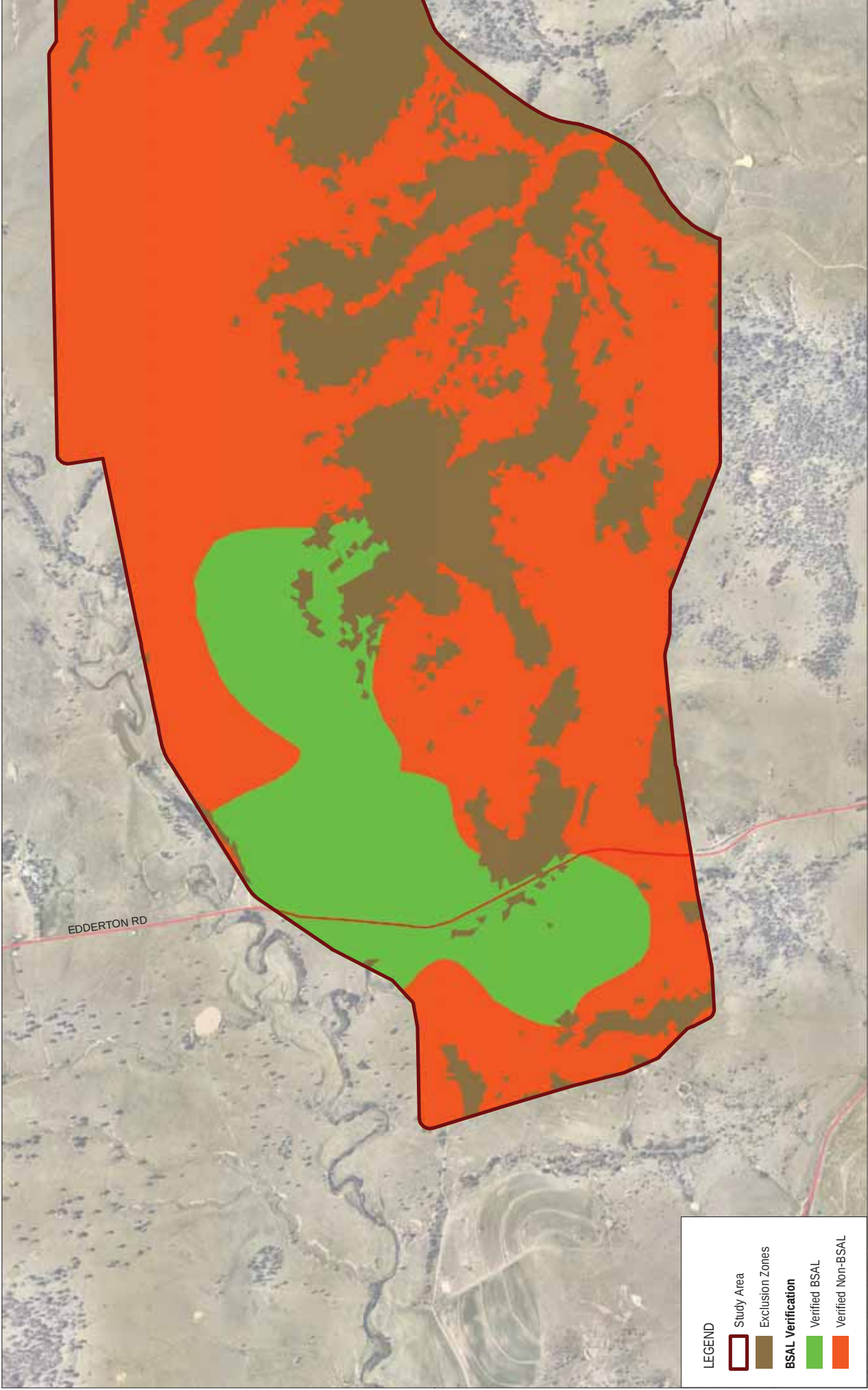


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NEW LAMBTON
NEW SOUTH WALES 2305
AUSTRALIA
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LEGEND

Study Area

Exclusion Zones

BSAL Verification

Verified BSAL

Verified Non-BSAL

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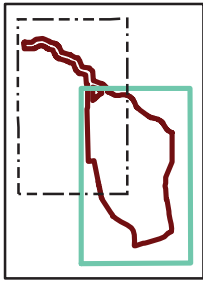
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Projection:GDA 1994 MGA Zone 56



MUSWELLBROOK
NSW
NEWCASTLE
SYDNEY



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Drayton South BSAL Assessment

BSAL Verification Map

Appendix A 3.1

Hansen Bailey

LEGEND

Study Area

Exclusion Zones

BSAL Verification

Verified BSAL

Verified Non-BSAL

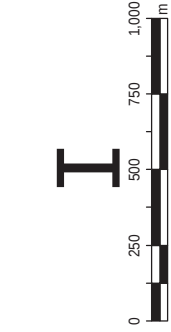
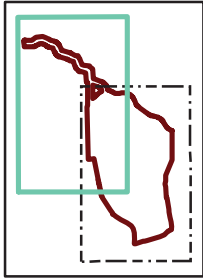
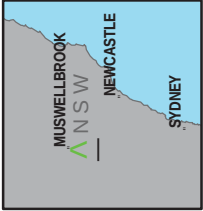




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Appendix B

Soil Laboratory Results

CERTIFICATE OF ANALYSIS

Work Order	: EB1447699	Page	: 1 of 18
Client	: SLR Consulting Australia Pty Ltd	Laboratory	: Environmental Division Brisbane
Contact	: MS ADELE CALANDRA	Contact	: Customer Services EB
Address	: LEVEL 1, 241 DENNISON STREET BROADMEADOW NSW 2292	Address	: 2 Byth Street Stafford QLD Australia 4053
E-mail	: acalandra@slrconsulting.com	E-mail	: ALSEnviro.Brisbane@alsglobal.com
Telephone	: +61 02 4920 3000	Telephone	: +61-7-3243 7222
Facsimile	: +61 02 4961 3360	Facsimile	: +61-7-3243 7218
Project	: 630.11145	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	:	Date Samples Received	: 03-Dec-2014 13:40
C-O-C number	:	Date Analysis Commenced	: 08-Dec-2014
Sampler	:	Issue Date	: 12-Dec-2014 18:35
Site	:	No. of samples received	: 80
Quote number	:	No. of samples analysed	: 80

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

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.

Signatories	Position	Accreditation Category
Andrew Epps	Senior Inorganic Chemist	Brisbane Inorganics





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.

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

Δ = This result is computed from individual analyte detections at or above the level of reporting

Ø = ALS is not NATA accredited for these tests.

- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl (Method 15G1) is a more suitable method for the determination of exchange acidity (H+ + Al3+).
- ED008 (Exchangeable Cations) Sample EB1447699069 shows poor duplicate results due to sample heterogeneity. Confirmed by visual inspection.



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID											
Compound	Client sampling date / time		Site 1 0-10 cm		Site 1 20-30 cm		Site 1 50-60 cm		Site 1 80-90 cm		Site 2 0-10 cm		
	CAS Number	LOR	Unit	EB1447699-001	EB1447699-002	EB1447699-003	EB1447699-004	EB1447699-005					
				Result	Result	Result	Result	Result					
EA002 : pH (Soils)													
pH Value		0.1	pH Unit	5.8	6.8	8.1	8.7	6.1					
EA010: Conductivity													
Electrical Conductivity @ 25°C		1	µS/cm	61	35	159	492	85					
ED008: Exchangeable Cations													
^ Exchangeable Calcium		0.1	meq/100g	4.5	4.4	9.3	12.2	5.5					
^ Exchangeable Magnesium		0.1	meq/100g	1.9	2.8	10.8	12.6	6.3					
^ Exchangeable Potassium		0.1	meq/100g	0.8	0.4	0.2	0.1	0.8					
^ Exchangeable Sodium		0.1	meq/100g	<0.1	0.2	2.3	3.4	<0.1					
^ Cation Exchange Capacity		0.1	meq/100g	7.3	7.9	22.6	28.5	12.9					



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID		Client sampling date / time		Site 2 10-20 cm	Site 2 50-60 cm	Site 2 80-90 cm	Site 3 0-10 cm	Site 3 20-30 cm
Compound	CAS Number	LOR	Unit			EB1447699-006	EB1447699-007	EB1447699-008	EB1447699-009	EB1447699-010
EA002 : pH (Soils)										
pH Value	---	0.1	pH Unit			6.7	8.2	8.2	6.2	6.9
EA010: Conductivity										
Electrical Conductivity @ 25°C	---	1	µS/cm			89	727	926	62	36
ED008: Exchangeable Cations										
^ Exchangeable Calcium	---	0.1	meq/100g			6.0	5.2	2.6	16.4	22.9
^ Exchangeable Magnesium	---	0.1	meq/100g			8.6	12.9	7.5	6.5	9.9
^ Exchangeable Potassium	---	0.1	meq/100g			0.7	<0.1	<0.1	0.9	0.2
^ Exchangeable Sodium	---	0.1	meq/100g			0.3	2.2	1.7	<0.1	0.1
^ Cation Exchange Capacity	---	0.1	meq/100g			15.7	20.5	11.9	24.0	33.3



