Hillview Quarry

Land Resource Assessment

Coastwide Materials Pty Ltd

Prepared for: ADW Johnson

Prepared by:

SLR Consulting Australia

SLR Project No.: 630.12117.00000

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Revision Record

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Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Prepared for: ADW Johnson (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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Executive Summary

SLR has been commissioned by Coastwide Materials Pty Ltd (Coastwide Materials) to complete a Land & Soil Capability (LSC) Assessment for the Hillview Quarry Project (the Project). The purpose of this LSC Assessment is to form part of the site due diligence and ultimately inform any Environmental Impact Statement (EIS) for the Project in support of a development application, to be submitted under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) (NSW Department of Planning and Environment (DP&E), 1979).

This report has been prepared to meet the Department of Planning, Housing and Infrastructure (DPHI) Secretary's Environmental Assessment Requirements (SEARs) for the Project received on 03 June 2024.

SLR Consulting has completed a Land and Soil Capability (LSC) assessment according to *The Land and Soil Capability Assessment Scheme; Second Approximation* (OEH, 2012) encompassing the proposed Hillview Quarry, comprising 46.0 hectares. The LSC Assessment found 2 hectares of LSC Class 4 (moderate capability land), 11 hectares of LSC Class 5 (moderately low capability land), 13 hectares of LSC Class 7 (very low capability land) and 21 hectares of LSC Class 8 (extremely low capability land) within the LSC assessment area.

A preliminary BSAL assessment found the entire LSC assessment area is non-BSAL and was verified as non-BSAL due to slope gradients of more than 10% and the remaining potential BSAL soils do not have a contiguous area of greater or equal to 20 hectares.

The LSC assessment area is suited to grazing and improved pastures. It is not considered highly productive agricultural land as defined in *The Land and Soil Capability Assessment Scheme; Second Approximation* (OEH 2012).

Soil erosion hazard can be classed as moderate to high based on a combination of high slope and soil erodibility. In addition to the soil erodibility class, the high slopes and presence of erosive surface flows over the survey area means that soil erosion risk is likely to be moderate to high. Control can be obtained with structural works, topsoiling and vegetative techniques and by phasing development.

Appropriate erosion and sediment control measures are recommended for the whole Project Site.

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1.0 Introduction

SLR has been commissioned by ADW Johnson Pty Limited (ADW) to complete a Land & Soil Capability (LSC) Assessment for the Hillview Quarry Project (the Project) for Coastwide Materials Pty Ltd (Coastwide Materials). The purpose of this LSC Assessment is to form part of the site due diligence and ultimately inform any Environmental Impact Statement (EIS) for the Project in support of a development application, to be submitted under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) (NSW Department of Planning and Environment (DP&E), 1979).

This report has been prepared to meet the Department of Planning, Housing and Infrastructure (DPHI) Secretary's Environmental Assessment Requirements (SEARs) for the Project received on 03 June 2024.

1.1 Background

The Hillview Quarry Project (the Project) is a proposed hard rock quarry located approximately 4km southwest of Booral, within the Great Lakes Local Government Area (LGA) in NSW (see **Figure 1**). It is proposed to quarry up to 1.5Mtpa of hard rock which will be used for road base, concrete aggregates, and crusher dust. The Project also includes the quarry extraction area, an infrastructure area with quarry product processing, workshop and an access road to the quarry site from Bucketts Way. The Project site is located within a larger property used for cattle grazing.

1.2 Objective

The objective was to conduct an LSC Assessment for an area of land proposed for the Project to support the EIS/Development Application for the Project.

1.3 Scope of Work

The LSC Assessment includes:

- Determination of Australian Soil Classification (ASC) (Isbell, 2021) soil types.
- Detailed assessment of the site and soil characteristics as per the requirements of *The Land and Soil Capability Assessment Scheme; Second Approximation* (OEH, 2012).
- Completion of field work to obtain the required level of field samples in accordance with any relevant guidelines.
- Documentation of the results of the detailed assessment comprising of a written report and associated mapping to address specific items in *The Land and Soil Capability Assessment Scheme; Second Approximation* (OEH, 2012).
- Determination of preliminary BSAL status according to the *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land* (OEH, 2013).
- Determination of erosive potential for soil types within development footprint.

1.4 LSC Assessment Area

Table 1 shows the areas requiring soil survey for the LSC Assessment Area. The LSC Assessment area includes the quarry and road to the Project Site boundary. The areas

associated with the project are shown on **Figure 2**. There is no BSAL mapped in the Project Site or Disturbance Footprint.

Table 1: LSC Assessment Area

Assessment Component	Hectares
Project Site	400
Disturbance Footprint	48.4
LSC Assessment Area	**46.0**

1.5 Legislation and Standards

An Environmental Impact Statement (EIS) will be prepared to address the Secretary's Environmental Assessment Requirements (SEARs), which were re-issued to the proponent on 03 June 2024 by the Department of Planning and Environment (Application number: SSD 70557215). Key issues to be addressed include the following:

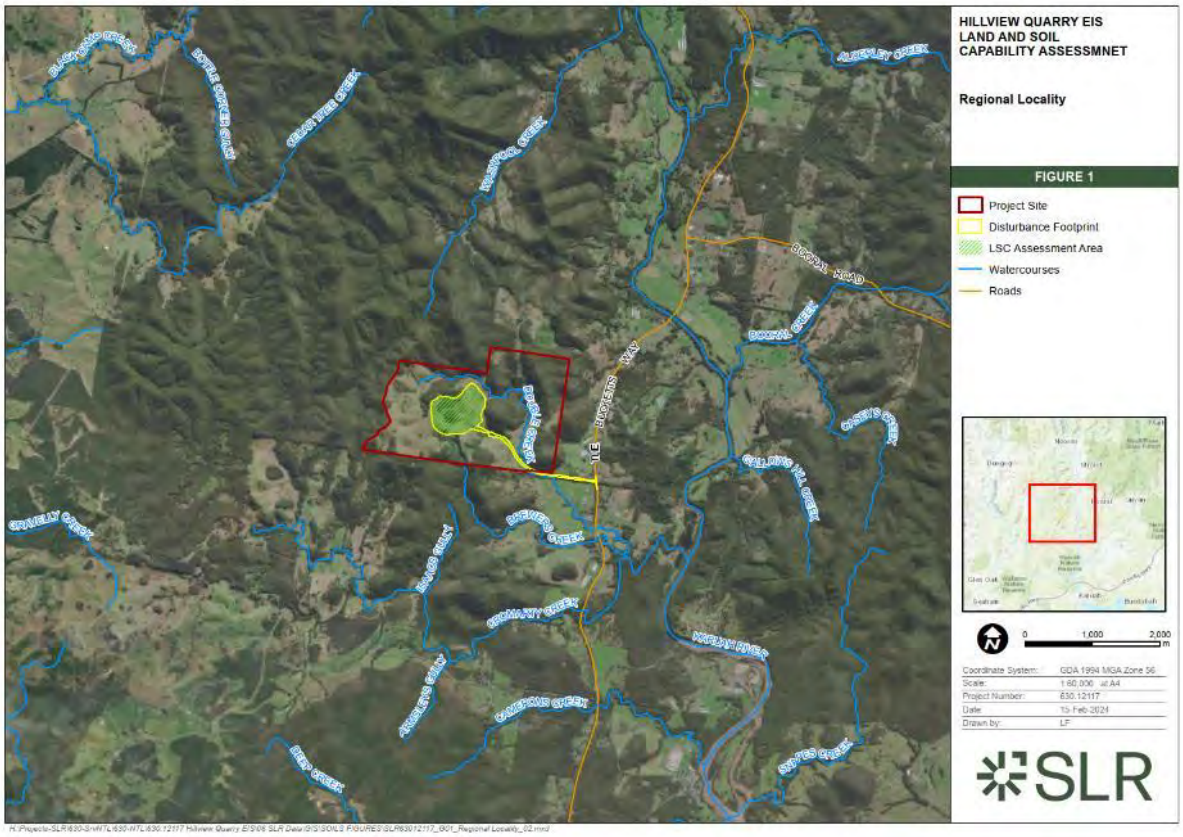
The EIS must address the following specific matters:

Land – including a detailed assessment of:

- *Potential impacts on soils and land capability (including potential erosion, land contamination and biosecurity risks) and the proposed mitigation, management and remedial measures (as appropriate);*
- *Potential impacts on landforms (topography), paying particular attention to the long-term geotechnical stability of any new landforms (such as overburden dumps, buns, etc.); and*
- *The compatibility of the development with other land uses in the vicinity of the development in accordance with the requirements in Clause 2.17 of State Environmental Planning Policy (Resources and Energy) 2021, paying particular attention to the agricultural land use in the region.*

Matters relating to land required by the SEARs which are not addressed in this report are assessed in the main EIS and the Surface Water Impact Assessment (SLR, 2023).

Figure 1: Regional Locality



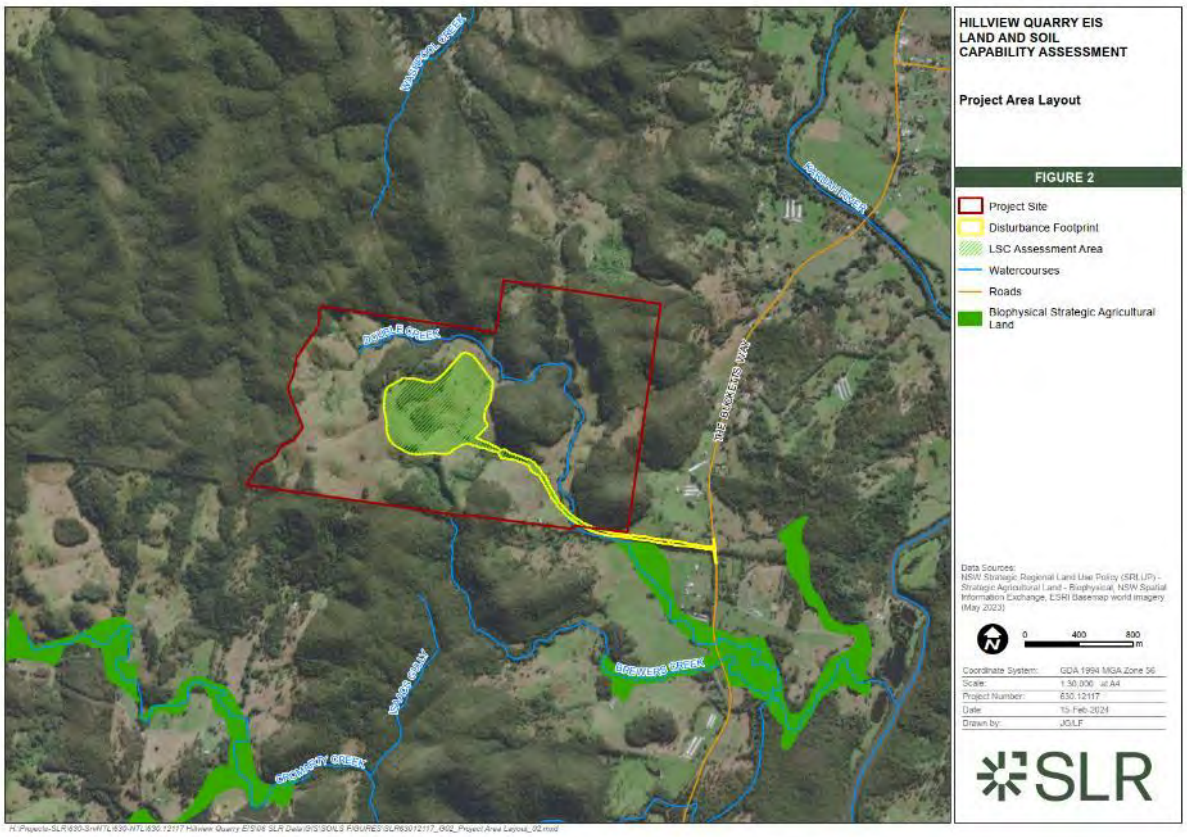


Figure 2: LSC Assessment Area Layout

2.0 Methodology

2.1 Field Survey

2.1.1 Survey Type

The field survey undertaken was an integrated survey and is a qualitative survey type. An integrated survey assumes that many land characteristics are interdependent and tend to occur in correlated sets. The specific type of integrated survey undertaken was a 'free survey'. A free survey is a conventional form of integrated survey and its strength lies in its ability to assess soil and land at medium to detailed-scales. Survey points are irregularly located according to the survey teams' judgement to enable the delineation of soil boundaries. Soil boundaries can be abrupt or gradual, and catena and toposequences are used to aid the description of this variation.

2.1.2 Survey Density

Survey observations undertaken comply with the 1:100,000 scale survey criteria prescribed in the Guidelines for Surveying Soil and Land Resources (McKenzie, et al. 2008). The recommended observation density for 1:25,000 scale survey is one observation every 25 ha.

For the Hillview Quarry disturbance area of 46 ha this equates to 2 observations. Generally, a minimum of 10-30 per cent are to be Detailed Profile Descriptions (also referred to as Class I observations), 5 percent are to be Laboratory Assessed (also referred to as Class II observations), and the remainder are to be made up by Check Site Observations (also referred to as Class IV observations). Sample categories are summarised in **Table 2**.

The field survey for the LSC Assessment was undertaken during December 2022 by SLR's Principal Agronomist Murray Fraser and overseen by SLR's Regional Sector Leader Rod Masters (CPSS).

To satisfy soil mapping requirements, although only a minimum of two sites were required, the field soil survey program comprised eight detailed sites in total, as shown on **Figure 3**. A breakdown of the required soil survey density which exceeds the requirements for an LSC Assessment is provided in **Table 2**.

Table 2: Assessment of Soil Survey Density

Category	LSC Assessment Area
LSC Assessment Area	46.0
1:25,000 Survey Density Target	Minimum 2 Required Sites
Detailed Sites	8
Check Sites	5
Total Number Sites	**13**
Laboratory Analysed Sites	**8**

2.1.3 Survey Observations

Soil profiles were assessed at eight sites in accordance with the *Australian Soil and Land Survey Field Handbook* (NCST, 2009). Each soil-profile exposure was sampled with a hydraulic soil corer, either a depth of 1.2 metres, to equipment refusal, or to bedrock.

Detailed soil profile morphological descriptions were prepared at all sites to record the information specified in *The Land and Soil Capability Assessment Scheme; Second Approximation* (OEH, 2012). Information was recorded for the major parameters specified in **Table 3**.

Global Positioning System (GPS) readings was taken for all sites where soil descriptions are recorded. Vegetation type, landform and aspect were also noted. Soil exposures from pits were photographed during field operations.