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID		Client sampling date / time		Site 3 50-60 cm	Site 4 0-10 cm	Site 4 20-30 cm	Site 4 50-60 cm	Site 4 80-90 cm
Compound	CAS Number	LOR	Unit			EB1447699-011	EB1447699-012	EB1447699-013	EB1447699-014	EB1447699-015
EA002 : pH (Soils)						Result	Result	Result	Result	Result
pH Value	----	0.1	pH Unit			7.6	6.6	8.4	8.8	8.8
EA010: Conductivity										
Electrical Conductivity @ 25°C	----	1	µS/cm			102	126	357	916	1060
ED008: Exchangeable Cations										
^ Exchangeable Calcium	----	0.1	meq/100g			33.4	5.2	11.0	21.6	9.3
^ Exchangeable Magnesium	----	0.1	meq/100g			11.6	7.6	14.5	11.3	12.0
^ Exchangeable Potassium	----	0.1	meq/100g			0.1	0.7	0.3	0.1	0.2
^ Exchangeable Sodium	----	0.1	meq/100g			0.2	0.5	2.7	1.8	2.6
^ Cation Exchange Capacity	----	0.1	meq/100g			45.4	14.0	28.7	34.9	24.1



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID		Client sampling date / time		Site 5 0-5 cm	Site 5 20-30 cm	Site 5 40-50 cm	Site 7 0-5 cm	Site 7 10-20 cm
Compound	CAS Number	LOR	Unit			Result	Result	Result	Result	Result
EA002 : pH (Soils)										
pH Value	----	0.1	pH Unit			6.7	7.2	7.9	5.6	6.6
EA010: Conductivity										
Electrical Conductivity @ 25°C	----	1	µS/cm			102	52	236	51	80
ED008: Exchangeable Cations										
^ Exchangeable Calcium	----	0.1	meq/100g			9.7	12.9	13.1	1.4	1.4
^ Exchangeable Magnesium	----	0.1	meq/100g			3.8	10.0	7.7	0.7	1.2
^ Exchangeable Potassium	----	0.1	meq/100g			1.1	0.7	0.5	0.5	0.4
^ Exchangeable Sodium	----	0.1	meq/100g			<0.1	0.8	0.3	<0.1	0.3
^ Cation Exchange Capacity	----	0.1	meq/100g			14.7	24.5	21.7	2.8	3.3



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID												
Compound	Client sampling date / time				Site 7 50-60 cm	Site 7 80-90 cm	Site 8 0-10 cm	Site 8 20-30 cm	Site 8 50-60 cm					
	CAS Number	LOR	Unit		EB1447699-021	EB1447699-022	EB1447699-023	EB1447699-024	EB1447699-025					
					Result	Result	Result	Result	Result					
EA002 : pH (Soils)														
pH Value		0.1	pH Unit		8.6	8.6	6.4	7.4	8.5					
EA010: Conductivity														
Electrical Conductivity @ 25°C		1	µS/cm		494	518	98	113	275					
ED008: Exchangeable Cations														
^ Exchangeable Calcium		0.1	meq/100g		7.2	5.4	23.7	27.4	41.8					
^ Exchangeable Magnesium		0.1	meq/100g		6.7	6.7	10.2	13.1	13.1					
^ Exchangeable Potassium		0.1	meq/100g		0.1	0.2	1.0	0.2	0.1					
^ Exchangeable Sodium		0.1	meq/100g		3.2	3.4	0.1	1.0	0.9					
^ Cation Exchange Capacity		0.1	meq/100g		17.2	15.8	35.1	41.8	55.9					



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID		Client sampling date / time		Site 9 0-5 cm	Site 9 20-30 cm	Site 9 50-60 cm	Site 9 80-90 cm	Site 10 0-10 cm
Compound	CAS Number	LOR	Unit			EB1447699-026	EB1447699-027	EB1447699-028	EB1447699-029	EB1447699-030
EA002 : pH (Soils)										
pH Value	----	0.1	pH Unit			6.3	7.6	7.8	8.8	6.8
EA010: Conductivity										
Electrical Conductivity @ 25°C	----	1	µS/cm			109	229	763	781	42
ED008: Exchangeable Cations										
^ Exchangeable Calcium	----	0.1	meq/100g			4.8	4.4	5.7	3.6	18.3
^ Exchangeable Magnesium	----	0.1	meq/100g			5.9	6.1	16.4	12.3	7.6
^ Exchangeable Potassium	----	0.1	meq/100g			0.7	0.3	0.2	0.2	1.4
^ Exchangeable Sodium	----	0.1	meq/100g			0.4	1.0	5.2	4.4	<0.1
^ Cation Exchange Capacity	----	0.1	meq/100g			11.9	11.8	27.5	20.5	27.5



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID		Client sampling date / time		Site 10 20-30 cm	Site 10 50-60 cm	Site 10 80-90 cm	Site 11 0-5 cm	Site 11 5-15 cm
Compound	CAS Number	LOR	Unit			Result	Result	Result	Result	Result
EA002 : pH (Soils)										
pH Value	----	0.1	pH Unit			7.8	8.1	8.0	7.2	7.8
EA010: Conductivity										
Electrical Conductivity @ 25°C	----	1	µS/cm			58	167	233	81	82
ED008: Exchangeable Cations										
^ Exchangeable Calcium	----	0.1	meq/100g			20.6	35.8	34.2	15.4	12.9
^ Exchangeable Magnesium	----	0.1	meq/100g			11.7	15.4	15.4	6.2	6.7
^ Exchangeable Potassium	----	0.1	meq/100g			0.3	0.2	0.2	0.9	0.3
^ Exchangeable Sodium	----	0.1	meq/100g			0.1	0.4	0.3	0.1	0.7
^ Cation Exchange Capacity	----	0.1	meq/100g			32.8	51.9	50.1	22.6	20.6



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID				Site 11 50-60 cm	Site 11 80-90 cm	Site 12 0-10 cm	Site 12 20-30 cm	Site 12 40-50 cm
Compound	Client sampling date / time			Unit	[03-Dec-2014]	[03-Dec-2014]	[03-Dec-2014]	[03-Dec-2014]	[03-Dec-2014]	
	CAS Number	LOR	EB1447699-036		EB1447699-037	EB1447699-038	EB1447699-039	EB1447699-040		
			Result		Result	Result	Result	Result		
EA002 : pH (Soils)										
pH Value		0.1	pH Unit	8.6	8.5	5.8	6.7	7.6		
EA010: Conductivity										
Electrical Conductivity @ 25°C		1	µS/cm	701	1180	57	43	198		
ED008: Exchangeable Cations										
^ Exchangeable Calcium		0.1	meq/100g	13.2	31.2	5.4	4.4	9.0		
^ Exchangeable Magnesium		0.1	meq/100g	16.1	16.4	3.3	3.4	15.7		
^ Exchangeable Potassium		0.1	meq/100g	0.3	0.2	1.0	0.7	0.9		
^ Exchangeable Sodium		0.1	meq/100g	3.9	3.9	<0.1	0.2	2.9		
^ Cation Exchange Capacity		0.1	meq/100g	33.6	51.7	9.8	8.9	28.5		

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID					
Compound	Client sampling date / time		Site 12 80-90 cm	Site 13 0-8 cm	Site 13 20-30 cm	Site 13 50-60 cm	Site 13 80-90 cm
	CAS Number	LOR	Unit				
				Result	Result	Result	Result
EA002 : pH (Solis)							
pH Value		0.1	pH Unit	6.5	8.2	8.5	8.8
EA010: Conductivity							
Electrical Conductivity @ 25°C		1	µS/cm	111	225	984	1160
ED008: Exchangeable Cations							
^ Exchangeable Calcium		0.1	meq/100g	8.8	13.9	34.3	32.1
^ Exchangeable Magnesium		0.1	meq/100g	7.2	15.6	19.7	20.5
^ Exchangeable Potassium		0.1	meq/100g	1.1	0.5	0.3	0.3
^ Exchangeable Sodium		0.1	meq/100g	0.2	2.8	3.7	4.9
^ Cation Exchange Capacity		0.1	meq/100g	17.4	32.8	58.0	57.8



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID		Site 14 0-5 cm	Site 14 20-30 cm	Site 14 50-60 cm	Site 14 80-90 cm	Site 16 0-10 cm
Compound	CAS Number	LOR	Unit	Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	---	0.1	pH Unit	6.3	7.8	8.7	8.9	7.1
EA010: Conductivity								
Electrical Conductivity @ 25°C	---	1	µS/cm	47	148	649	904	83
ED008: Exchangeable Cations								
^ Exchangeable Calcium	---	0.1	meq/100g	6.2	10.3	31.8	29.2	10.2
^ Exchangeable Magnesium	---	0.1	meq/100g	4.4	11.3	16.1	17.3	5.1
^ Exchangeable Potassium	---	0.1	meq/100g	0.8	0.4	0.2	0.2	1.1
^ Exchangeable Sodium	---	0.1	meq/100g	<0.1	1.5	2.2	2.6	<0.1
^ Cation Exchange Capacity	---	0.1	meq/100g	11.5	23.6	50.4	49.4	16.6



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID													
Compound	CAS Number	Client sampling date / time		LOR	Unit	Site 16 20-30 cm		Site 16 50-60 cm		Site 20 0-10 cm		Site 20 20-30 cm		Site 20 50-60 cm	
		[03-Dec-2014]				[03-Dec-2014]		[03-Dec-2014]		[03-Dec-2014]		[03-Dec-2014]		[03-Dec-2014]	
		EB1447699-051	EB1447699-052			EB1447699-053	EB1447699-054	EB1447699-055							
						Result		Result		Result		Result		Result	
EA002 : pH (Soils)															
pH Value	-----		0.1		pH Unit	8.2		8.9		7.2		8.5		8.8	
EA010: Conductivity															
Electrical Conductivity @ 25°C	-----		1		µS/cm	98		320		156		200		481	
ED008: Exchangeable Cations															
^ Exchangeable Calcium	-----		0.1		meq/100g	11.1		34.2		5.6		20.2		25.0	
^ Exchangeable Magnesium	-----		0.1		meq/100g	8.2		11.8		4.6		11.4		11.2	
^ Exchangeable Potassium	-----		0.1		meq/100g	0.4		0.2		0.7		0.4		0.2	
^ Exchangeable Sodium	-----		0.1		meq/100g	0.9		1.2		<0.1		0.6		1.1	
^ Cation Exchange Capacity	-----		0.1		meq/100g	20.7		47.6		11.0		32.6		37.5	



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID		Client sampling date / time		Site 20 80-90 cm	Site 21 0-8 cm	Site 21 20-30 cm	Site 21 50-60 cm	Site 22 0-10 cm
Compound	CAS Number	LOR	Unit			EB1447699-056	EB1447699-057	EB1447699-058	EB1447699-059	EB1447699-060
Result										
EA002 : pH (Soils)										
pH Value	---	0.1	pH Unit			8.9	6.7	8.7	8.8	8.2
EA010: Conductivity										
Electrical Conductivity @ 25°C	---	1	µS/cm			732	110	274	391	170
ED008: Exchangeable Cations										
^ Exchangeable Calcium	---	0.1	meq/100g			23.4	8.3	12.4	32.0	45.9
^ Exchangeable Magnesium	---	0.1	meq/100g			11.8	5.8	13.0	12.3	7.0
^ Exchangeable Potassium	---	0.1	meq/100g			0.2	1.0	0.3	0.2	1.2
^ Exchangeable Sodium	---	0.1	meq/100g			1.5	0.2	1.6	1.4	<0.1
^ Cation Exchange Capacity	---	0.1	meq/100g			37.0	15.3	27.5	46.0	54.3



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID													
Compound	Client sampling date / time		Site 22 20-30 cm		Site 22 50-60 cm		Site 23 0-10 cm		Site 23 20-30 cm		Site 23 50-60 cm				
	CAS Number	LOR	Unit												
EA002 : pH (Soils)															
pH Value		0.1	pH Unit		8.4		8.6		6.7		8.4		8.8		
EA010: Conductivity															
Electrical Conductivity @ 25°C		1	µS/cm		158		209		96		274		474		
ED008: Exchangeable Cations															
^ Exchangeable Calcium		0.1	meq/100g		38.4		35.1		8.0		18.0		29.2		
^ Exchangeable Magnesium		0.1	meq/100g		11.5		15.4		4.4		15.2		15.8		
^ Exchangeable Potassium		0.1	meq/100g		0.3		0.3		1.0		0.5		0.3		
^ Exchangeable Sodium		0.1	meq/100g		0.1		0.7		0.2		2.8		3.2		
^ Cation Exchange Capacity		0.1	meq/100g		50.5		51.6		13.6		36.6		48.6		



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID				Site 24 0-10 cm	Site 24 20-30 cm	Site 24 50-60 cm	Site 25 0-10 cm	Site 25 20-30 cm
Compound	Client sampling date / time		CAS Number	LOR	Unit	[03-Dec-2014]	[03-Dec-2014]	[03-Dec-2014]	[03-Dec-2014]	[03-Dec-2014]
						EB1447699-066	EB1447699-067	EB1447699-068	EB1447699-069	EB1447699-070
						Result	Result	Result	Result	Result
EA002 : pH (Soils)										
pH Value	----	0.1			pH Unit	6.7	7.0	7.9	6.4	6.5
EA010: Conductivity										
Electrical Conductivity @ 25°C	----	1			µS/cm	89	36	69	60	46
ED008: Exchangeable Cations										
^ Exchangeable Calcium	----	0.1			meq/100g	6.2	2.8	7.7	7.1	8.0
^ Exchangeable Magnesium	----	0.1			meq/100g	1.9	1.2	4.3	3.4	9.3
^ Exchangeable Potassium	----	0.1			meq/100g	0.9	0.8	1.6	1.1	0.7
^ Exchangeable Sodium	----	0.1			meq/100g	<0.1	<0.1	<0.1	<0.1	0.5
^ Cation Exchange Capacity	----	0.1			meq/100g	9.2	5.0	13.8	11.7	18.6

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID						
Compound	Client sampling date / time		Site 26 0-10 cm	Site 26 20-30 cm	Site 26 50-60 cm	Site 27 0-10 cm	Site 27 20-30 cm	
	CAS Number	LOR	Unit					
			Result	Result	Result	Result	Result	
EA002 : pH (Solis)								
pH Value		0.1	pH Unit	6.1	7.2	7.3	6.4	7.3
EA010: Conductivity								
Electrical Conductivity @ 25°C		1	µS/cm	39	18	41	92	56
ED008: Exchangeable Cations								
^ Exchangeable Calcium		0.1	meq/100g	3.4	2.4	7.8	9.2	14.1
^ Exchangeable Magnesium		0.1	meq/100g	1.0	0.4	3.1	5.3	11.8
^ Exchangeable Potassium		0.1	meq/100g	0.7	0.3	0.7	1.1	0.4
^ Exchangeable Sodium		0.1	meq/100g	<0.1	<0.1	<0.1	<0.1	0.3
^ Cation Exchange Capacity		0.1	meq/100g	5.2	3.3	11.7	15.6	26.7



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID				Client sampling date / time		Site 27 50-60 cm	Site 28 0-10 cm	Site 28 20-30 cm	Site 28 50-60 cm	Site 28 80-90 cm
Compound	CAS Number	LOR	Unit					EB1447699-076	EB1447699-077	EB1447699-078	EB1447699-079	EB1447699-080
Result												
EA002 : pH (Soils)												
pH Value	---	0.1	pH Unit					7.3	6.3	7.0	6.9	7.9
EA010: Conductivity												
Electrical Conductivity @ 25°C	---	1	µS/cm					219	31	17	11	47
ED008: Exchangeable Cations												
^ Exchangeable Calcium	---	0.1	meq/100g					34.9	2.5	2.3	1.3	3.5
^ Exchangeable Magnesium	---	0.1	meq/100g					15.3	0.7	0.4	0.3	2.3
^ Exchangeable Potassium	---	0.1	meq/100g					0.2	0.5	0.4	0.3	0.3
^ Exchangeable Sodium	---	0.1	meq/100g					0.5	<0.1	<0.1	<0.1	<0.1
^ Cation Exchange Capacity	---	0.1	meq/100g					50.9	3.8	3.3	1.9	6.4



Environmental

CERTIFICATE OF ANALYSIS

Work Order	: EB1447707	Page	: 1 of 18
Client	: SLR Consulting Australia Pty Ltd	Laboratory	: Environmental Division Brisbane
Contact	: MS ADELE CALANDRA	Contact	: Customer Services EB
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Project	: 630.11145	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	:	Date Samples Received	: 03-Dec-2014 13:40
C-O-C number	:	Date Analysis Commenced	: 08-Dec-2014
Sampler	:	Issue Date	: 12-Dec-2014 12:41
Site	:	No. of samples received	: 81
Quote number	:	No. of samples analysed	: 76

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

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.