Table 3: Field Assessment Parameters

Descriptor	Application
Horizon depth	Weathering characteristics, soil development
Field colour	Permeability, susceptibility to dispersion/erosion
Field texture grade	Erodibility, hydraulic conductivity, moisture retention, root penetration
Boundary distinctness and shape	Erosional/dispositional status, textural grade
Consistence force	Structural stability, dispersion, ped formation
Structure pedality grade	Soil structure, root penetration, permeability, aeration
Structure ped and size	Soil structure, root penetration, permeability, aeration
Stones – amount and size	Water holding capacity, weathering status, erosional/depositional character
Roots – amount and size	Effective rooting depth, vegetative sustainability
Ants, termites, worms etc.	Biological mixing depth

Eight detailed sites were evaluated, with soil collected from each major soil horizon (soil layer). Soil samples from all eight detailed sites were utilised in the LSC Assessment laboratory testing program. Samples were analysed in order to classify ASC (Isbell, 2021) soil taxonomic class and enable LSC classification.

Soil collected from each major soil horizon (soil layer) was sent to a National Association of Testing Authorities Australia (NATA) accredited laboratory (EAL Laboratories) for analysis. The selected physical and chemical laboratory analysis properties and their relevant application are listed in **Table 4**.

Table 4: Laboratory Analysis Parameters

Property	Application
Coarse Fragments (>2mm)	Soil workability; root development
Particle-Size Distribution (<2mm)	Determine fraction of clay, silt, fine sand and coarse sand; nutrient retention; exchange properties; erodibility; workability; permeability; sealing; drainage; interpretation of most other physical and chemical properties and soil qualities
Soil Reaction (pH)	Nutrient availability; nutrient fixation; toxicities (especially aluminium and manganese); liming; Sodicity; correlation with other soil properties
Electrical Conductivity (EC)	Appraisal of salinity hazard in soil substrates or groundwater; total soluble salts

Property	Application
Cation Exchange Capacity (CEC) & Exchangeable Cations	Nutrient status; calculation of exchangeable cations including sodium, calcium, magnesium, potassium and exchangeable sodium percentage (ESP); assessment of other physical and chemical properties, especially dispersivity, shrink – swell, water movement, aeration
Munsell Colour Chart (Munsell)	Drainage, oxidation, fertility, correlation with other physical, chemical and biological properties

Soil salinity in the samples from the detailed sites was determined through measurement of the electrical conductivity (EC) of soil:water (1:5) suspensions. These values were converted to the EC of a saturated extract (ECe) based on soil texture in accordance with the *Interim Protocol* (OEH, 2013).

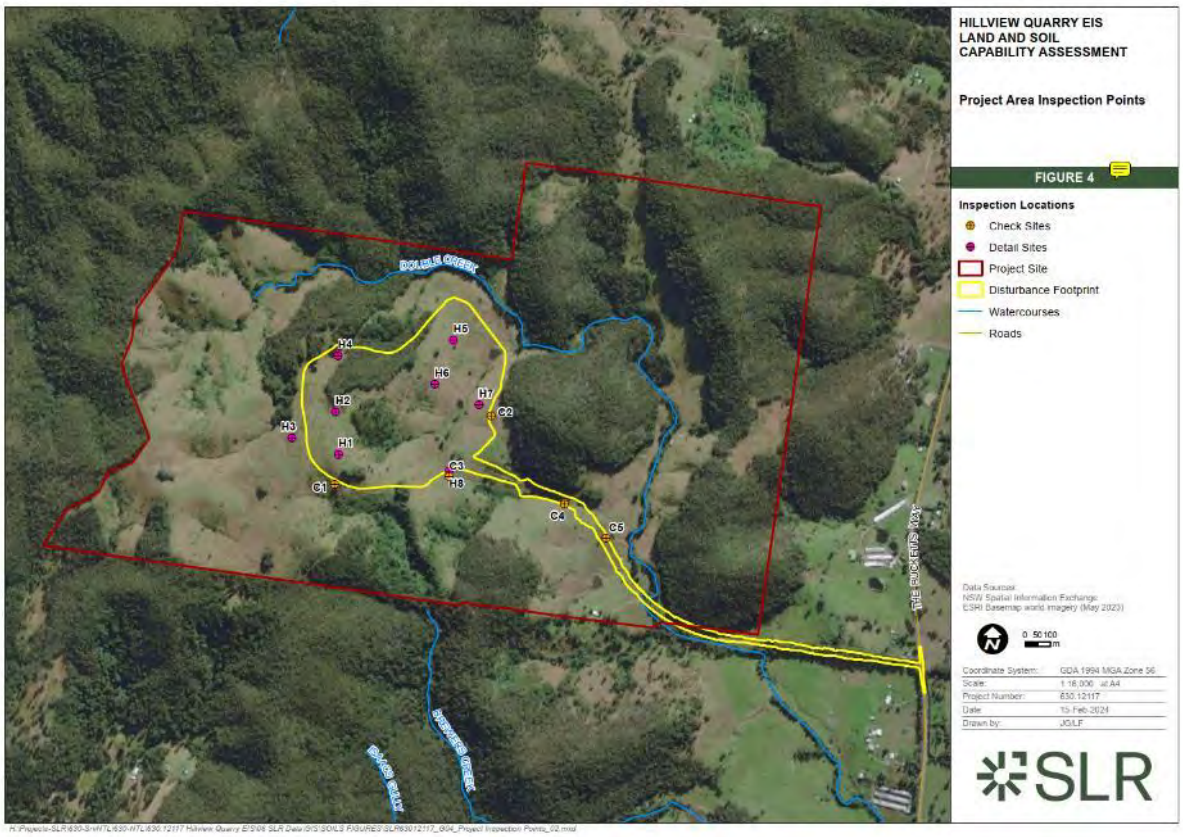


Figure 3: Site Inspection Points

2.2 LSC Assessment Methodology

The LSC classification applied to the LSC assessment area was in accordance with the OEH guideline, *The Land and Soil Capability Assessment Scheme; Second Approximation* (OEH, 2012). This scheme uses the biophysical features of the land and soil to derive detailed rating tables for a range of land and soil hazards. The scheme consists of eight classes, which classify the land based on the severity of long-term limitations. The LSC Classes are described in **Table 5** and their definition has been based on two considerations:

- The biophysical features of the land to derive the LSC classes associated with various hazards.
- The management of the hazards including the level of inputs, expertise and investment required to manage the land sustainably.

Table 5: Land and Soil Capability Assessment Classification

Class	Land and Soil Capability
Land capable of a wide variety of land uses (cropping, grazing, horticulture, forestry, conservation)	
1	**Extremely high capability land**: Land has no limitations. No special land management practices required. Land capable of all rural land uses and land management practices.
2	**Very high capability land**: Land has slight limitations. These can be managed by readily available, easily implemented management practices. Land is capable of most land uses and land management practices, including intensive cropping with cultivation.
3	**High capability land**: Land has moderate limitations and is capable of sustaining high-impact land uses, such as cropping with cultivation, using more intensive, readily available and widely accepted management practices. However, careful management of limitations is required for cropping and intensive grazing to avoid land and environmental degradation.
Land capable of a variety of land uses (cropping with restricted cultivation, pasture cropping, grazing, some horticulture, forestry, nature conservation)	
4	**Moderate capability land**: Land has moderate to high limitations for high-impact land uses. Will restrict land management options for regular high-impact land uses such as cropping, high-intensity grazing and horticulture. These limitations can only be managed by specialised management practices with a high level of knowledge, expertise, inputs, investment and technology.
5	**Moderate–low capability land**: Land has high limitations for high-impact land uses. Will largely restrict land use to grazing, some horticulture (orchards), forestry and nature conservation. The limitations need to be carefully managed to prevent long-term degradation.
Land capable for a limited set of land uses (grazing, forestry and nature conservation, some horticulture)	
6	**Low capability land**: Land has very high limitations for high-impact land uses. Land use restricted to low-impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation.
Land generally incapable of agricultural land use (selective forestry and nature conservation)	
7	**Very low capability land**: Land has severe limitations that restrict most land uses and generally cannot be overcome. On-site and off-site impacts of land management practices can be extremely severe if limitations not managed. There should be minimal disturbance of native vegetation.
8	**Extremely low capability land**: Limitations are so severe that the land is incapable of sustaining any land use apart from nature conservation. There should be no disturbance of native vegetation.

The biophysical features of the land that are associated with various hazards are broadly soil, climate and landform and more specifically: slope, landform position, acidity, salinity, drainage, rockiness; and climate.

The eight hazards associated with these biophysical features that are assessed by the scheme are:

1 Water erosion
2 Wind erosion
3 Soil structure decline
4 Soil acidification
5 Salinity
6 Water logging
7 Shallow soils and rockiness
8 Mass movement

Each hazard is assessed against set criteria tables, as described in the LSC Guideline; each hazard for the land is ranked from 1 through to 8 with the overall ranking of the land determined by its most significant limitation.

Hazard 1: Water Erosion

The Project Site lies within the Eastern NSW Division, and the appropriate criteria for this division were used in the assessment. Assessment of water erosion hazard is almost solely dependent on the slope percentage of the land, based on each Soil Landscape Unit. The only exception is land which falls within the slope range of 10 to 20%, which may be designated LSC Class 4 or LSC Class 5 depending on the presence of gully erosion and/or sodic/dispersible soils. A slope analysis for the Project Site is shown on **Figure 4** while the slope analysis methodology is shown in Appendix A.

Hazard 2: Wind Erosion

There are four factors used to assess wind erosion hazard for each soil type. Three criteria were assessed to be consistent for each soil type:

- Average rainfall determines the capacity of the land to maintain vegetative cover and keep soil wet. Rainfall and evaporation analysis for the project site is based on Bureau of Meteorology data at the Stroud Post Office, AWS number 061071, which is approximately 10.5 km to the north-north-west of the Project Site. This station has 131 years of daily rainfall data and provides an excellent record of historical rainfall. The average rainfall measured is 1,137 millimetres (BOM, 2022), and therefore the Project Site lies within the “greater than 500 millimetres rainfall” category for the purpose of assessing wind erosion hazard.
- Wind erosive power for the Project Site has been mapped as “Moderate” on the Department of Planning and Environment eSPADE 2.2 spatial viewer system (DPE, 2023); and
- Exposure of the land to wind was also determined to be “Moderate” throughout the Project Site.

The determining factor with regard to wind erosion hazard was therefore the erodibility of each soil type as determined by soil texture according the LSC Guideline.

Hazard 3: Soil Structure Decline

Soil structure decline is assessed on soil characteristics, including surface soil texture, sodicity (laboratory tested) and degree of self-mulching (field tested). These parameters assess the soil structure, stability and resilience of the soil.

Hazard 4: Soil Acidification

The soil acidification hazard is assessed using three criteria, being soil buffering capacity, pH and mean annual rainfall. In this assessment, soil buffering capacity was based on soil Great Soil Group; surface soil pH and a regional mean annual rainfall range of >900 millimetres.

Hazard 5: Salinity

The salinity hazard is determined through a range of data and criteria. The closest Bureau of Meteorology weather station recording daily evaporation is near Paterson (Tocal -AWS 061250), which has 43 years of Class A pan evaporation data. This station is situated a similar distance inland and likely to have very similar evaporation levels as the Project Site.

The recharge potential for the site was determined based on an average annual rainfall of 1,137 millimetres, with annual evaporation of 1,553 millimetres. This would suggest a low recharge potential.

Based on the annual rainfall data (1,137 millimetres) and an average annual evapotranspiration of 1,553 millimetres, a low discharge potential exists for the site due to a likely balanced rate of water flow. The Project Site according to the Salt Store Map of NSW, is located in an area of low salt store. However, due to the current available scale of this mapping, laboratory tested EC values were used to determine salt store, all of which were non-saline.

Hazard 6: Water Logging

Water logging was determined by the soils drainage characteristics, specifically field sample evidence of mottling, soil texture attributes as well as slope and climate.

Hazard 7: Shallow Soils and Rockiness

The shallow soils and rockiness hazard is determined by an estimated exposure of rocky outcrops and average soil depth.

Hazard 8: Mass Movement

The mass movement hazard is assessed through a combination of three criteria; mean annual rainfall, presence of mass movement and slope class.

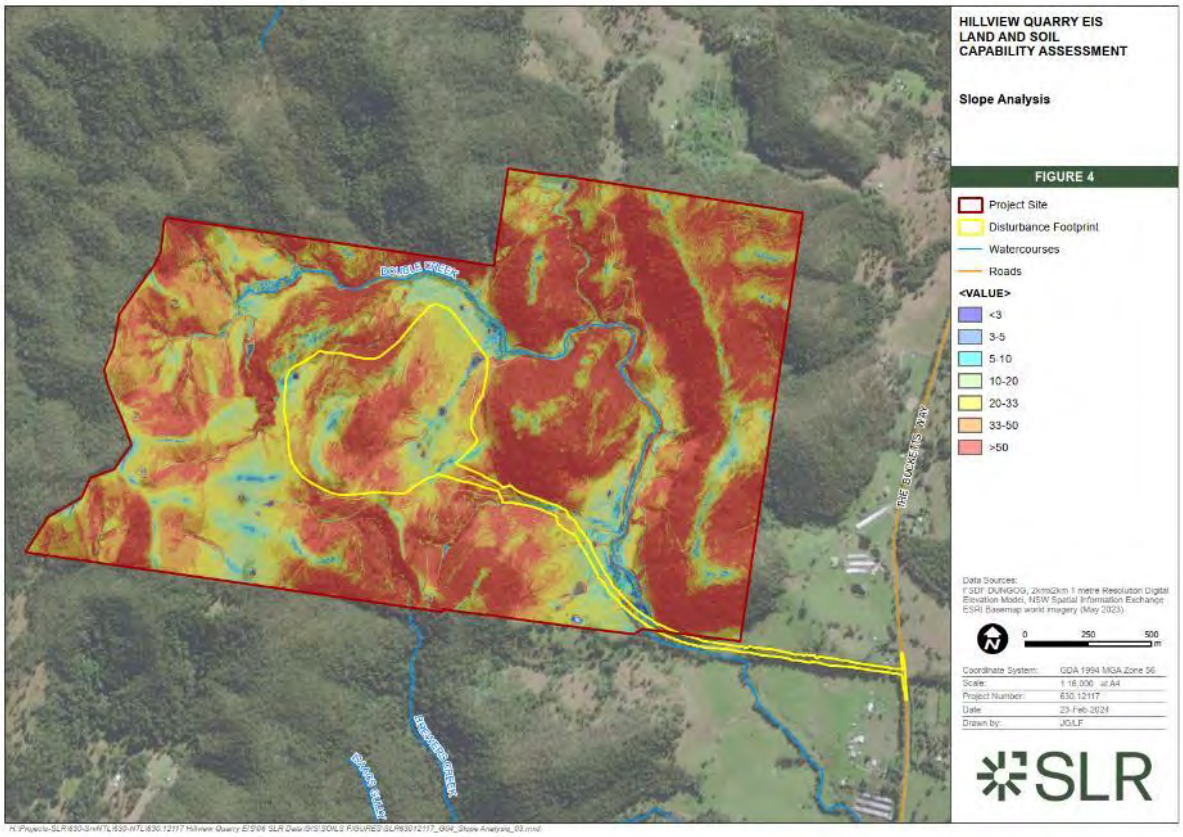


Figure 4: Slope Analysis

3.0 Soil Assessment

3.1 Soil Landscape Units

Soil Landscapes Units (SLU's) within the Project Site have been mapped by the former NSW Department of Land and Water Conservation, incorporating the NSW Soil Conservation Service (now part of NSW Department of Primary Industries (DPI)), on the *Soil Landscapes of Central and Eastern NSW* (DPIE, 2020) as shown on **Figure 5**.