Signatories	Position	Accreditation Category
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics





Page : 2 of 18
Work Order : EB1447707
Client : SLR Consulting Australia Pty Ltd
Project : 630.11145

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.

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

Δ = This result is computed from individual analyte detections at or above the level of reporting

Ø = ALS is not NATA accredited for these tests.

- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl (Method 15G1) is a more suitable method for the determination of exchange acidity (H⁺ + Al³⁺).



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID		Client sampling date / time		Site 29 0-10cm	Site 29 20-30cm	Site 29 50-60cm	Site 29 80-90cm	Site 30 0-10cm
Compound	CAS Number	LOR	Unit			EB1447707-001	EB1447707-002	EB1447707-003	EB1447707-004	EB1447707-005
EA002 : pH (Soils)										
pH Value	---	0.1	pH Unit			6.2	7.2	7.6	6.1	6.4
EA010: Conductivity										
Electrical Conductivity @ 25°C	---	1	µS/cm			31	34	282	575	28
ED008: Exchangeable Cations										
^ Exchangeable Calcium	---	0.1	meq/100g			2.4	1.2	0.5	1.0	3.7
^ Exchangeable Magnesium	---	0.1	meq/100g			1.0	1.2	1.5	3.2	2.8
^ Exchangeable Potassium	---	0.1	meq/100g			0.5	0.2	<0.1	<0.1	0.7
^ Exchangeable Sodium	---	0.1	meq/100g			<0.1	0.2	0.8	1.4	<0.1
^ Cation Exchange Capacity	---	0.1	meq/100g			4.0	2.8	2.9	5.8	7.4



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID		Client sampling date / time		Site 30 20-30cm	Site 30 50-60cm	Site 30 90-100cm	Site 31 0-10cm	Site 31 20-30cm
Compound	CAS Number	LOR	Unit			EB1447707-006	EB1447707-007	EB1447707-008	EB1447707-009	EB1447707-010
EA002 : pH (Soils)						Result	Result	Result	Result	Result
pH Value	----	0.1	pH Unit			7.3	8.6	8.1	5.9	7.1
EA010: Conductivity										
Electrical Conductivity @ 25°C	----	1	µS/cm			158	860	798	35	213
ED008: Exchangeable Cations										
^ Exchangeable Calcium	----	0.1	meq/100g			8.2	19.2	2.3	5.4	8.3
^ Exchangeable Magnesium	----	0.1	meq/100g			6.8	11.4	11.0	3.0	13.5
^ Exchangeable Potassium	----	0.1	meq/100g			0.2	0.3	0.2	0.6	0.2
^ Exchangeable Sodium	----	0.1	meq/100g			1.2	2.1	3.7	<0.1	2.6
^ Cation Exchange Capacity	----	0.1	meq/100g			16.7	33.1	17.3	9.2	24.7



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID		Client sampling date / time		Site 31 50-60cm	Site 31 80-90cm	Site 32 0-10cm	Site 32 20-30cm	Site 32 50-60cm
Compound	CAS Number	LOR	Unit			EB1447707-011 Result	EB1447707-012 Result	EB1447707-013 Result	EB1447707-014 Result	EB1447707-015 Result
EA002 : pH (Soils)										
pH Value	---	0.1	pH Unit			8.7	8.9	6.7	7.1	9.0
EA010: Conductivity										
Electrical Conductivity @ 25°C	---	1	µS/cm			779	839	45	39	199
ED008: Exchangeable Cations										
^ Exchangeable Calcium	---	0.1	meq/100g			8.7	27.3	7.9	11.0	24.7
^ Exchangeable Magnesium	---	0.1	meq/100g			18.0	15.6	6.1	11.0	13.0
^ Exchangeable Potassium	---	0.1	meq/100g			0.3	0.2	1.0	0.8	0.2
^ Exchangeable Sodium	---	0.1	meq/100g			4.4	3.0	<0.1	0.4	0.8
^ Cation Exchange Capacity	---	0.1	meq/100g			31.4	46.2	15.2	23.4	38.8



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID		Client sampling date / time		Site 33 0-10cm	Site 33 40-50cm	Site 34 0-10cm	Site 34 20-30cm	Site 34 50-60cm
Compound	CAS Number	LOR	Unit			Result	Result	Result	Result	Result
EA002 : pH (Soils)										
pH Value	----	0.1	pH Unit			7.0	8.8	5.9	6.9	8.2
EA010: Conductivity										
Electrical Conductivity @ 25°C	----	1	µS/cm			51	339	26	36	141
ED008: Exchangeable Cations										
^ Exchangeable Calcium	----	0.1	meq/100g			7.1	17.4	8.2	9.0	9.6
^ Exchangeable Magnesium	----	0.1	meq/100g			11.3	17.4	4.8	5.0	6.1
^ Exchangeable Potassium	----	0.1	meq/100g			1.0	0.4	0.6	0.2	0.2
^ Exchangeable Sodium	----	0.1	meq/100g			0.4	1.4	0.1	0.6	1.9
^ Cation Exchange Capacity	----	0.1	meq/100g			19.9	36.7	13.9	15.0	18.0



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID		Client sampling date / time		Site 34 80-90cm	Site 35 0-10cm	Site 35 20-30cm	Site 35 50-60cm	Site 36 0-10cm
Compound	CAS Number	LOR	Unit			EB1447707-021	EB1447707-022	EB1447707-023	EB1447707-024	EB1447707-025
EA002 : pH (Soils)						Result	Result	Result	Result	Result
pH Value	----	0.1	pH Unit			8.8	6.8	8.2	8.8	6.0
EA010: Conductivity						665	86	86	705	22
Electrical Conductivity @ 25°C										
ED008: Exchangeable Cations										
^ Exchangeable Calcium	----	0.1	meq/100g			7.1	10.0	16.3	27.6	3.4
^ Exchangeable Magnesium	----	0.1	meq/100g			7.6	5.9	16.0	16.6	0.9
^ Exchangeable Potassium	----	0.1	meq/100g			0.2	1.8	1.0	0.6	0.4
^ Exchangeable Sodium	----	0.1	meq/100g			3.2	<0.1	1.5	1.7	<0.1
^ Cation Exchange Capacity	----	0.1	meq/100g			18.3	17.9	34.9	46.6	4.8



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID		Client sampling date / time		Site 36 30-40cm	Site 36 50-60cm	Site 36 80-90cm	Site 38 0-10cm	Site 38 20-30cm
Compound	CAS Number	LOR	Unit			Result	Result	Result	Result	Result
EA002 : pH (Soils)										
pH Value	----	0.1	pH Unit			6.9	7.4	7.8	6.7	7.4
EA010: Conductivity										
Electrical Conductivity @ 25°C	----	1	µS/cm			9	33	55	86	90
ED008: Exchangeable Cations										
^ Exchangeable Calcium	----	0.1	meq/100g			2.1	9.1	12.1	7.6	9.3
^ Exchangeable Magnesium	----	0.1	meq/100g			0.8	6.8	10.9	4.7	12.6
^ Exchangeable Potassium	----	0.1	meq/100g			0.3	0.7	1.1	0.8	0.5
^ Exchangeable Sodium	----	0.1	meq/100g			<0.1	0.2	0.4	<0.1	0.8
^ Cation Exchange Capacity	----	0.1	meq/100g			3.2	16.9	24.6	13.2	23.3



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID															
Compound	Client sampling date / time		CAS Number	LOR	Unit	Site 38 50-60cm		Site 39 0-10cm		Site 39 30-40cm		Site 40 0-10cm		Site 40 20-30cm			
						Result	EB1447707-031	Result	EB1447707-032	Result	EB1447707-033	Result	EB1447707-034	Result	EB1447707-035		
EA002 : pH (Soils)																	
pH Value			0.1	pH Unit		8.8		6.4		7.2		6.9		8.3			
EA010: Conductivity																	
Electrical Conductivity @ 25°C			1	µS/cm		388		56		64		51		267			
ED008: Exchangeable Cations																	
^ Exchangeable Calcium			0.1	meq/100g		27.5		8.2		11.9		6.8		8.4			
^ Exchangeable Magnesium			0.1	meq/100g		14.9		4.0		10.6		4.8		14.8			
^ Exchangeable Potassium			0.1	meq/100g		0.2		0.8		0.4		0.8		0.6			
^ Exchangeable Sodium			0.1	meq/100g		1.0		<0.1		0.6		<0.1		2.7			
^ Cation Exchange Capacity			0.1	meq/100g		43.6		13.3		23.7		12.7		26.7			