This map is a compilation of all 40 published soil landscape maps that cover central and eastern NSW, based on standard 1:100,000 and 1:250,000 topographic sheets. The mapping provides an inventory of soil and landscape properties of the area and identifies major soil and landscape qualities and constraints. It integrates soil and topographic features into single units with relatively uniform land management requirements. In the associated reports, soils are described in terms of soil materials in addition to the Australian Soil Classification, the Great Soil Groups, and the Northcote systems.

Two SLU's occur within the LSC assessment area and their features are summarised in **Table 6**. The occurrence of each SLU is shown in **Table 7**. Below is a summary of the key agricultural features of each SLU.

Table 6: Soil Landscape Units Features

Soil Landscape Unit	Ten Mile Road	Gilmore Hill
Landscape	Undulating low hills to rolling low hills on Carboniferous sediments and volcanics in the Medowie Lowlands and Clarencetown Hills in the central east of the Hunter Region. Slopes are 5 - 10%, local relief 40 - 80 m, elevation 70 - 150 m. Uncleared open-forest.	Rolling hills to very steep hills comprising conical hills on Carboniferous lithic sandstone and ignimbrites of the Carboniferous Gilmore Volcanic Group and Martins Creek Ignimbrite Member in the central east of the Hunter Region. Slopes 20 - >50%, local relief 120 - 170 m, elevation 150 - 230 m. Partially cleared open-forest.
Soils	Shallow to deep (25 - <150 cm), well to imperfectly drained Brown Kurosols (Yellow Podzolic Soils and Soloths) and shallow (25 - <50 cm) well-drained Leptic Tenosols (Bleached Loams / Lithosols).	Moderately deep (50 - <100 cm), well-drained Leptic Tenosols (Lithosols); and moderately deep (50 - <100 cm), imperfectly drained Natric Brown Kurosols (Soloths) and Grey Kandosols (Grey Earths).
Qualities and Limitations	Localised shallow soils, localised foundation hazard, widespread recharge zone, localised discharge zone, localised gully erosion hazard, widespread sheet erosion hazard, localised high run-on, localised seasonal waterlogging	Localised poor moisture availability, localised steep slopes, localised rock outcrop hazard, widespread rockfall hazard, localised foundation hazard, localised discharge zone, localised wind erosion hazard, localised gully erosion hazard, localised sheet erosion hazard, localised poor drainage.
Limitations to Grazing	Not assessed	High
Limitations to Cultivation	Not assessed	Extreme
Limitations to Urban	Not assessed	High to very high

Table 7: Soil Landscape Units

Soil Landscape Unit	LSC Assessment Area		Agricultural Limitation Rating	
	Hectares	Percentage	Grazing	Cultivation
Ten Mile Road	32	69.3%	Not assessed	Not assessed
Gilmore Hill	14	30.7%	High	Extreme
Total	**46**	**100%**		

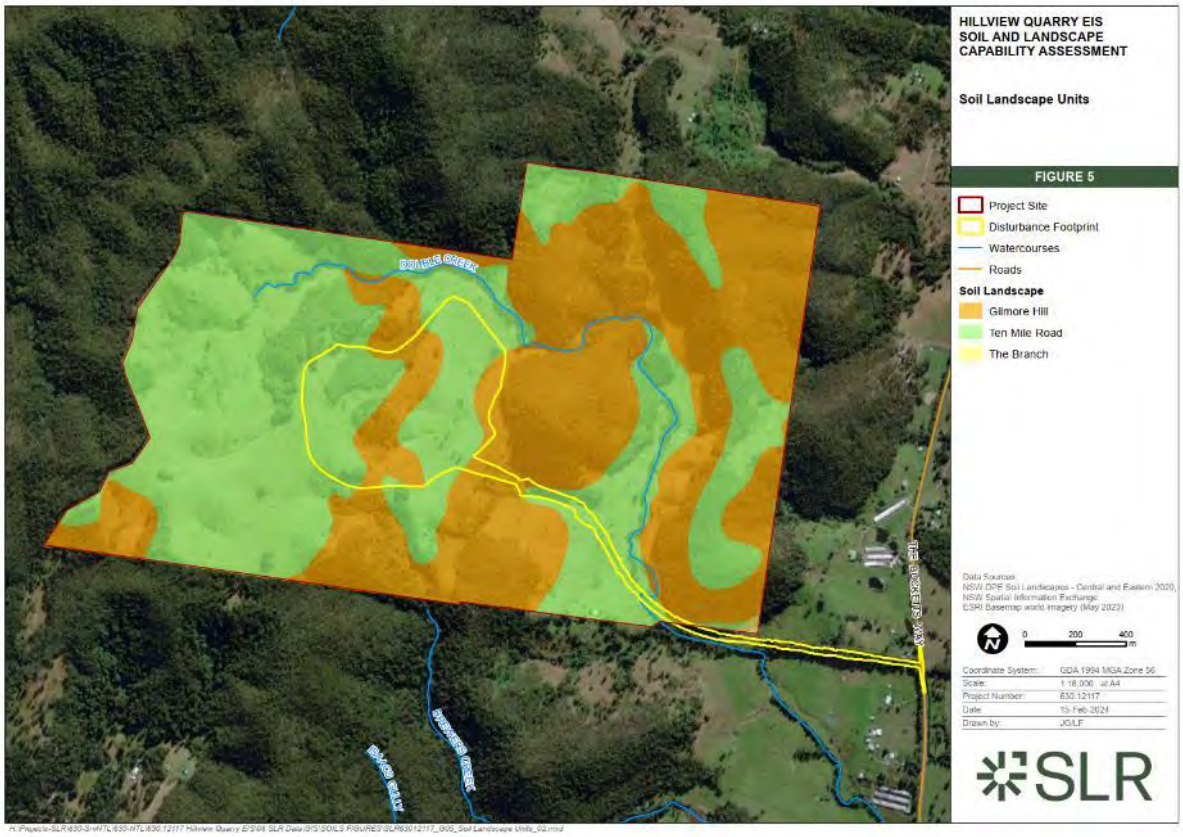


Figure 5: Soil Landscape Units

3.2 Australian Soil Classification

The NSW Soil and Land Information eSPade site (DPIE, 2021) mapped soils in the Project Site as Kurosols (natric) and Rudosols (**Figure 6**).

Based on this investigation two soil map units were identified within the LSC assessment area. The LSC assessment area is mapped according to the dominant ASC soil types using a combination of the soil survey and laboratory analysis results: Eutrophic Brown Kandosols located on the western portion of the site characterised by rolling hills to very steep hills and Subnatric Brown Sodosols to the east of the site characterised by an alluvial plain landform pattern (**Figure 7**). The soil units and the associated observation sites are shown below in **Table 8**.

Kandosols are soils which lack strong texture contrast between the A and B horizons, have massive or only weakly structured B horizons and are not calcareous throughout. Kandosols have a maximum clay content in some part of the B horizon which exceeds 15%. The Eutrophic Kandosol includes slightly gravelly weak structured soils. These are moderately deep (>0.5 metre) soils with a black, brown or grey loam surface grading overlying a dark loam subsoil. The topsoil is mostly non-dispersive and non-saline. The topsoil is moderately acidic. The subsoils are typically mostly non-dispersive, non-saline and slightly to moderately acidic.

Sodosols are soils with a strong texture contrast between the A horizons and a sodic B horizon which are not strongly acidic (pH is greater than 5.5). The strongly sodic nature of the B horizon in Sodosols leave them prone to dispersion and tunnel erosion if left exposed for prolonged periods to water movement or rainfall. The Subnatric Brown Sodosol comprise medium hard-set thin sandy loamy surface duplex soils with a pale or bleached sub-surface (A2) horizon with yellowish-red, light clay moderately deep subsoils. The topsoil is non-dispersive, is non-saline and moderately acidic. The subsoils are generally sodic and dispersive, non-saline, and slightly acidic.

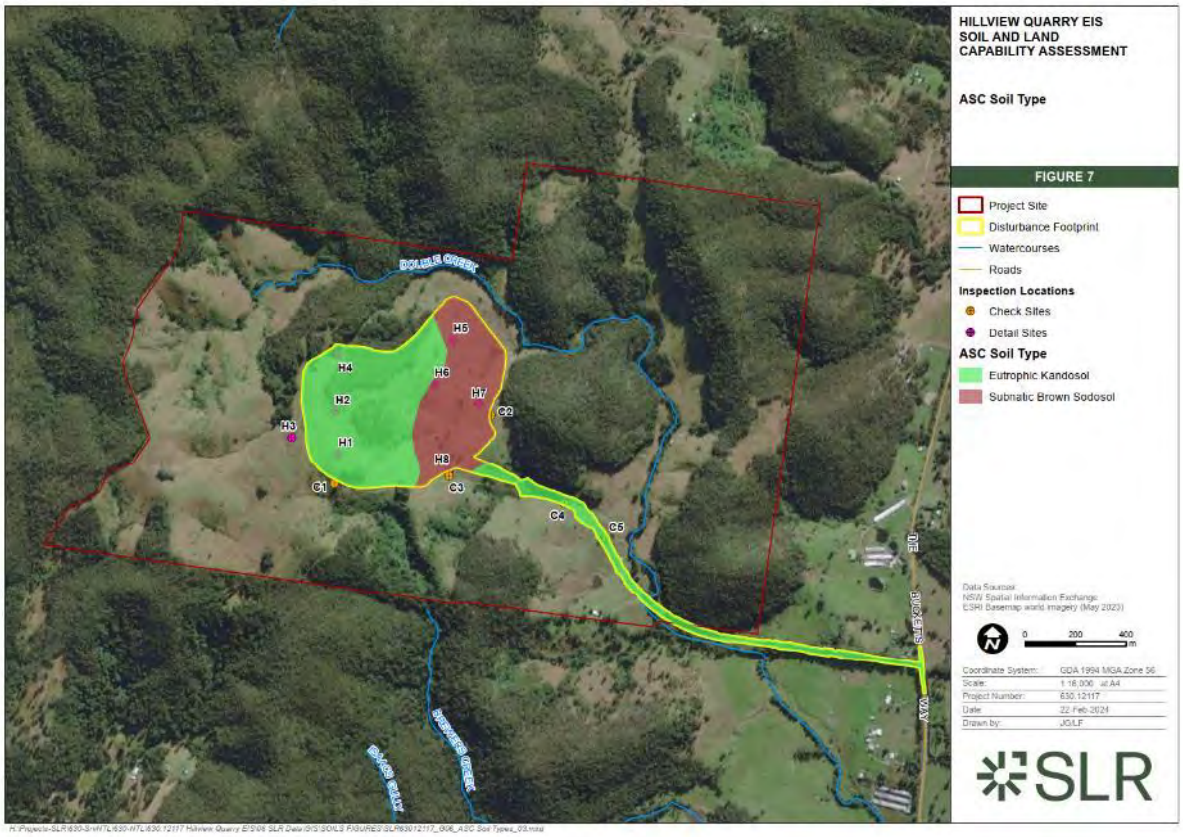
A description of the two detailed sites from the mapped dominant soil unit follows **Table 8**. Detailed site descriptions and mapping observations site descriptions are provided in **Appendix B** and **Appendix C**. Laboratory certificates of analysis are shown in **Appendix E**.

Table 8: Soil Units within LSC Assessment Area

SMU	ASC Soil Type	Soil Type Group	Detailed Site	Check Site	Hectares	Percentage
1	Eutrophic Brown Kandosol	Dominant	H1, H2, H3, H4, H6	C1	29	63%
	Eutrophic Black Dermosol	Sub dominant				
2	Subnatric Brown Sodosol	Dominant	H5, H7, H8	C2, C3, C4, C5	17	37%
	Eutrophic Brown Chromosol	Sub dominant				
				Total	**46**	**100%**

Figure 6: eSpade ASC Soil Types

Figure 7: ASC Soil Types



3.2.1 Soil Unit 1: Eutrophic Kandosol

Table 9: Summary: Eutrophic Brown Kandosol (Site H1)

Overview	
Landscape Site H1 	
ASC Name	Eutrophic Brown Kandosol
Representative Site	H1
Other Mapped Sites	H3, H4, H6
Survey Type	Detailed lab
Dominant Topography	Upper Slope
Dominant Land Use	Grazing
Vegetation	Native Pasture
Inherent Soil Fertility	Moderately High
Slope (%)	18%
Surrounding Slope (%)	>10%
Aspect	East

Table 10: Profile: Eutrophic Brown Kandosol (Site H1)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.15	Very dark brown (7.5YR 2.5/2) loam, moderate structure of 5-10mm crumb peds with a rough fabric and weak consistence. Nil mottling; 10-20%, 20-60mm gravel content; nil segregations; abundant fine roots. Well drained with a gradual and wavy boundary. Sampled 0-10cm.
	B21 0.15 – 0.30	Very dark brown (7.5YR 2.5/3) loam, weak structure of 5-10mm crumb peds with a rough fabric and weak consistence. Nil mottling; 10-20%, 20-60mm gravel content; nil segregations; fine roots common. Well drained with a gradual and wavy boundary. Sampled 20-30cm.
	B22 0.30 – 0.70	Yellowish-brown (10YR 5/4) loam, weak structure of 20-50mm blocky peds with a sandy fabric and weak consistence. Nil mottling; 20-50%, 20-60mm gravel content; nil segregations; few fine roots. Well drained with layer continuing beyond sample depth. Sampled 50-60cm.

Table 11: Chemical Parameters: Eutrophic Brown Kandosol (Site H1)

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	Unit	Rating	%	Rating	dS/m	Rating	Ratio	Rating
A1	5.8	Moderately Acidic	2.3	Non sodic	0.4	Non-saline	1.7	Ca low
B21	5.8	Moderately Acidic	2.8	Non sodic	0.2	Non-saline	1.9	Ca low
B22	6.0	Moderately Acidic	3.7	Non sodic	0.1	Non-saline	1.0	Ca deficient

3.2.2 Soil Unit 2: Subnatric Brown Sodosol

Table 12: Summary: Subnatric Brown Sodosol (Site H7)

Overview	
Landscape Site H7	
	
ASC Name	Subnatric Brown Sodosol
Representative Site	H7
Other Mapped Sites	H5
Survey Type	Detailed lab
Dominant Topography	Mid-slope
Dominant Land Use	Grazing
Vegetation	Native Pasture
Inherent Soil Fertility	Moderately Low
Slope (%)	39%
Surrounding Slope (%)	>30%
Aspect	North-west

Table 13: Profile: Subnatric Brown Sodosol (Site H7)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.10	Very dark brown (7.5YR 2.5/2) loam, strong structure of <2mm crumb peds with a rough fabric and weak consistence. Nil mottling; 2-10%, 2-6mm gravel content; nil segregations; abundant fine roots. Well drained with a gradual and wavy boundary. Sampled 0-10cm.
	A2 0.10 – 0.25	Very dark greyish brown (10YR 3/2) loam, moderate structure of 2-5mm crumb peds with a rough fabric and weak consistence. Nil mottling; 2-10%, 20-60mm gravel content; nil segregations; abundant fine roots. Well drained with a clear and wavy boundary. Sampled 10-20cm.
	B21 0.25 – 0.60	Dark yellowish-brown (10YR 4/4) light clay, massive structure with a rough fabric and firm consistence. 20-50% distinct orange mottling; 2-10%, 2-6mm gravel content; nil segregations; common fine roots. Poorly drained with a gradual and even boundary. Sampled 50-60cm.
	B22 0.60 – 0.75	Dark yellowish-brown (10YR 4/4) light clay, massive with a rough fabric and firm consistence. Nil mottling; 2-10%, 2-6mm gravel content; nil segregations; few fine roots. Poorly drained with layer continuing beyond sample depth. Sampled 60-70cm.

Table 14: Chemical Parameters: Subnatric Brown Sodosol (Site H7)

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	Unit	Rating	%	Rating	dS/m	Rating	Ratio	Rating
A1	5.8	Moderately Acidic	4.1	Non sodic	0.3	Non-saline	1.0	Ca low
A2	6.0	Slightly Acidic	5.2	Non sodic	0.2	Non-saline	0.9	Ca deficient
B21	7.4	Mildly Alkaline	6.3	Sodic	0.5	Non-saline	0.6	Ca deficient
B22	8.1	Moderately Alkaline	8.9	Sodic	0.9	Non-saline	0.5	Ca deficient

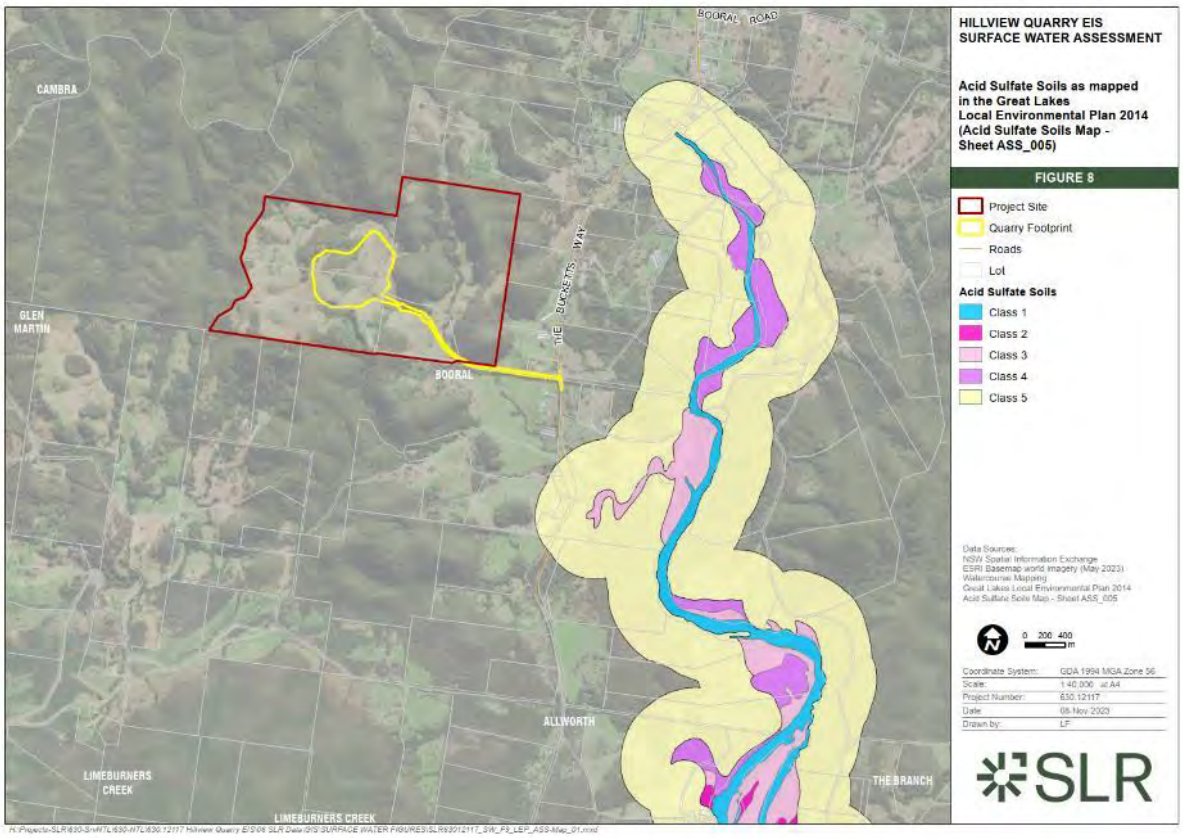
3.3 Acid Sulfate Soils

The likelihood of acid sulfate soils occurring within the Project Site is very low due to its position away from the coast and potential acid sulfate landform type.

The LEP maps the presence of Acid Sulfate Soils (ASS) in the LGA of the Project Site through the 'Acid Sulfate Soils Map' which is broken down into 13 separate sub-maps. The ASS sub-map relevant to the Project is titled ASS_005.

Figure 8 presents an extract of the Acid Sulfate Soils Map nearby to the Project Site. ASS is mapped as occurring within the estuary of the Karuah River, but the mapped extent does not coincide with the Project Site. Accordingly, the potential of encountering ASS from regolith material within the Project Site is considered to be low since there are no known occurrences of ASS on lands proximal to the site.

Figure 8: Acid Sulfate Soils as Mapped in the Great Lakes Local Environmental Plan 2014 (Acid Sulfate Soils Map – Sheet ASS_005)



3.4 LSC Assessment

3.4.1 Pre-Mining LSC Assessment

Land within the LSC assessment area classification range from LSC Class 4 to LSC Class 8. At least 45% of the site is classified as LSC Class 8. With less than 30% classified as LSC Class 4 to LSC Class 5. The remainer of the site is classified as LSC Class 7.

Soil survey sites were evaluated to inform the LSC classification and are summarised in **Table 15**. The major hazard criteria associated with the classification is water erosion which is almost solely dependent on the slope percentage of the land, based on each Soil Landscape Unit. The LSC for the LSC assessment area is shown on **Figure 9**. The major assessment points are listed below.

Although one sample site has been classified as LSC Class 3 (H8) and two sites as LSC Class 6 (H4 and H5) (see **Table 15**) the surrounding slope indicates a classification of LSC Class 7 for the larger area.

Table 15: Land and Soil Capability Assessment

Site	Soil Type	Hazard Criteria								LSC
	ASC Great Group	Water erosion	Wind erosion	Soil structure decline	Soil acidification	Salinity	Water logging	Shallow soils and rockiness	Mass Movement	
H1	Eutrophic Brown Kandosol	4	3	3	3	1	1	2	1	**4**
H2	Eutrophic Black Dermosol	4	3	3	3	1	1	2	1	**4**
H3	Eutrophic Black Kandosol	5	2	3	3	1	1	2	1	**5**
H4	Eutrophic Black Kandosol	6	1	4	3	1	1	4	1	**6**
H5	Subnatric Brown Sodosol	6	1	3	3	2	6	4	1	**6**
H6	Eutrophic Grey Kandosol	7	2	4	3	1	1	2	1	**7**
H7	Subnatric Brown Sodosol	7	2	3	3	2	6	2	1	**7**
H8	Eutrophic Brown Chromosol	3	1	3	3	1	1	2	1	**3**

The predominant Land Capability criteria associated with the LSC Classification for the LSC Assessment Area, is water erosion which is a function of the slope percentage of the land (see **Table 16**).

LSC Class 4 is associated with the Kandosols found on areas with a slope between 10 and 20% and covers 4% hectares within the LSC assessment area. LSC Class 4 is rated as having moderate capability land. Land has moderate to high limitations for high-impact land uses and will restrict land management options for regular high-impact land uses such as cropping, high-intensity grazing and horticulture. These limitations can only be managed by specialised management practices with a high level of knowledge, expertise, inputs, investment and technology.

LSC Class 5 is associated with the Sodosols found on areas with a slope greater than or equal to 20% and covers 23% hectares within the LSC assessment area. LSC Class 5 is rated as having moderate–low capability land. Land has high limitations for high-impact land

uses and will largely restrict land use to grazing, some horticulture (orchards), forestry and nature conservation. The limitations need to be carefully managed to prevent long-term degradation.

LSC Class 7 is rated as having very low capability land. Land has severe limitations that restrict most land uses and generally cannot be overcome. On-site and off-site impacts of land management practices can be extremely severe if limitations not managed. There should be minimal disturbance of native vegetation.

LSC Class 8 is rated as having extremely low capability land. Limitations are so severe that the land is incapable of sustaining any land use apart from nature conservation. There should be no disturbance of native vegetation.

This land is generally more suitable for grazing.

The entire LSC assessment area is considered to have moderate to extremely low agricultural capability according to definitions given in *The Land and Soil Capability Assessment Scheme: Second Approximation* (OEH, 2012).

Table 16: Land and Soil Capability Class

LSC Class	Soil Type	Limitation	Agricultural Capability Rating	Hectares	Percentage
4	Dermosol	Water erosion	Moderate	2	4%
5	Sodosol	Water erosion	Moderately Low	11	23%
7	Dermosol and Sodosol	Water erosion	Very low	13	28%
8	Dermosol and Sodosol	Water erosion Water logging	Extremely low	21	45%
			Total	**46.0**	**100%**