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID		Client sampling date / time		Site 40 50-60cm	Site 42 0-5cm	Site 42 20-30cm	Site 42 50-60cm	Site 43 0-10cm
Compound	CAS Number	LOR	Unit			EB1447707-036	EB1447707-037	EB1447707-038	EB1447707-039	EB1447707-040
EA002 : pH (Soils)						Result	Result	Result	Result	Result
pH Value	---	0.1	pH Unit			8.8	6.6	7.5	8.8	6.6
EA010: Conductivity										
Electrical Conductivity @ 25°C	---	1	µS/cm			962	76	204	747	30
ED008: Exchangeable Cations										
^ Exchangeable Calcium	---	0.1	meq/100g			25.5	7.6	8.4	15.6	2.1
^ Exchangeable Magnesium	---	0.1	meq/100g			20.0	5.4	12.3	19.9	1.9
^ Exchangeable Potassium	---	0.1	meq/100g			0.3	1.0	0.7	0.4	0.4
^ Exchangeable Sodium	---	0.1	meq/100g			3.3	<0.1	1.3	2.5	<0.1
^ Cation Exchange Capacity	---	0.1	meq/100g			49.2	14.3	22.8	38.4	4.4



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID		Site 43 20-30cm	Site 43 50-60cm	Site 43 80-90cm	Site 46 0-10cm	Site 46 20-30cm
Compound	CAS Number	LOR	Unit	Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	---	0.1	pH Unit	7.8	9.0	9.1	6.6	7.9
EA010: Conductivity								
Electrical Conductivity @ 25°C	---	1	µS/cm	104	450	467	83	230
ED008: Exchangeable Cations								
^ Exchangeable Calcium	---	0.1	meq/100g	3.3	1.6	2.2	7.2	13.0
^ Exchangeable Magnesium	---	0.1	meq/100g	10.1	7.1	6.6	4.0	8.9
^ Exchangeable Potassium	---	0.1	meq/100g	0.3	0.2	0.1	0.5	0.2
^ Exchangeable Sodium	---	0.1	meq/100g	1.7	2.3	2.1	0.3	2.4
^ Cation Exchange Capacity	---	0.1	meq/100g	15.6	11.4	11.1	12.2	24.6



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID		Client sampling date / time		Site 46 50-60cm	Site 46 80-90cm	Site 48 0-10cm	Site 48 20-30cm	Site 48 60-70cm
Compound	CAS Number	LOR	Unit			Result	Result	Result	Result	Result
EA002 : pH (Soils)										
pH Value	---	0.1	pH Unit			8.1	7.6	6.3	6.1	5.1
EA010: Conductivity										
Electrical Conductivity @ 25°C	---	1	µS/cm			816	674	71	20	342
ED008: Exchangeable Cations										
^ Exchangeable Calcium	---	0.1	meq/100g			17.2	6.6	5.7	0.6	3.3
^ Exchangeable Magnesium	---	0.1	meq/100g			10.4	6.7	1.7	0.6	5.6
^ Exchangeable Potassium	---	0.1	meq/100g			0.2	0.2	0.5	0.3	<0.1
^ Exchangeable Sodium	---	0.1	meq/100g			2.8	2.4	<0.1	<0.1	1.2
^ Cation Exchange Capacity	---	0.1	meq/100g			30.8	16.0	8.0	1.8	10.5



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID												
Compound	Client sampling date / time				Site 48 100-110cm	Site 49 0-10cm	Site 49 20-30cm	Site 49 60-70cm	Site 49 90-100cm					
	CAS Number	LOR	Unit		EB1447707-051	EB1447707-052	EB1447707-053	EB1447707-054	EB1447707-055					
					Result	Result	Result	Result	Result					
EA002 : pH (Soils)														
pH Value		0.1	pH Unit		7.5	7.5	8.7	9.0		8.9				
EA010: Conductivity														
Electrical Conductivity @ 25°C		1	µS/cm		383	225	168	693		1120				
ED008: Exchangeable Cations														
^ Exchangeable Calcium		0.1	meq/100g		5.3	24.5	38.7	32.1		30.4				
^ Exchangeable Magnesium		0.1	meq/100g		7.7	6.8	13.6	19.8		20.4				
^ Exchangeable Potassium		0.1	meq/100g		0.1	1.2	0.2	0.2		0.1				
^ Exchangeable Sodium		0.1	meq/100g		2.0	<0.1	0.2	2.3		3.3				
^ Cation Exchange Capacity		0.1	meq/100g		15.3	32.6	52.8	54.5		54.2				



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID		Client sampling date / time		Site 51 0-10cm	Site 51 10-20cm	Site 51 50-60cm	Site 51 90-100cm	Site 53 0-10cm
Compound	CAS Number	LOR	Unit			Result	Result	Result	Result	Result
EA002 : pH (Soils)										
pH Value	---	0.1	pH Unit			6.5	6.8	7.7	8.2	6.2
EA010: Conductivity										
Electrical Conductivity @ 25°C	---	1	µS/cm			32	23	194	329	82
ED008: Exchangeable Cations										
^ Exchangeable Calcium	---	0.1	meq/100g			2.8	1.8	3.4	2.6	4.5
^ Exchangeable Magnesium	---	0.1	meq/100g			1.2	1.4	6.5	5.4	2.6
^ Exchangeable Potassium	---	0.1	meq/100g			0.5	0.3	0.3	0.3	0.6
^ Exchangeable Sodium	---	0.1	meq/100g			<0.1	<0.1	1.0	1.0	<0.1
^ Cation Exchange Capacity	---	0.1	meq/100g			4.5	3.6	11.4	9.6	7.8



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID		Client sampling date / time		Site 53 10-20cm	Site 53 20-30cm	Site 53 50-60cm	Site 53 90-100cm	Site 54 0-10cm
Compound	CAS Number	LOR	Unit			EB1447707-065	EB1447707-066	EB1447707-067	EB1447707-068	EB1447707-069
EA002 : pH (Soils)						Result	Result	Result	Result	Result
pH Value	---	0.1	pH Unit			6.9	7.4	8.0	8.7	6.2
EA010: Conductivity										
Electrical Conductivity @ 25°C	---	1	µS/cm			32	149	577	1030	35
ED008: Exchangeable Cations										
^ Exchangeable Calcium	---	0.1	meq/100g			1.5	3.0	1.8	12.7	4.1
^ Exchangeable Magnesium	---	0.1	meq/100g			1.2	5.6	7.3	11.6	1.4
^ Exchangeable Potassium	---	0.1	meq/100g			0.4	0.4	0.2	0.2	0.7
^ Exchangeable Sodium	---	0.1	meq/100g			0.1	1.2	2.2	2.0	<0.1
^ Cation Exchange Capacity	---	0.1	meq/100g			3.2	10.3	11.5	26.6	6.3



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID		Client sampling date / time		Site 54 20-30cm	Site 54 50-60cm	Site 56 0-10cm	Site 56 20-30cm	Site 57 0-10cm
Compound	CAS Number	LOR	Unit			EB1447707-070	EB1447707-071	EB1447707-072	EB1447707-073	EB1447707-074
EA002 : pH (Soils)										
pH Value	---	0.1	pH Unit			7.4	8.9	7.0	8.2	6.4
EA010: Conductivity										
Electrical Conductivity @ 25°C	---	1	µS/cm			42	335	159	221	93
ED008: Exchangeable Cations										
^ Exchangeable Calcium	---	0.1	meq/100g			10.6	31.4	8.4	18.3	7.6
^ Exchangeable Magnesium	---	0.1	meq/100g			6.9	9.2	4.4	6.0	3.2
^ Exchangeable Potassium	---	0.1	meq/100g			0.6	0.2	0.8	0.6	0.8
^ Exchangeable Sodium	---	0.1	meq/100g			1.0	1.0	<0.1	0.2	<0.1
^ Cation Exchange Capacity	---	0.1	meq/100g			19.2	42.0	13.8	25.2	11.7



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID		Site 57 30-40cm	Site 58 0-10cm	Site 58 20-30cm	Site 59 0-10cm	Site 59 20-30cm
Compound	CAS Number	LOR	Unit	Client sampling date / time	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	---	0.1	pH Unit		8.6	6.8	6.8	7.9
EA010: Conductivity								
Electrical Conductivity @ 25°C	---	1	µS/cm		282	83	72	169
ED008: Exchangeable Cations								
^ Exchangeable Calcium	---	0.1	meq/100g		31.0	9.2	8.2	16.2
^ Exchangeable Magnesium	---	0.1	meq/100g		13.2	4.8	3.6	9.2
^ Exchangeable Potassium	---	0.1	meq/100g		0.3	0.9	0.9	0.5
^ Exchangeable Sodium	---	0.1	meq/100g		1.5	<0.1	<0.1	0.3
^ Cation Exchange Capacity	---	0.1	meq/100g		46.1	15.0	12.9	26.3