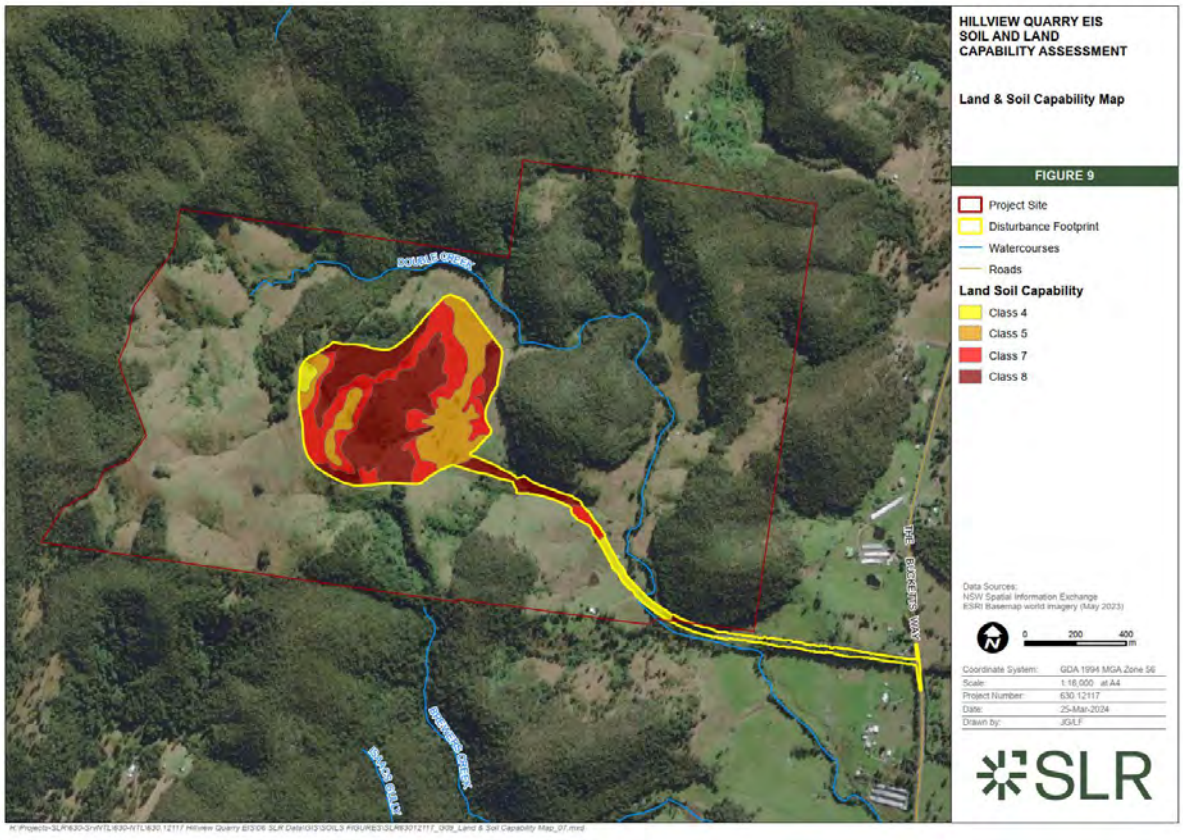


Figure 9: Land and Soil Capability

3.5 BSAL Assessment

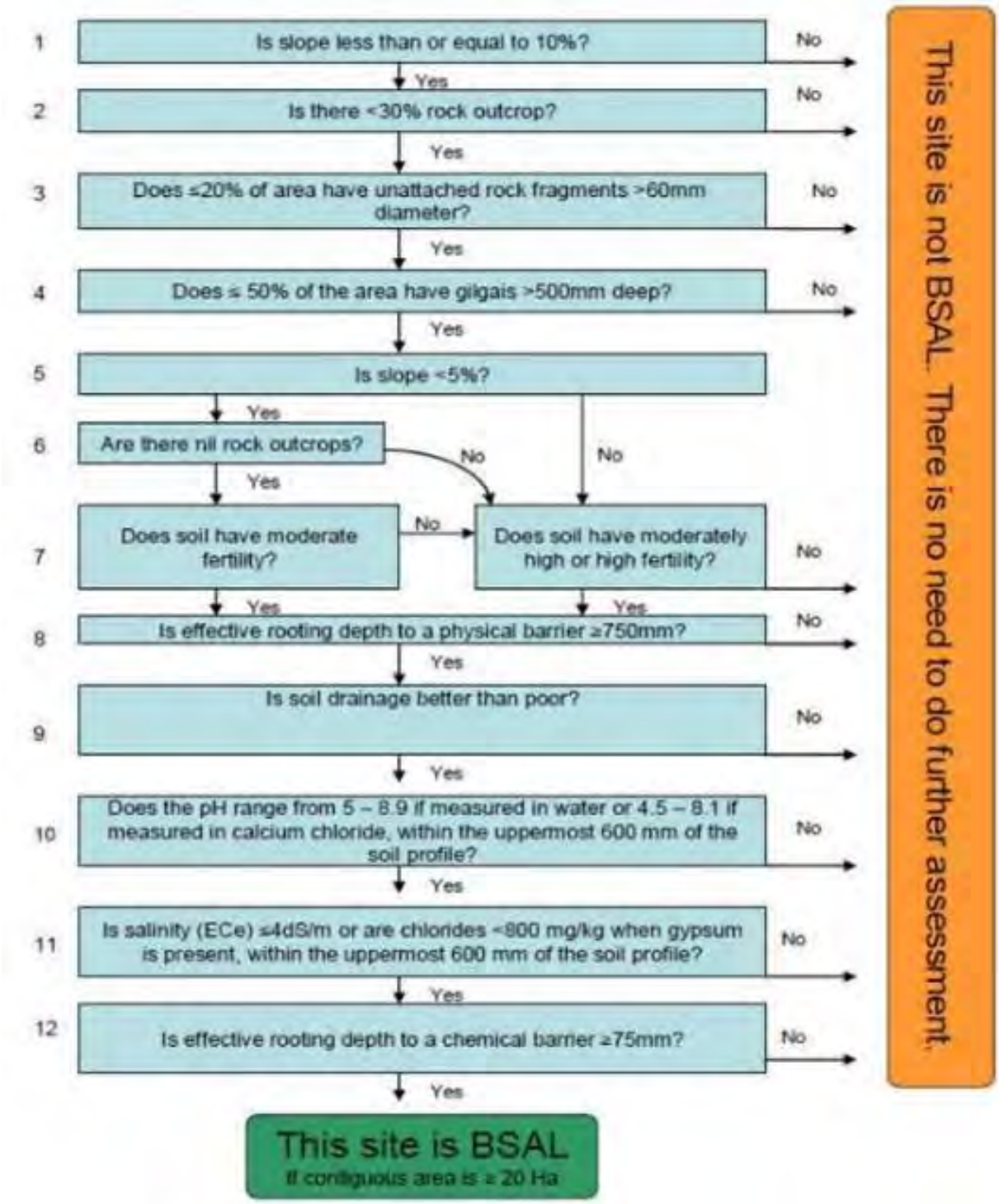
According to the *Interim protocol for site verification and mapping of biophysical strategic agricultural land* (the Interim Protocol) (OEH, 2013), the LSC assessment area cannot be considered biophysical strategic agricultural land (BSAL) due to failing Step 1 (slope gradient of more than 10%, with the remaining BSAL soils within the LSC assessment area do not have a contiguous area of greater or equal to 20 hectares) shown on the Interim Protocol BSAL Criteria Flow Diagram shown below (**Figure 10**). The preliminary BSAL assessment is shown on **Figure 11** and the outcome is summarised in **Table 17**.

Under clause 17A (2) of the 2013 Mining SEPP amendment, mining development as defined for the purposes of the Gateway process, does not include development on land outside the area of a proposed mining lease. Therefore, any components of the proposal, for example linear infrastructure such as roads and pipelines, outside of the proposed lease areas are not subject to the site verification.

Table 17: BSAL Assessment Summary

Verified Non-BSAL	LSC Assessment area	LSC Assessment Area + 100m Buffer
	Percentage (%)	
Exclusion Greater Than 10% Slope	93%	93%
Exclusion Less Than 20 Hectares Contiguous Area	7%	7%
Verified Non-BSAL Total	**100%**	**100%**

Diagram 1: Interim Protocol BSAL Criteria Flow Diagram



Note: In applying step 12 it was assumed that the effective rooting depth to a chemical barrier of ≥75 mm was incorrect as stated in Diagram 1, and instead a value of ≥750 mm was adopted as stated in Section 6.10 of the Interim Protocol. Where soil profiles fail BSAL criteria they are shown in red font in the detailed description.

Figure 10: ASC Soil Types and BSAL Exclusion Area

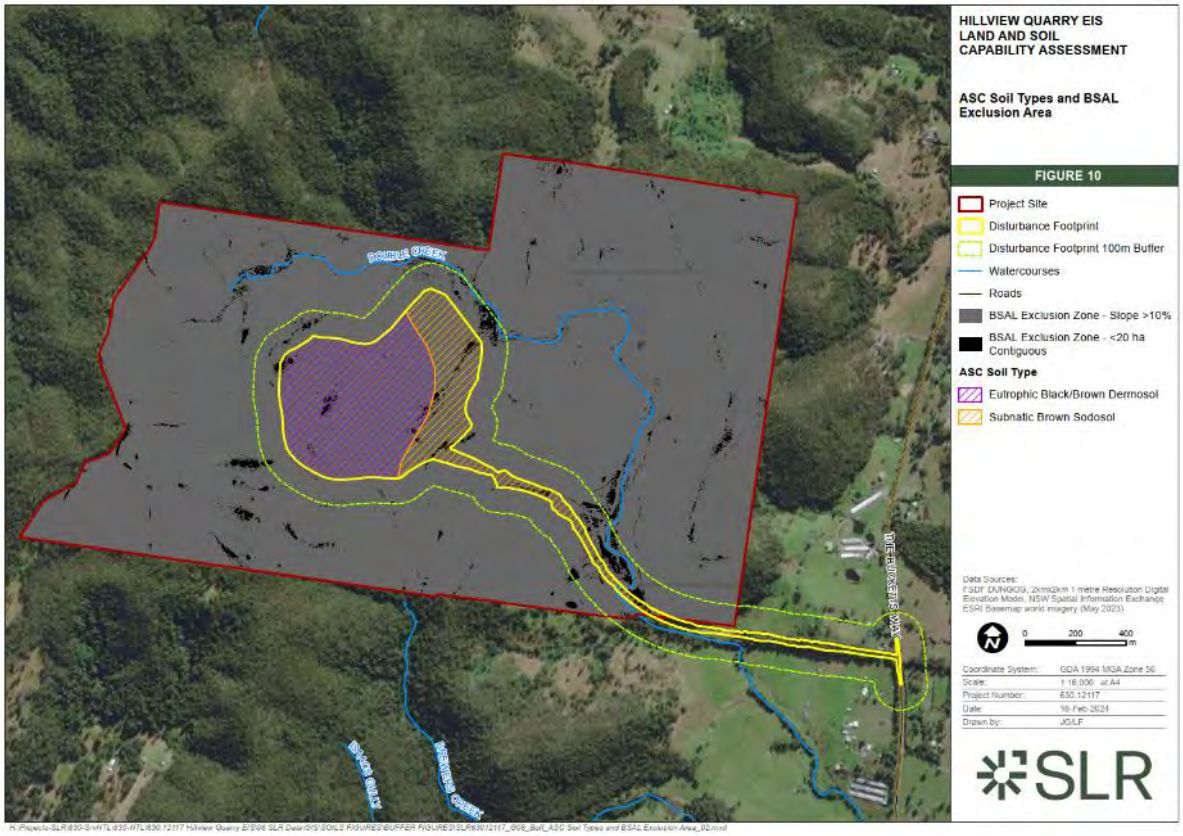
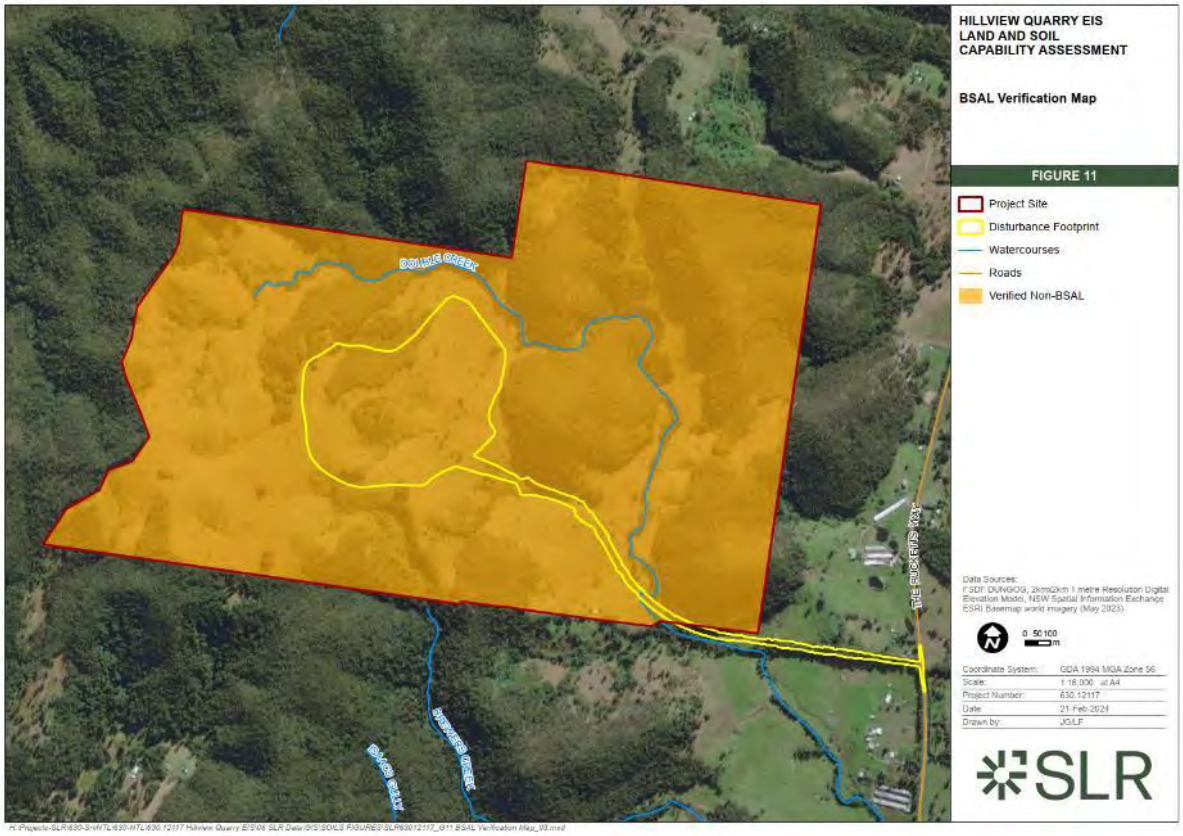


Figure 11: BSAL Verification Map



3.6 Soil Erosive Potential

The soils with the highest erodibility are those with weak bonds between soil particles and an abundance of soil particles that are easily transported by flowing water. If these properties are combined with low infiltration the soil erodibility is very high (Hazelton & Murphy, 2016).

The dispersion class and erosive potential of soils within the LSC assessment area were determined using the Emmerson Aggregate Test (EAT), ESP, soil texture (see **Appendix E**) and soil structure. Soils with a high to very high silt and fine sand (>65%) surface horizon, tend to have a high erodibility. This was not the case with the survey sites assessed for the LSC assessment area. Laboratory analysis of ESP values for the detailed sites identified non-sodic levels (<6% ESP) at 50% of the sites and sodic levels (6-14% ESP) at the remaining 50% which included most of the topsoil and subsoils at the sites. The EAT score ranged from 2 to 4 for most of the subsoils which indicates moderate to slight dispersivity can occur. Soil erodibility class for the topsoil and subsoil for each site is summarised in **Table 18**.

Table 18: Soil Erodibility Class

SMU	SMU Dominant Soil Type	Detailed Site	Soil Erodibility Class and Soil Morphology Associated with Class	
			Topsoil	Subsoil
1	Eutrophic Kandosol	H1, H2, H3, H4, H6	Low Silt and fine sand <65%, ESP <6%	Moderate EAT score of 3-4
2	Subnatric Brown Sodosol	H5, H7, H8	Moderate Silt and fine sand <65%, ESP >6%	High EAT score of 2

In addition to the soil erodibility class, the high slopes and presence of erosive surface flows over the survey area means that soil erosion risk is likely to be moderate to high. Soil erosion hazard can be classed as moderate to high based on a combination of high slope and soil erodibility. Control can be obtained with structural works, topsoiling and vegetative techniques and by phasing development.

Appropriate erosion and sediment control measures are recommended for the whole Project Site.

4.0 Potential Impacts on Soil Resources

Potential impacts of the project on soil resources are associated with permanent loss of land due to quarrying. Activities that may impact on soil physical and chemical properties and post-quarrying land use include the following:

- Excavation of soil to access the resource;
- Permanent storage of overburden;
- Temporary to long-term storage of soil in stockpiles;
- Compaction of soil by machinery; and
- Loss of soil through wind and water erosion.

These activities can reduce the capability of land and soils and also reduce its quality as agricultural land.

4.1 Rehabilitation Cumulative Impacts

Potential rehabilitation interactions between the Project and other existing and proposed major developments have been considered, including other nearby mining projects, renewable energy projects and electricity transmission lines.

The Project Area is suited to grazing and improved pastures. It is not considered highly productive agricultural land as defined in The Land and Soil Capability Assessment Scheme; Second Approximation (OEH 2012). A total of 282 plant species were identified within the Project Site: 213 native species and 69 exotic species. No threatened plant species listed under the NSW Biodiversity Conservation Act 2016, or the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 were detected.

The two key rehabilitation domains proposed for the site are Native Ecosystems and Water Storage.

Two projects were identified using the New South Wales (NSW) Planning Portal Tracker, are listed below;

- Bobs Farm Sand Mine Project, SSD-6395 (~8km northeast) - Proposal to establish and operate a sand quarry to extract up to 750,000 tonnes per annum for a period of up to 15 years. Construct sand processing and transport infrastructure, and rehabilitate the site to include forest and an artificial lake.
- Deep Creek Quarry, SSD-11591659 (~6km south) - Proposal for a new hard rock quarry in the Limeburners Creek area to extract up to 500,000 tonnes per annum of hard rock aggregate products. Construction of new intersection and access road, workshop, stockpiles, weigh bridge, power line and office.

The project area is well suited to re-establishment of Native Ecosystems and grazing activities post quarrying activities and rehabilitation. No cumulative rehabilitation impacts are predicted to the Hillview Quarry site from these developments.

5.0 Soil Suitability for Rehabilitation

Topsoils are suitable for use in rehabilitation. Much of the subsoil in the future disturbance area has physical characteristics such as sodic properties or weak or massive structure that will need to be treated before it is used in rehabilitation.

Sodic soils are not ideal for rehabilitation works because clay particles tend to disperse and swell which produces poor physical soil conditions. These conditions include water logging and hard setting which reduce infiltration rates, plant available water capacity, seedling emergency and root development. These physical limitations can be overcome through the application of soil ameliorants that decrease soil dispersivity and increase soil aggregate stability.

Weak soil structure will be improved through adding carbon in the form of compost which increases soil aggregate stability and improves soil structure.

Possible limitations in topsoil or subsoil quality can be addressed during the soil stripping process. The stripping process constitutes a highly effective mechanism for achieving thorough mixing of amendments to the soil. Amendments of soil pH, exchangeable sodium or magnesium levels and the addition of immobile elements such as phosphorus can be undertaken during the stripping process.

The maximum stripping depth for each soil type and their limitations are summarised in **Table 19**.

Table 19: Soil Stripping Depths and Limitations

Soil Type	Indicative Stripping Depth (cm)		Limitations	
	Topsoil	Subsoil	Topsoil	Subsoil
Eutrophic Kandosol	0-20	10-60	Low Ca:Mg	Weak to massive structure Deficient Ca:Mg
Subnatric Brown Sodosol	0-10	20-60	Low Ca:Mg	Sodic Deficient Ca:Mg Massive structure

An estimation of the volume of available topdressing material has been made for the disturbance area. These results are shown in **Table 20** and indicate a resource of approximately 288,000 m^3 from the disturbance area.

Table 20: Topdressing Material Volume Estimation

Soil Type	Area (ha)	Volume (m^3)		Total (m^3)
		Topsoil	Subsoil	Total
Eutrophic Kandosol	29	58,000	145,000	203,000
Subnatric Brown Sodosol	17	17,000	68,000	85,000
	Total	**75,000**	**213,000**	**288,000**

6.0 Conclusion

SLR Consulting has completed an LSC Assessment according to *The Land and Soil Capability Assessment Scheme; Second Approximation* (OEH, 2012) encompassing the proposed Hillview Quarry, comprising 46 hectares. Land within the LSC assessment area classification range from LSC Class 4 to LSC Class 8. At least 73% (33 ha) of the site is classified as LSC Class 7 and LSC Class 8. With the remainder of the site classified as LSC Class 4 (4%) to LSC Class 5 (23%).

A BSAL assessment found the entire LSC assessment area is non-BSAL and was verified as non-BSAL due to slope more than 10% and the remaining BSAL soils do not have a contiguous area of greater or equal to 20 hectares.

The LSC assessment area is suited to grazing and improved pastures. It is not considered highly productive agricultural land as defined in *The Land and Soil Capability Assessment Scheme; Second Approximation* (OEH 2012).

7.0 References

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OEH. (2013). Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land. Sydney: Office of Environment and Heritage .

Appendix A Slope Analysis Methodology

Hillview Quarry

Land Resource Assessment

Prepared for: ADW Johnson

SLR Project No.: 630.12117.00000

4 July 2024

Hillview Quarry BSAL Verification

SLR Slope Analysis

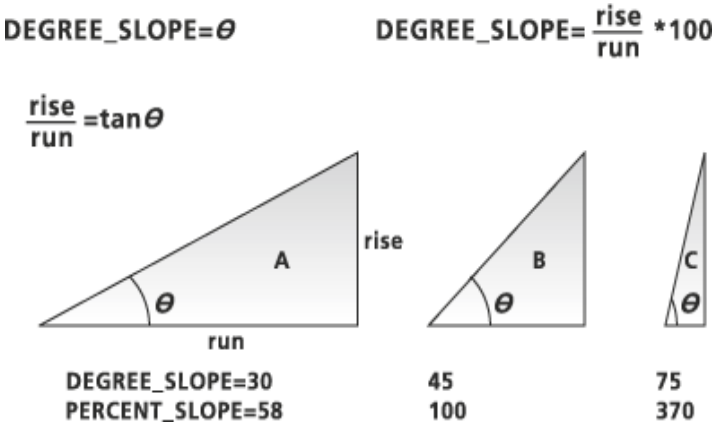
Methodology

1. Acquire appropriate elevation information.
2. Load Contours into ArcMap 10.3
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

= 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

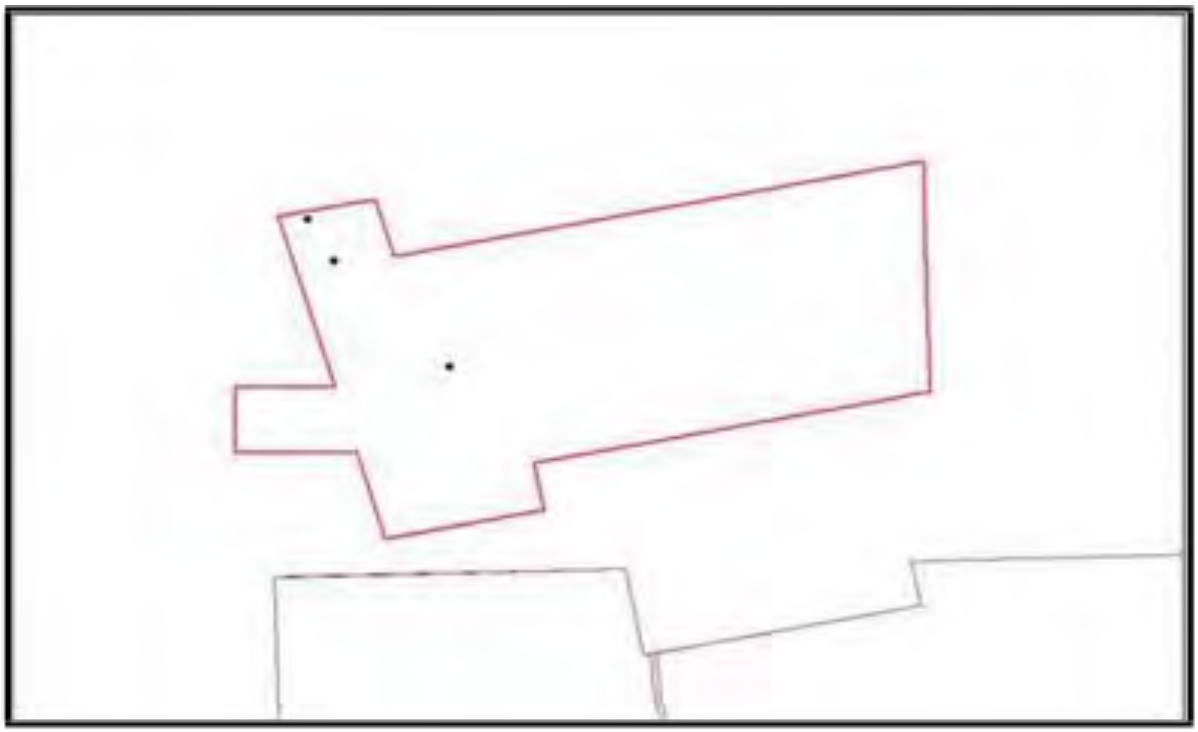
25.0, 22

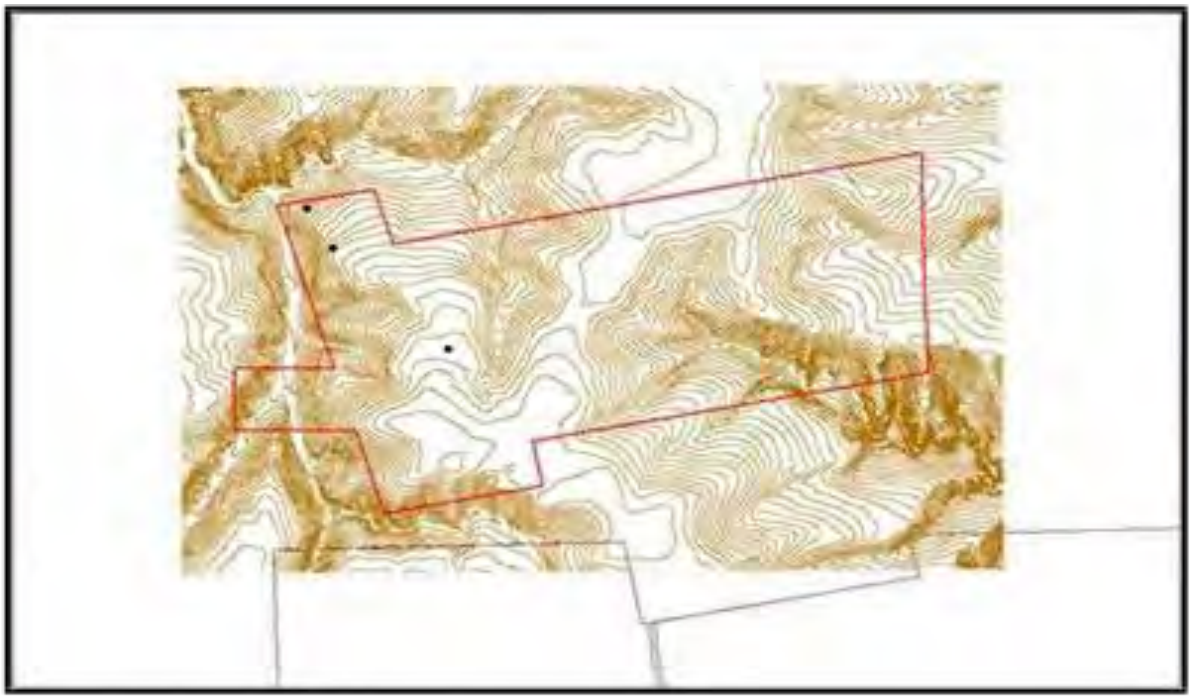
40.0, 33

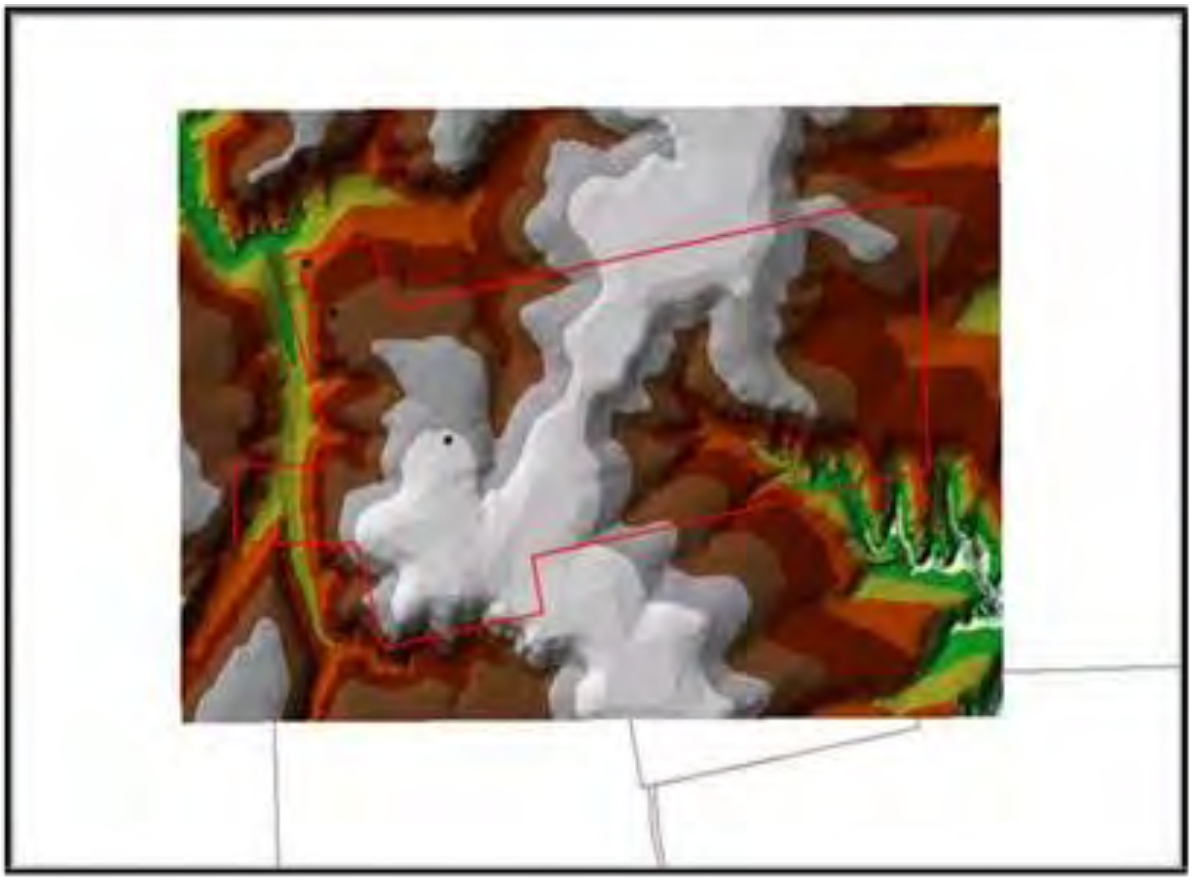
70.0, 44

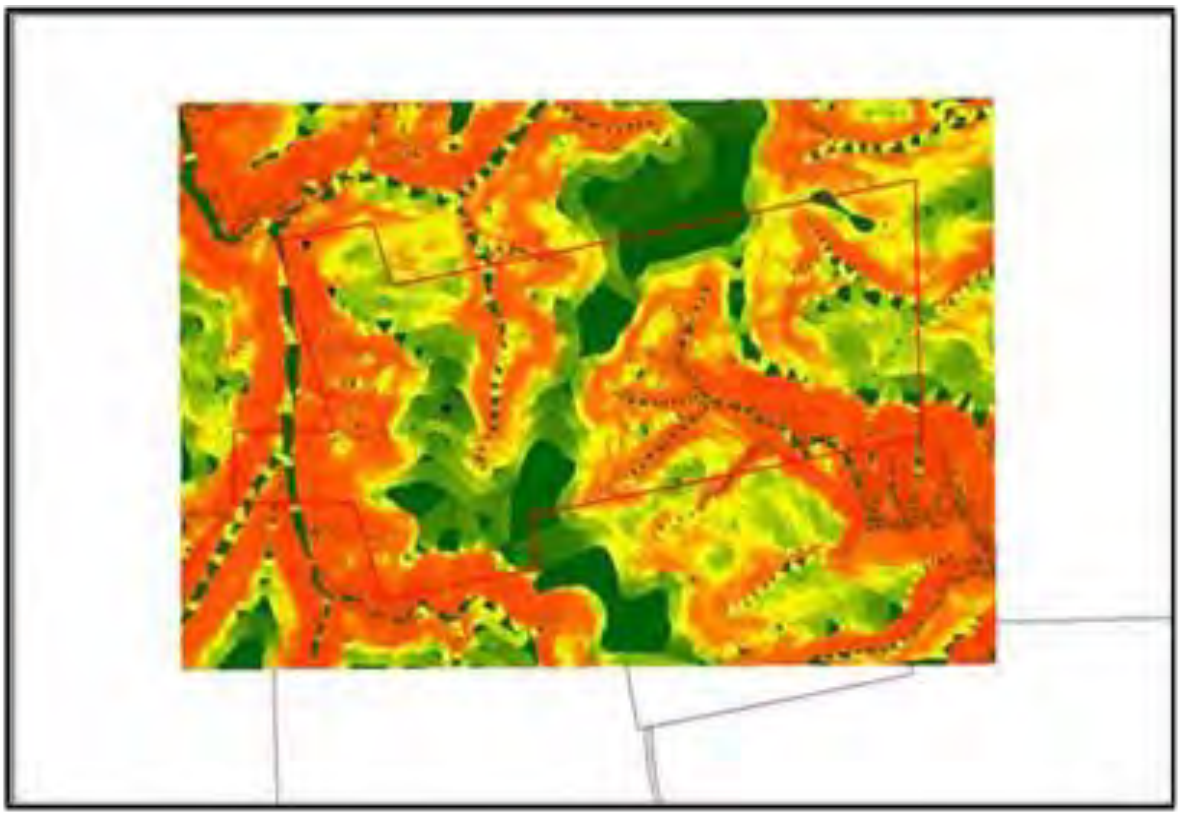
Note the comma delineation and use of decimals in the first field. Field names are needed but are ignored. The first field represents the breaks and values need to be decimal, the second field represents codes and values need to be integer. The units of the slope range are defined by the {units}. When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