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID			Site 59 50-60cm						
		Client sampling date / time			[03-Dec-2014]						
Compound	CAS Number	LOR	Unit		EB1447707-080	Result	Result	Result	Result	Result	Result
EA002 : pH (Soils)											
pH Value		0.1	pH Unit		8.9						
EA010: Conductivity											
Electrical Conductivity @ 25°C		1	µS/cm		321						
ED008: Exchangeable Cations											
^ Exchangeable Calcium		0.1	meq/100g		31.7						
^ Exchangeable Magnesium		0.1	meq/100g		11.9						
^ Exchangeable Potassium		0.1	meq/100g		0.2						
^ Exchangeable Sodium		0.1	meq/100g		0.9						
^ Cation Exchange Capacity		0.1	meq/100g		44.7						



Environmental

CERTIFICATE OF ANALYSIS

Work Order	: EB1510282	Page	: 1 of 2
Client	: SLR Consulting Australia Pty Ltd	Laboratory	: Environmental Division Brisbane
Contact	: MS ADELE CALANDRA	Contact	: Customer Services EB
Address	: LEVEL 1, 241 DENNISON STREET BROADMEADOW NSW 2292	Address	: 2 Byth Street Stafford QLD Australia 4053
E-mail	: acalandra@slrconsulting.com	E-mail	: ALSEnviro.Brisbane@alsglobal.com
Telephone	: +61 02 4920 3000	Telephone	: +61-7-3243 7222
Facsimile	: +61 02 4961 3360	Facsimile	: +61-7-3243 7218
Project	: 630.11145	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number		Date Samples Received	: 08-Jan-2015 08:05
C-O-C number		Date Analysis Commenced	: 09-Jan-2015
Sampler		Issue Date	: 15-Jan-2015 16:27
Site			
Quote number		No. of samples received	: 5
		No. of samples analysed	: 5

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

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.

Signatories	Position	Accreditation Category
Andrew Epps	Senior Inorganic Chemist	Brisbane Inorganics
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics



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.

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

Ø = ALS is not NATA accredited for these tests.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID		Site 40 80-90cm	Site 52 0-10cm	Site 52 20-30cm	Site 52 50-60cm	Site 52 90-100cm
Compound	CAS Number	LOR	Unit	Result	Result	Result	Result	Result
EA002 : pH (Solis)								
pH Value		0.1	pH Unit	8.9	7.1	8.2	8.7	9.0
EA010: Conductivity								
Electrical Conductivity @ 25°C		1	µS/cm	893	142	455	1040	1140
ED008: Exchangeable Cations								
^ Exchangeable Calcium		0.1	meq/100g	18.0	6.0	20.5	26.6	30.9
^ Exchangeable Magnesium		0.1	meq/100g	18.4	5.1	11.7	15.1	12.2
^ Exchangeable Potassium		0.1	meq/100g	0.2	0.8	0.3	0.3	0.3
^ Exchangeable Sodium		0.1	meq/100g	2.2	0.2	1.3	3.2	2.4
^ Cation Exchange Capacity		0.1	meq/100g	38.9	12.2	34.0	45.2	46.0

SOIL TEST REPORT

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Scone Research Centre

REPORT NO: SCO14/252R1

REPORT TO: Adele Calandra
SLR Consulting
10 Kings Road
New Lambton NSW 2305

REPORT ON: One hundred and sixty soil samples
Your ref: 630.11145

PRELIMINARY RESULTS
ISSUED: Not issued

REPORT STATUS: Final

DATE REPORTED: 15 December 2014

METHODS: Information on test procedures can be obtained from Scone
Research Centre

TESTING CARRIED OUT ON SAMPLE AS RECEIVED
THIS DOCUMENT MAY NOT BE REPRODUCED EXCEPT IN FULL



SR Young
(Laboratory Manager)

SOIL CONSERVATION SERVICE
Scone Research Centre

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Report No: SCO14/252R1
Client Reference: Adele Calandra
SLR Consulting
10 Kings Road
New Lambton NSW 2305

Lab No	Method	P7B/2 Particle Size Analysis (%)					Colour	
	Sample Id	clay	silt	f sand	c sand	gravel	Dry	Moist
1	Site 1 0-10 cm	15	22	41	22	<1	7.5YR 4/4	7.5YR 3/3
2	Site 1 20-30 cm	17	14	28	22	19	7.5YR 5/3	7.5YR 4/2
3	Site 1 50-60 cm	58	13	20	9	<1	7.5YR 4/6	7.5YR 3/4
4	Site 1 80-90 cm	54	12	23	11	<1	7.5YR 4/6	7.5YR 3/4
5	Site 2 0-10 cm	39	11	29	13	8	10YR 5/2	10YR 3/2
6	Site 2 10-20 cm	50	13	23	13	1	10YR 5/2	10YR 3/2
7	Site 2 50-60 cm	48	11	26	13	2	10YR 5/2	10YR 4/2
8	Site 2 80-90 cm	46	11	26	13	4	10YR 5/3	10YR 4/3
9	Site 3 0-10 cm	34	28	33	5	<1	7.5YR 4/3	7.5YR 3/2
10	Site 3 20-30 cm	59	18	20	3	<1	5YR 4/4	5YR 3/4
11	Site 3 50-60 cm	42	18	26	13	1	5YR 4/4	7.5YR 3/3
12	Site 4 0-10 cm	29	10	36	20	5	7.5YR 5/2	7.5YR 4/1
13	Site 4 20-30 cm	53	9	23	14	1	10YR 5/2	10YR 4/2
14	Site 4 50-60 cm	40	6	29	18	7	10YR 5/3	10YR 4/3
15	Site 4 80-90 cm	48	9	22	16	5	10YR 6/4	10YR 5/4
16	Site 5 0-5 cm	21	12	34	29	4	7.5YR 5/3	7.5YR 3/2
17	Site 5 20-30 cm	42	14	21	23	<1	10YR 5/4	10YR 4/4
18	Site 5 40-50 cm	43	15	18	24	<1	10YR 4/4	10YR 4/4
19	Site 7 0-5 cm	3	17	45	30	5	10YR 5/3	10YR 3/3
20	Site 7 10-20 cm	12	17	37	30	4	10YR 6/3	10 R 4/3
21	Site 7 50-60 cm	27	22	28	22	1	10YR 6/4	10YR 5/4
22	Site 7 80-90 cm	35	23	16	24	2	10YR 5/4	10YR 4/4
23	Site 8 0-10 cm	44	25	26	5	<1	7.5YR 3/3	7.5 R 3/3
24	Site 8 20-30 cm	61	20	17	2	<1	7.5YR 3/4	7.5YR 3/4
25	Site 8 50-60 cm	49	18	22	10	1	7.5YR 5/3	7.5YR 4/4
26	Site 9 0-5 cm	13	30	45	11	1	10YR 4/4	10YR 3/3
27	Site 9 20-30 cm	17	35	36	12	<1	10YR 5/3	10YR 3/3
28	Site 9 50-60 cm	65	18	13	4	0	7.5YR 4/3	10YR 4/4
29	Site 9 80-90 cm	51	23	21	5	<1	7.5YR 4/6	7.5YR 4/6



SOIL CONSERVATION SERVICE
Scone Research Centre

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Report No: SCO14/252R1
Client Reference: Adele Calandra
SLR Consulting
10 Kings Road
New Lambton NSW 2305

Lab No	Method	P7B/2 Particle Size Analysis (%)					Colour	
	Sample Id	clay	silt	f sand	c sand	gravel	Dry	Moist
30	Site 10 0-10 cm	34	29	30	7	<1	10YR 4/3	10YR 3/3
31	Site 10 20-30 cm	54	23	19	4	0	7.5YR 3/4	7.5YR 3/4
32	Site 10 50-60 cm	58	25	14	3	<1	7.5YR 4/4	7.5YR 3/4
33	Site 10 80-90 cm	56	13	18	12	1	7.5YR 4/4	7.5YR 4/4
34	Site 11 0-10 cm	38	14	32	15	1	10YR 4/3	10YR 3/3
35	Site 11 20-30 cm	41	16	27	15	1	10YR 4/3	10YR 3/3
36	Site 11 50-60 cm	58	12	19	10	1	10YR 4/3	10YR 3/3
37	Site 11 80-90 cm	61	22	10	7	<1	10YR 6/4	10YR 5/6
38	Site 12 0-5 cm	19	21	40	18	2	10YR 5/3	10YR 3/3
39	Site 12 5-15 cm	22	24	33	18	3	10YR 5/3	10YR 3/3
40	Site 12 40-50 cm	58	13	20	9	<1	10YR 5/3	10YR 4/3
41	Site 12 80-90 cm	46	21	32	1	<1	10YR 6/3	10YR 5/4
42	Site 13 0-8 cm	26	11	46	15	2	10YR 4/3	10YR 3/3
43	Site 13 20-30 cm	61	8	24	7	<1	10YR 4/3	10YR 3/3
44	Site 13 50-60 cm	62	11	18	8	1	7.5YR 5/4	7.5YR 4/6
45	Site 13 80-90 cm	68	8	16	8	<1	7.5YR 5/4	7.5YR 4/6
46	Site 14 0-5 cm	20	16	44	19	1	10YR 4/3	10YR 3/3
47	Site 14 20-30 cm	44	8	29	19	<1	10YR 4/3	10YR 4/3
48	Site 14 50-60 cm	51	11	24	13	1	7.5YR 5/4	7.5YR 4/6
49	Site 14 80-90 cm	49	14	25	12	<1	7.5YR 6/4	7.5YR 5/6
50	Site 16 0-10 cm	29	16	39	15	1	7.5YR 4/4	7.5YR 3/4
51	Site 16 20-30 cm	43	18	26	12	1	10YR 6/4	10YR 4/6
52	Site 16 50-60 cm	47	13	24	15	1	10YR 5/4	10YR 4/6
53	Site 20 0-10 cm	20	14	26	32	8	10YR 4/3	10YR 3/3
54	Site 20 20-30 cm	35	13	25	26	1	10YR 5/4	10YR 4/4
55	Site 20 50-60 cm	33	13	23	28	3	7.5YR 5/4	7.5YR 4/6
56	Site 20 80-90 cm	40	13	21	25	1	10YR 6/4	10YR 5/6
57	Site 21 0-8 cm	24	17	41	17	1	7.5YR 4/3	7.5YR 3/4
58	Site 21 20-30 cm	45	14	26	15	<1	7.5YR 4/4	7.5YR 4/4
59	Site 21 50-60 cm	30	21	37	12	<1	7.5YR 5/4	7.5YR 4/6



SOIL CONSERVATION SERVICE**Scone Research Centre**

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Report No: SCO14/252R1
Client Reference: Adele Calandra
SLR Consulting
10 Kings Road
New Lambton NSW 2305

Lab No	Method	P7B/2 Particle Size Analysis (%)					Colour	
	Sample Id	clay	silt	f sand	c sand	gravel	Dry	Moist
60	Site 22 0-10 cm	35	18	34	12	1	10YR 4/3	10YR 3/3
61	Site 22 20-30 cm	43	31	18	7	1	10YR 6/4	10YR 5/4
62	Site 22 50-60 cm	46	26	21	6	1	10YR 6/4	10YR 4/6
63	Site 23 0-10 cm	15	26	38	14	7	10YR 5/3	10YR 3/3
64	Site 23 20-30 cm	58	19	17	6	<1	10YR 4/2	10YR 3/3
65	Site 23 50-60 cm	55	17	16	9	3	2.5Y 4/2	2.5Y 3/3
66	Site 24 0-10 cm	10	15	35	40	<1	7.5YR 4/3	7.5YR 3/3
67	Site 24 20-30 cm	12	17	38	32	1	5YR 6/3	5YR 4/4
68	Site 24 50-60 cm	46	13	21	20	0	5YR 5/6	5YR 4/6
69	Site 25 0-10 cm	14	21	46	15	4	10YR 4/4	10YR 3/3
70	Site 25 20-30 cm	51	16	24	9	<1	7.5YR 5/6	7.5YR 4/6
71	Site 26 0-10 cm	10	13	31	46	<1	10YR 5/3	10YR 3/3
72	Site 26 20-30 cm	10	12	33	43	2	7.5YR 6/3	7.5YR 4/4
73	Site 26 50-60 cm	41	12	15	31	1	7.5YR 5/6	7.5YR 5/6
74	Site 27 0-10 cm	18	20	50	11	1	7.5YR 4/4	7.5YR 2.5/3
75	Site 27 20-30 cm	49	11	34	6	0	7.5YR 4/4	7.5YR 3/4
76	Site 27 50-60 cm	42	26	24	7	1	7.5YR 5/6	7.5YR 4/6
77	Site 28 0-10 cm	4	11	19	65	1	10YR 5/3	10YR 3/3
78	Site 28 20-30 cm	5	14	18	60	3	10YR 5/3	10YR 3/3
79	Site 28 50-60 cm	5	12	16	54	13	10YR 7/2	10YR 6/4
80	Site 28 80-90 cm	32	8	16	30	14	2.5Y 7/4	2.5Y 6/4
81	Site 29 0-10 cm	12	15	32	38	3	10YR 5/3	10YR 3/3
82	Site 29 20-30 cm	13	16	31	36	4	10YR 7/2	10YR 6/2
83	Site 29 50-60 cm	34	9	25	28	4	10YR 7/3	10YR 6/3
84	Site 29 80-90 cm	31	3	36	30	<1	7.5YR 5/6	7.5YR 4/6
85	Site 30 0-10 cm	21	12	32	29	6	10YR 5/2	10YR 3/2
86	Site 30 20-30 cm	31	11	25	27	6	10YR 5/2	10YR 3/2
87	Site 30 50-60 cm	54	9	16	18	3	10YR 5/3	10YR 4/3
88	Site 30 90-100 cm	58	29	11	2	0	2.5Y 7/4	2.5Y 6/4



SOIL CONSERVATION SERVICE
Scone Research Centre

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Report No: SCO14/252R1
Client Reference: Adele Calandra
SLR Consulting
10 Kings Road
New Lambton NSW 2305

Lab No	Method	P7B/2 Particle Size Analysis (%)					Colour	
	Sample Id	clay	silt	f sand	c sand	gravel	Dry	Moist
89	Site 31 0-10 cm	20	20	42	17	1	10YR 4/3	10YR 3/3
90	Site 31 20-30 cm	64	8	21	7	<1	7.5YR 4/4	7.5YR 3/4
91	Site 31 50-60 cm	65	9	17	8	1	7.5YR 4/6	5YR 4/4
92	Site 31 80-90 cm	65	8	17	10	<1	7.5YR 5/6	7.5YR 5/6
93	Site 32 0-10 cm	33	29	25	12	1	7.5YR 5/3	7.5YR 4/3
94	Site 32 20-30 cm	55	27	12	6	<1	10YR 5/3	10YR 4/3
95	Site 32 50-60 cm	45	30	12	7	6	10YR 5/3	10YR 4/3
96	Site 33 0-10 cm	42	22	25	7	4	10YR 4/4	10YR 3/3
97	Site 33 40-50 cm	58	23	13	4	2	10YR 5/4	10YR 4/3
98	Site 34 0-10 cm	27	30	35	8	<1	10YR 5/2	10YR 3/2
99	Site 34 20-30 cm	29	18	37	16	<1	10YR 5/3	10YR 4/2
100	Site 34 50-60 cm	28	21	28	23	<1	7.5YR 5/1	7.5YR 3/1
101	Site 34 80-90 cm	41	11	21	27	<1	10YR 6/4	10YR 5/4
102	Site 35 0-10 cm	27	20	27	16	10	7.5YR 5/2	7.5YR 3/2
103	Site 35 20-30 cm	54	14	19	11	2	7.5YR 5/3	7.5 YR 4/2
104	Site 35 50-60 cm	58	12	18	10	2	7.5YR 5/3	7.5YR 4/3
105	Site 36 0-10 cm	5	15	30	47	3	7.5YR 5/2	7.5YR 3/2
106	Site 36 30-40 cm	8	15	33	31	13	7.5YR 7/2	7.5YR 5/2
107	Site 36 50-60 cm	36	13	27	23	1	10YR 6/4	10YR 5/4
108	Site 36 80-90 cm	48	13	24	14	1	10YR 6/3	10YR 5/3
109	Site 38 0-10 cm	19	36	36	8	1	7.5YR 4/3	7.5YR 3/3
110	Site 38 20-30 cm	58	23	15	3	1	7.5YR 5/4	5YR 4/3
111	Site 38 50-60 cm	48	26	16	7	3	7.5YR 5/4	7.5YR 4/4
112	Site 39 0-10 cm	22	31	38	9	<1	7.5YR 4/3	7.5YR 3/3
113	Site 39 30-40 cm	60	23	14	3	<1	5YR 5/4	5YR 4/3
114	Site 40 0-10 cm	22	24	41	11	2	7.5YR 5/3	7.5YR 3/3
115	Site 40 20-30 cm	53	16	24	7	<1	7.5YR 5/4	7.5YR 4/4
116	Site 40 50-60 cm	57	15	22	6	<1	5YR 5/4	5YR 4/4



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Report No: SCO14/252R1
Client Reference: Adele Calandra
SLR Consulting
10 Kings Road
New Lambton NSW 2305