And here is how we do it pictographically (example study shown):









Appendix B Detailed Sites

Hillview Quarry

Land Resource Assessment

Prepared for: ADW Johnson

SLR Project No.: 630.12117.00000

4 July 2024

Soil Unit 1: Eutrophic Kandosol

Table B1: Summary: Eutrophic Brown Kandosol (Site H1)

Overview	
Landscape Site H1	
	
ASC Name	Eutrophic Brown Kandosol
Representative Site	H1
Other Mapped Sites	H3, H4, H6
Survey Type	Detailed lab
Dominant Topography	Upper Slope
Dominant Land Use	Grazing
Vegetation	Native Pasture
Inherent Soil Fertility	Moderately High
Slope (%)	18%
Surrounding Slope (%)	>10%
Aspect	East

Table B2: Profile: Eutrophic Brown Kandosol (Site H1)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.15	Very dark brown (7.5YR 2.5/2) loam, moderate structure of 5-10mm crumb peds with a rough fabric and weak consistence. Nil mottling; 10-20%, 20-60mm gravel content; nil segregations; abundant fine roots. Well drained with a gradual and wavy boundary. Sampled 0-10cm.
	B21 0.15 – 0.30	Very dark brown (7.5YR 2.5/3) loam, weak structure of 5-10mm crumb peds with a rough fabric and weak consistence. Nil mottling; 10-20%, 20-60mm gravel content; nil segregations; fine roots common. Well drained with a gradual and wavy boundary. Sampled 20-30cm.
	B22 0.30 – 0.70	Yellowish-brown (10YR 5/4) loam, weak structure of 20-50mm blocky peds with a sandy fabric and weak consistence. Nil mottling; 20-50%, 20-60mm gravel content; nil segregations; few fine roots. Well drained with layer continuing beyond sample depth. Sampled 50-60cm.

Table B3: Chemical Parameters: Eutrophic Brown Kandosol (Site H1)

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	Unit	Rating	%	Rating	dS/m	Rating	Ratio	Rating
A1	5.8	Moderately Acidic	2.3	Non sodic	0.4	Non-saline	1.7	Ca low
B21	5.8	Moderately Acidic	2.8	Non sodic	0.2	Non-saline	1.9	Ca low
B22	6.0	Moderately Acidic	3.7	Non sodic	0.1	Non-saline	1.0	Ca deficient

Soil Unit 1: Eutrophic Kandosol

Table B4: Summary: Eutrophic Black Dermosol (Site H2)

Overview	
Landscape Site H2 	
ASC Name	Eutrophic Black Dermosol
Representative Site	H2
Other Mapped Sites	Nill
Survey Type	Detailed lab
Dominant Topography	Upper Slope
Dominant Land Use	Grazing
Vegetation	Native Pasture
Inherent Soil Fertility	Moderately High
Slope (%)	18%
Surrounding Slope (%)	>10%
Aspect	West

Table B5: Profile: Eutrophic Black Dermosol (Site H2)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.20	Black (10YR 2/1) loam, moderate structure of 5-10mm crumb peds with a rough fabric and weak consistence. Nil mottling; 10-20%, 2-6mm gravel content; nil segregations; abundant fine roots. Well drained with a gradual and wavy boundary. Sampled 0-10cm.
	B21 0.20 – 0.35	Very dark greyish brown (10YR 3/2) loam, moderate structure of 10-20mm crumb peds with a rough fabric and weak consistence. Nil mottling; 2-10%, 20-60mm gravel content; nil segregations; fine roots common. Well drained with a gradual and wavy boundary. Sampled 20-30cm.
	B22 0.35 – 0.60	Brown (10YR 4/3) sandy loam, strong structure of 2-5mm crumb peds with a rough fabric and weak consistence. Nil mottling; 10-20%, 6-20mm gravel content; nil segregations; few fine roots. Well drained with a gradual and wavy boundary. Sampled 50-60cm.
	B23 0.60 – 0.75	Brown (10YR 5/3) loam, weak structure of 10-20mm sub angular blocky peds with a rough fabric and weak consistence. Nil mottling; 20-50%, 6-20mm gravel content; nil segregations; nil roots. Well drained with layer continuing beyond sample depth. Sampled 60-70cm.

Table B6: Chemical Parameters: Eutrophic Black Dermosol (Site H2)

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	Unit	Rating	%	Rating	dS/m	Rating	Ratio	Rating
A1	5.8	Moderately Acidic	2.7	Non sodic	0.3	Non-saline	1.3	Ca low
B21	5.9	Moderately Acidic	3.6	Non sodic	0.2	Non-saline	1.2	Ca low
B22	6.1	Slightly Acidic	4.6	Non sodic	0.2	Non-saline	0.5	Ca deficient
B23	5.9	Moderately Acidic	4.3	Non sodic	0.2	Non-saline	0.4	Ca deficient

Soil Unit 1: Eutrophic Kandosol

Table B7: Summary: Eutrophic Black Kandosol (Site H3)

Overview	
Landscape Site H3 	
ASC Name	Eutrophic Black Kandosol
Representative Site	H3
Other Mapped Sites	H1, H4, H6
Survey Type	Detailed lab
Dominant Topography	Mid-slope
Dominant Land Use	Grazing
Vegetation	Native Pasture
Inherent Soil Fertility	Moderately High
Slope (%)	22%
Surrounding Slope (%)	>20%
Aspect	West

Table B8: Profile: Eutrophic Black Kandosol (Site H3)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.20	Black (5YR 2.5/1) loam, moderate structure of 5-10mm crumb peds with a rough fabric and weak consistence. Nil mottling; 2-10%, 2-6mm gravel content; Nil segregations; abundant fine roots. Well drained with a gradual and even boundary. Sampled 0-10cm.
	B21 0.20 – 0.35	Very dark brown (7.5YR 2.5/2) loam, weak structure of 10-20mm crumb peds with a rough fabric and weak consistence. Nil mottling; 10-20%, 20-60mm gravel content; Nil segregations; abundant fine roots. Well drained with a gradual and even boundary. Sampled 20-30cm.
	B22 0.35 – 0.70	Very dark greyish brown (10YR 3/2) loam, weak structure of 2-5mm crumb peds with a rough fabric and weak consistence. Nil mottling; 20-50%, 20-60mm gravel content; Nil segregations; fine roots common. Well drained with a gradual and wavy boundary. Sampled 50-60cm.
	B23 0.70 – 0.90	Greyish brown (10YR 5/2) sandy loam, weak structure of 2-5mm crumb peds with a rough fabric and weak consistence. Nil mottling; 20-50%, 6-20mm gravel content; Nil segregations; nil roots. Well drained with layer continuing beyond sample depth. Sampled 70-80cm.

Table B9: Chemical Parameters: Eutrophic Black Kandosol (Site H3)

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	Unit	Rating	%	Rating	dS/m	Rating	Ratio	Rating
A1	5.8	Moderately Acidic	2.2	Non sodic	0.4	Non-saline	1.7	Ca low
B21	6.0	Moderately Acidic	3.1	Non sodic	0.2	Non-saline	1.4	Ca low
B22	6.2	Slightly Acidic	3.3	Non sodic	0.2	Non-saline	0.7	Ca deficient
B23	6.4	Slightly Acidic	3.7	Non sodic	0.3	Non-saline	0.7	Ca deficient

Soil Unit 1: Eutrophic Kandosol

Table B10: Summary: Eutrophic Black Kandosol (Site H4)

Overview	
Landscape Site H4	
	
ASC Name	Eutrophic Black Kandosol
Representative Site	H4
Other Mapped Sites	H1, H3, H6
Survey Type	Detailed lab
Dominant Topography	Lower Slope
Dominant Land Use	Grazing
Vegetation	Native Pasture
Inherent Soil Fertility	Moderately High
Slope (%)	33%
Surrounding Slope (%)	>20%
Aspect	West

Table B11: Profile: Eutrophic Black Kandosol (Site H4)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.20	Very dark brown (10YR 2/2) loam, moderate structure of 10-20mm blocky peds with a rough fabric and firm consistence. Nil mottling; 10-20%, 20-60mm gravel content; nil segregations; abundant fine roots. Well drained with a gradual and even boundary. Sampled 0-10cm.
	B21 0.20 – 0.35	Very dark grey (2.5Y 3/1) loam, weak structure of 5-10mm crumb peds with a rough fabric and weak consistence. Nil mottling; 20-50%, 20-60mm gravel content; nil segregations; few fine roots. Well drained with a gradual and wavy boundary. Sampled 20-30cm.
	B22 0.35 – 0.60	Grey (10YR 6/1) loam, weak structure of 10-20mm platy peds with a rough fabric and weak consistence. Nil mottling; 2-10%, 20-60mm gravel content; nil segregations; few fine roots. Well drained with an abrupt and even boundary. Sampled 50-60cm.
	BC 0.60+	Weathered parent material. Not sampled.

Table B12: Chemical Parameters: Eutrophic Black Kandosol (Site H4)

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	Unit	Rating	%	Rating	dS/m	Rating	Ratio	Rating
A1	5.5	Moderately Acidic	7.2	Sodic	0.3	Non-saline	0.4	Ca deficient
B21	5.8	Moderately Acidic	6.3	Sodic	0.2	Non-saline	0.4	Ca deficient
B22	5.8	Moderately Acidic	6.2	Sodic	0.2	Non-saline	0.2	Ca deficient

Soil Unit 2: Subnatric Brown Sodosol

Table B13: Summary: Subnatric Brown Sodosol (Site H5)

Overview	
Landscape Site H5	
	
ASC Name	Subnatric Brown Sodosol
Representative Site	H5
Other Mapped Sites	H7
Survey Type	Detailed lab
Dominant Topography	Lower Slope
Dominant Land Use	Grazing
Vegetation	Native Pasture
Inherent Soil Fertility	Moderately Low
Slope (%)	32%
Surrounding Slope (%)	>20%
Aspect	North-east

Table B14: Profile: Subnatric Brown Sodosol (Site H5)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.10	Very dark brown (7.5YR 2.5/3) loam, moderate structure of 5-10mm crumb peds with a rough fabric and weak consistence. Nil mottling; 2-10%, 2-6mm gravel content; nil segregations; abundant fine roots. Well drained with a gradual and even boundary. Sampled 0-10cm.
	A2 0.10 – 0.25	Dark brown (7.5YR 3/4) sandy loam, moderate structure of 10-20mm crumb peds with a rough fabric and weak consistence. Nil mottling; <2% gravel content; nil segregations; fine roots common. Well drained with a clear and even boundary. Sampled 10-20cm.
	B21 0.25 – 0.60	Brown (7.5YR 4/3) light clay, massive structure with a rough fabric and firm consistence. Nil mottling; 10-0%, 2-6mm gravel content; nil segregations; fine roots common. Poorly drained with an abrupt and even boundary. Sampled 50-60cm.
	BC 60+	Weathered parent material. Not sampled.

Table B15: Chemical Parameters: Subnatric Brown Sodosol (Site H5)

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	Unit	Rating	%	Rating	dS/m	Rating	Ratio	Rating
A1	5.7	Moderately Acidic	5.8	Non sodic	0.4	Non-saline	1.1	Ca low
A2	6.2	Slightly Acidic	7.2	Sodic	0.2	Non-saline	0.9	Ca deficient
B21	6.3	Slightly Acidic	10.1	Sodic	0.4	Non-saline	0.3	Ca deficient

Soil Unit 1: Eutrophic Kandosol

Table B16: Summary: Eutrophic Grey Kandosol (Site H6)

Overview	
Landscape Site H6 	
ASC Name	Eutrophic Grey Kandosol
Representative Site	H6
Other Mapped Sites	H1, H3, H4
Survey Type	Detailed lab
Dominant Topography	Mid-slope
Dominant Land Use	Grazing
Vegetation	Native Pasture
Inherent Soil Fertility	Moderately High
Slope (%)	38%
Surrounding Slope (%)	>30%
Aspect	South-east

Table B17: Profile: Eutrophic Grey Kandosol (Site H6)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.20	Very dark brown (10YR 2/2) loam, weak structure of 5-10mm sub angular blocky peds with a rough fabric and weak consistence. Nil mottling; 2-10%, 20-60mm gravel content; nil segregations; abundant fine roots. Well drained with a clear and wavy boundary. Sampled 0-10cm.
	A2 0.20 – 0.40	Dark greyish brown (10YR 4/2) loam, weak structure of 5-10mm sub angular blocky peds with a rough fabric and weak consistence. Nil mottling; 2-10%, 20-60mm gravel content; nil segregations; fine roots common. Well drained with a clear and wavy boundary. Sampled 20-30cm.
	B2 0.40 – 0.90	Light olive brown (2.5Y 5/4) loam, massive structure with a rough fabric and firm consistence. 50% distinct orange mottling; nil gravel content; nil segregations; nil roots. Poorly drained with layer continuing beyond sample depth. Sampled 50-60cm.