Lab No	Method	P7B/2 Particle Size Analysis (%)					Colour	
	Sample Id	clay	silt	f sand	c sand	gravel	Dry	Moist
117	Site 42 0-5 cm	24	21	36	15	4	10YR 5/2	10YR 4/2
118	Site 42 20-30 cm	52	21	20	5	2	7.5YR 5/3	7.5YR 4/2
119	Site 42 50-60 cm	71	20	7	2	<1	10YR 6/2	10YR 5/2
120	Site 43 0-10 cm	10	18	34	37	1	7.5YR 6/2	7.5YR 4/2
121	Site 43 20-30 cm	34	14	22	30	<1	10YR 6/3	10YR 5/3
122	Site 43 50-60 cm	32	14	23	31	<1	10YR 6/4	10YR 5/4
123	Site 43 80-90 cm	34	10	24	28	4	7.5YR 5/4	7.5YR 4/4
124	Site 46 0-10 cm	20	29	40	11	<1	10YR 5/3	10YR 4/2
125	Site 46 20-30 cm	56	21	19	4	0	10YR 5/3	10YR 4/3
126	Site 46 50-60 cm	55	21	20	4	<1	10YR 5/4	10YR 4/4
127	Site 46 80-90 cm	49	23	24	4	0	7.5YR 5/3	7.5YR 4/3
128	Site 48 0-10 cm	9	16	28	45	2	7.5YR 5/2	7.5YR 3/2
129	Site 48 20-30 cm	8	11	27	45	9	10YR 7/2	10YR 5/3
130	Site 48 60-70 cm	39	7	25	27	2	2.5Y 7/4	2.5Y 6/4
131	Site 48 100-110 cm	34	9	28	26	3	10YR 5/4	10YR 4/4
132	Site 49 0-10 cm	39	18	29	13	1	10YR 4/2	10YR 3/2
133	Site 49 20-30 cm	63	17	15	5	<1	2.5Y 6/3	2.5Y 5/3
134	Site 49 60-70 cm	64	13	16	6	1	2.5Y 6/3	2.5Y 5/4
135	Site 49 90-100 cm	65	15	15	5	<1	10YR 6/3	10YR 5/4
136	Site 50 0-10 cm	nt	nt	nt	nt	nt	nt	nt
137	Site 50 20-30 cm	nt	nt	nt	nt	nt	nt	nt
138	Site 50 50-60 cm	nt	nt	nt	nt	nt	nt	nt
139	Site 50 80-90 cm	nt	nt	nt	nt	nt	nt	nt
140	Site 51 0-10 cm	7	11	49	32	1	10YR 5/4	10YR 4/4
141	Site 51 10-20 cm	13	12	50	25	<1	7.5YR 6/4	7.5YR 5/6
142	Site 51 50-60 cm	46	9	31	14	<1	5YR 5/6	5YR 5/6
143	Site 51 90-100 cm	28	3	42	27	<1	5YR 5/6	5YR 5/6

nt-not tested



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Report No: SCO14/252R1
Client Reference: Adele Calandra
SLR Consulting
10 Kings Road
New Lambton NSW 2305

Lab No	Method	P7B/2 Particle Size Analysis (%)					Colour	
	Sample Id	clay	silt	f sand	c sand	gravel	Dry	Moist
144	Site 53 0-10 cm	14	16	44	25	1	10YR 5/4	10YR 4/4
145	Site 53 10-20 cm	15	23	42	19	1	10YR 6/3	10YR 4/4
146	Site 53 20-30 cm	62	11	18	9	<1	5YR 4/6	5YR 4/6
147	Site 53 50-60 cm	66	9	17	6	2	5YR 4/6	5YR 4/6
148	Site 53 90-100 cm	47	12	29	12	<1	10YR 4/6	10YR 4/6
149	Site 54 0-10 cm	14	14	47	22	3	10YR 4/4	10YR 3/4
150	Site 54 20-30 cm	55	11	25	9	<1	7.5YR 4/4	7.5YR 4/4
151	Site 54 50-60 cm	44	30	15	10	1	7.5YR 5/6	7.5YR 4/6
152	Site 56 0-10 cm	29	20	35	12	4	7.5YR 5/4	7.5YR 4/4
153	Site 56 20-30 cm	55	16	23	5	1	10YR 5/4	10YR 4/4
154	Site 57 0-10 cm	19	22	35	22	2	10YR 4/2	10YR 3/2
155	Site 57 30-40 cm	57	15	12	10	6	10YR 5/4	10YR 4/4
156	Site 58 0-10 cm	21	18	34	17	10	10YR 5/3	10YR 3/3
157	Site 58 20-30 cm	57	17	18	7	1	10YR 5/4	10YR 4/4
158	Site 59 0-10 cm	24	19	37	18	2	10YR 4/3	10YR 3/3
159	Site 59 20-30 cm	52	13	22	11	2	10YR 5/4	10YR 4/4
160	Site 59 50-60 cm	47	22	17	11	3	7.5YR 5/4	7.5YR 4/6
161	Site 40 80-90 cm	40	51	7	2	0	10YR 7/3	10YR 6/4
162	Site 52 0-10 cm	26	18	37	17	2	7.5YR 5/3	7.5YR 3/4
163	Site 52 20-30 cm	58	15	18	9	<1	7.5YR 4/4	7.5YR 4/4
164	Site 52 50-60 cm	56	13	20	10	1	7.5YR 4/6	7.5YR 4/6
165	Site 52 90-100 cm	54	30	12	4	<1	10YR 6/4	10YR 5/6



END OF TEST REPORT

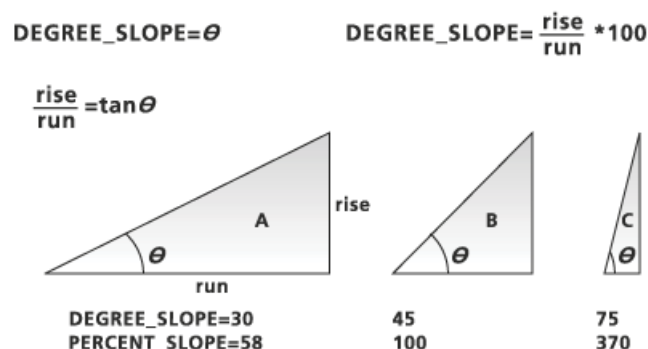
Appendix C

Slope Analysis Methodology

1. Acquire appropriate elevation information. In this case, LIDAR data provided by Anglo American Pty Limited.
2. Load Contours into ArcMap 10.1
3. Using 3D Analyst Extension - Create a TIN Surface based on the contours
(http://resources.arcgis.com/en/help/main/10.1/index.html#/Create_TIN/00q90000001v000000/)
4. Using 3D Analyst Extension – Run the Surface Slope Tool
(<http://resources.arcgis.com/en/help/main/10.1/index.html#/00q900000076000000/>) using a custom Break File (attached).
5. Using a Spatial Join, correlate the Surface Slope at the Soil Survey coordinates.

The Surface Slope Tool:

Surface Slope creates an output polygon feature class containing polygons that classify an input TIN or terrain dataset by slope. The slope is the angle of inclination between the surface and a horizontal plane, which may be analysed in degrees or percent. Slope in degrees is given by calculating the arctangent of the ratio of the change in height (dZ) to the change in horizontal distance (dS), or slope = $\text{Arctan}(dZ/dS)$. Percent slope is equal to the change in height divided by the change in horizontal distance multiplied by 100, or $(dZ/dX) * 100$.



The {**slope_field**} is the name of attribute field used to record the polygon aspect codes. Its default value is SlopeCode.

Each triangle is classified into a slope class. Contiguous triangles belonging to the same class are merged during the formation of output polygons. The {units} parameter can be set to use PERCENT or DEGREES. The default is PERCENT. The default percent slope class breaks are 1.00, 2.15, 4.64, 10.00, 21.50, 46.40, 100.00, 1000.00. Optionally, DEGREES may be used to classify slope. The default degree slope class breaks are 0.57, 1.43, 2.66, 5.71, 12.13, 24.89, 45.0, 90.0.

The **{class_breaks_table}** is used to define custom slope classes. The table can be either a TXT or DBF file for a Windows environment, and a DBF file in a UNIX environment. Each record in the table needs to contain two values that are used to represent the slope range of the class and its corresponding class code.

Table example:

```
break, code
```

```
10.0, 11
```

```
25.0, 22
```

```
40.0, 33
```

```
70.0, 44
```

Note the comma delineation and use of decimals in the first field. Field names are needed but are ignored. The first field represents the breaks and values need to be decimal, the second field represents codes and values need to be integer. The units of the slope range are defined by the {units}. When this argument is not specified, the default classification is used.