Table B18: Chemical Parameters: Eutrophic Grey Kandosol (Site H6)

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	Unit	Rating	%	Rating	dS/m	Rating	Ratio	Rating
A1	6.0	Moderately Acidic	6.4	Sodic	0.2	Non-saline	1.0	Ca deficient
B21	6.4	Slightly Acidic	7.1	Sodic	0.2	Non-saline	0.6	Ca deficient
B22	7.2	Neutral	9.3	Sodic	0.3	Non-saline	0.2	Ca deficient

Soil Unit 2: Subnatric Brown Sodosol

Table B19: Summary: Subnatric Brown Sodosol (Site H7)

Overview	
Landscape Site H7	
	
ASC Name	Subnatric Brown Sodosol
Representative Site	H7
Other Mapped Sites	H5
Survey Type	Detailed lab
Dominant Topography	Mid-slope
Dominant Land Use	Grazing
Vegetation	Native Pasture
Inherent Soil Fertility	Moderately Low
Slope (%)	39%
Surrounding Slope (%)	>30%
Aspect	North-west

Table B20: Profile: Subnatric Brown Sodosol (Site H7)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.10	Very dark brown (7.5YR 2.5/2) loam, strong structure of <2mm crumb peds with a rough fabric and weak consistence. Nil mottling; 2-10%, 2-6mmgravel content; nil segregations; abundant fine roots. Well drained with a gradual and wavy boundary. Sampled 0-10cm.
	A2 0.10 – 0.25	Very dark greyish brown (10YR 3/2) loam, moderate structure of 2-5mm crumb peds with a rough fabric and weak consistence. Nil mottling; 2-10%, 20-60mm gravel content; nil segregations; abundant fine roots. Well drained with a clear and wavy boundary. Sampled 10-20cm.
	B21 0.25 – 0.60	Dark yellowish-brown (10YR 4/4) light clay, massive structure with a rough fabric and firm consistence. 20-50% distinct orange mottling; 2-10%, 2-6mm gravel content; nil segregations; common fine roots. Poorly drained with a gradual and even boundary. Sampled 50-60cm.
	B22 0.60 – 0.75	Dark yellowish-brown (10YR 4/4) light clay, massive with a rough fabric and firm consistence. Nil mottling; 2-10%, 2-6mm gravel content; nil segregations; few fine roots. Poorly drained with layer continuing beyond sample depth. Sampled 60-70cm.

Table 21: Chemical Parameters: Subnatric Brown Sodosol (Site H7)

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	Unit	Rating	%	Rating	dS/m	Rating	Ratio	Rating
A1	5.8	Moderately Acidic	4.1	Non sodic	0.3	Non-saline	1.0	Ca low
A2	6.0	Slightly Acidic	5.2	Non sodic	0.2	Non-saline	0.9	Ca deficient
B21	7.4	Mildly Alkaline	6.3	Sodic	0.5	Non-saline	0.6	Ca deficient
B22	8.1	Moderately Alkaline	8.9	Sodic	0.9	Non-saline	0.5	Ca deficient

Soil Unit 2: Subnatric Brown Sodosol

Sub-Dominant Soil Type: Eutrophic Brown Chromosol

Table B22: Summary: Eutrophic Brown Chromosol (Site H8)

Overview	
Landscape Site H8 	
ASC Name	Eutrophic Brown Chromosol
Representative Site	H8
Other Mapped Sites	Nil
Survey Type	Detailed lab
Dominant Topography	Plain
Dominant Land Use	Grazing
Vegetation	Native Pasture
Inherent Soil Fertility	Moderately High
Slope (%)	8%
Surrounding Slope (%)	>5%
Aspect	North

Table B23: Profile: Eutrophic Brown Chromosol (Site H8)

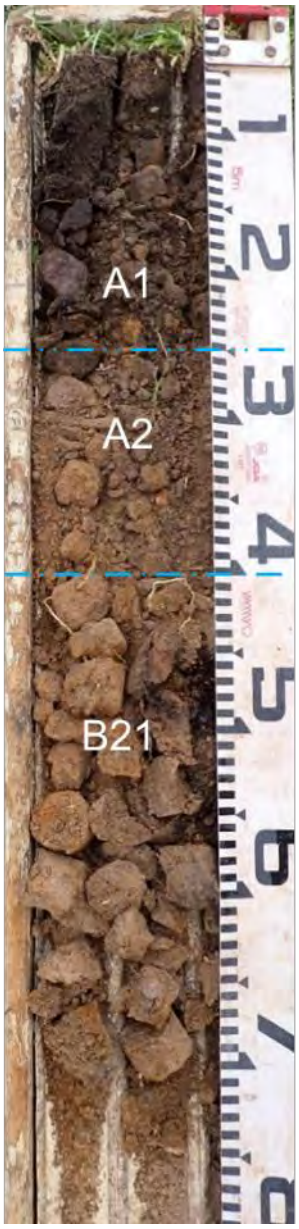
Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.25	Reddish-black (2.5YR 2.5/1) loam, weak structure of <2mm crumb peds with a rough fabric and weak consistence. Nil mottling; 2-10%, 6-2mm gravel content; nil segregations; abundant fine roots. Well drained with a gradual and even boundary. Sampled 0-10cm and 10-20cm.
	A2 0.25 – 0.40	Dark brown (7.5YR 3/4) loam, moderate structure of 5-10mm sub angular blocky peds with a rough fabric and weak consistence. Nil mottling; 2-10%, 2-6mm gravel content; nil segregations; fine roots common. Well drained with a clear and even boundary. Sampled 30-40cm.
	B21 0.40 – 0.70	Dark yellowish brown (10YR 4/4) light clay, massive structure with a rough fabric and weak consistence. Nil mottling; 2-10%, 2-6mm gravel content; nil segregations; fine roots common. Poorly drained with layer continuing beyond sample depth. Sampled 60-70cm.

Table B24: Chemical Parameters: Eutrophic Brown Chromosol (Site H8)

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	Unit	Rating	%	Rating	dS/m	Rating	Ratio	Rating
A1	5.6	Moderately Acidic	2.0	Non sodic	0.6	Non-saline	1.9	Ca low
A2	6.2	Slightly Acidic	1.4	Non sodic	0.2	Non-saline	2.5	Ca low
B21	6.3	Slightly Acidic	1.3	Non sodic	0.2	Non-saline	2.3	Ca low
B22	6.1	Slightly Acidic	2.6	Non sodic	0.2	Non-saline	1.1	Ca low

Appendix C Check Sites

Hillview Quarry

Land Resource Assessment

Prepared for: ADW Johnson

SLR Project No.: 630.12117.00000

4 July 2024

Soil Unit 1: Eutrophic Brown Dermosol

Table C1: Site C1 Brown Dermosol

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.20	Loam with a gradual and even boundary
	B2 +0.20	Loam, moderate structure, 10YR 5/4 (yellowish brown)

ASC Name	Brown Dermosol
Representative Site	Site C1
Other Mapped Detailed Sites	H1, H2, H3, H4, H6
Survey Type	Check site
Dominant Topography	Mid slope
Dominant Land Use	Cattle grazing
Vegetation	Native vegetation
Inherent Soil Fertility	Moderately high
Slope (%)	33%
Aspect	South

Soil Unit 2: Subnatric Brown Sodosol

Table C2: Site C2 Brown Sodosol

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.20	Sandy loam sand with a gradual and even boundary
	B2 +0.20	Sandy clay loam, weak structure, 10YR 5/4 (yellowish brown)

ASC Name	Brown Sodosol
Representative Site	Site C2
Other Mapped Detailed Sites	H5, H7
Survey Type	Check site
Dominant Topography	Mid slope
Dominant Land Use	Cattle grazing
Vegetation	Native vegetation
Inherent Soil Fertility	Moderately high
Slope (%)	32%
Aspect	South

Soil Unit 2: Subnatric Brown Sodosol

Table C3: Site C3 Brown Chromosol

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.20	Loam with a gradual and even boundary
	B2 +0.20	Medium clay, weak structure, 10YR 5/4 (yellowish brown)

ASC Name	Brown Chromosol
Representative Site	Site C3
Other Mapped Detailed Sites	H8
Survey Type	Check site
Dominant Topography	Mid slope
Dominant Land Use	Cattle grazing
Vegetation	Native vegetation
Inherent Soil Fertility	Moderately high
Slope (%)	7%
Aspect	South

Soil Unit 2: Subnatric Brown Sodosol

Table C4: Site C2 Brown Sodosol

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.20	Loamy sand with a gradual and even boundary
	B2 +0.20	Sandy clay loam, weak structure, 10YR 5/4 (yellowish brown)

ASC Name	Brown Dermosol
Representative Site	Site C4
Other Mapped Detailed Sites	H5, H7
Survey Type	Check site
Dominant Topography	Mid slope
Dominant Land Use	Cattle grazing
Vegetation	Native vegetation
Inherent Soil Fertility	Moderately high
Slope (%)	105%
Aspect	South

Soil Unit 2: Subnatric Brown Sodosol

Table C5: Site C2 Brown Sodosol

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.20	Loam with a gradual and even boundary
	B2 +0.20	Medium clay, weak structure, 10YR 5/4 (yellowish brown)

ASC Name	Brown Sodosol
Representative Site	Site C5
Other Mapped Detailed Sites	H5, H7
Survey Type	Check site
Dominant Topography	Mid slope
Dominant Land Use	Cattle grazing
Vegetation	Native vegetation
Inherent Soil Fertility	Moderately high
Slope (%)	9%
Aspect	South

Appendix D Certificate of Analysis

Hillview Quarry

Land Resource Assessment

Prepared for: ADW Johnson

SLR Project No.: 630.12117.00000

4 July 2024

Environmental Analysis Laboratory

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AGRICULTURAL SOIL ANALYSIS REPORT

28 samples supplied by SLR Consulting Australia Pty Ltd on 13/12/2022. Lab Job No.N5636
Analysis requested by Murray Fraser. Your Job: SLR 630.12117.003 Hillview Quarry
10 Kings Road NEW LAMBTON NSW 2305

	Parameter	Method reference	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7
	Sample ID:		H1 0-10	H1 20-30	H1 50-60	H2 0-10	H2 20-30	H2 50-60	H2 60-70
	Crop:		N/G	N/G	N/G	N/G	N/G	N/G	N/G
	Client:		Hillview	Hillview	Hillview	Hillview	Hillview	Hillview	Hillview
			N5636/1	N5636/2	N5636/3	N5636/4	N5636/5	N5636/6	N5636/7
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	5.84	5.81	5.98	5.84	5.87	6.06	5.92
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.037	0.019	0.014	0.036	0.020	0.016	0.022
	Exchangeable Calcium (cmol$_+$/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	2.2	1.5	1.4	2.2	1.4	0.95	0.76
	Exchangeable Calcium (kg/ha)		991	664	616	993	613	425	342
	Exchangeable Calcium (mg/kg)		442	297	275	443	274	190	153
	Exchangeable Magnesium (cmol$_+$/kg)		1.3	0.77	1.4	1.7	1.1	1.7	2.1
	Exchangeable Magnesium (kg/ha)		355	209	385	451	300	476	562
	Exchangeable Magnesium (mg/kg)		158	93	172	201	134	212	251
	Exchangeable Potassium (cmol$_+$/kg)		0.45	0.26	0.14	0.39	0.30	0.27	0.24
	Exchangeable Potassium (kg/ha)		395	232	122	338	260	239	212
	Exchangeable Potassium (mg/kg)		176	104	54	151	116	107	95
	Exchangeable Sodium (cmol$_+$/kg)		0.10	0.09	0.14	0.12	0.12	0.17	0.17
	Exchangeable Sodium (kg/ha)		50	46	71	64	62	86	85
	Exchangeable Sodium (mg/kg)		22	21	32	29	28	38	38
	Exchangeable Aluminium (cmol$_+$/kg)	**Inhouse S37 (KCl)	0.12	0.49	0.60	0.12	0.39	0.40	0.58
	Exchangeable Aluminium (kg/ha)		24	100	121	23	79	81	118
	Exchangeable Aluminium (mg/kg)		11	45	54	10	35	36	53
	Exchangeable Hydrogen (cmol$_+$/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	0.08	0.09	0.06	0.06	0.08	0.11	0.06
	Exchangeable Hydrogen (kg/ha)		1.7	2.0	1.4	1.3	1.7	2.4	1.2
	Exchangeable Hydrogen (mg/kg)		<1	<1	<1	<1	<1	1.1	<1
	Effective Cation Exchange Capacity (ECEC) (cmol$_+$/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol$_+$/kg)	4.3	3.2	3.7	4.5	3.4	3.6	3.9
	Calcium (%)	**Base Saturation Calculations - Cation cmol$_+$/kg / ECEC x 100	52	46	37	49	41	26	20
	Magnesium (%)		31	24	38	36	33	48	53
	Potassium (%)		11	8.3	3.7	8.5	8.9	7.5	6.3
	Sodium - ESP (%)		2.3	2.8	3.7	2.7	3.6	4.6	4.3
	Aluminium (%)		2.9	16	16	2.5	12	11	15
	Hydrogen (%)		1.8	2.8	1.6	1.2	2.3	3.0	1.4
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol$_+$/kg)	1.7	1.9	0.97	1.3	1.2	0.54	0.37
	Emerson Aggregate Test (EAT)	**AS1289.3.8.1-2017	04	03	03	04	03	03	03
	Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	7.5 YR 2.5/2 Very Dark Brown	7.5 YR 2.5/3 Very Dark Brown	10 YR 5/4 Yellowish Brown	10 YR 2/1 Black	10 YR 3/2 Very Dark Grayish Brown	10 YR 4/3 Brown	10 YR 5/3 Brown
	Mottles Munsell Colour		..	..	..	..	..	..	..
	Degree of Mottling (%)		..	..	..	..	..	..	..

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. National Environmental Protection (Assessment of Site Contamination) Measure 2013, Schedule B(1) - Guideline on Investigation Levels for Soil and Groundwater. Table 5-A Background Ranges.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 cmol$_+$/kg = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
13. ** NATA accreditation does not cover the performance of this service.
14. Analysis conducted between sample arrival date and reporting date.
15. This report is not to be reproduced except in full. Results only relate to the item tested.
16. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions (refer SCU.edu.au/eal/t&cs).
17. This report was issued on 21/12/2022.

Quality Checked: Kris Saville
Agricultural Co-Ordinator

NATA
WORLD RECOGNISED ACCREDITATION
Accreditation No. 14960
Accredited for compliance with ISO/IEC 17025 - Testing

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AGRICULTURAL SOIL ANALYSIS REPORT

28 samples supplied by SLR Consulting Australia Pty Ltd on 13/12/2022. Lab Job No.N5636
Analysis requested by Murray Fraser. Your Job: SLR 630.12117.003 Hillview Quarry
10 Kings Road NEW LAMBTON NSW 2305

	Parameter		Method reference	Sample 8	Sample 9	Sample 10	Sample 11	Sample 12	Sample 13	Sample 14
	Sample ID:			H3 0-10	H3 20-30	H3 50-60	H3 70-80	H4 0-10	H4 20-30	H4 50-60
	Crop:			N/G	N/G	N/G	N/G	N/G	N/G	N/G
	Client:			Hillview	Hillview	Hillview	Hillview	Hillview	Hillview	Hillview
				N5636/8	N5636/9	N5636/10	N5636/11	N5636/12	N5636/13	N5636/14
	pH		Rayment & Lyons 2011 - 4A1 (1:5 Water)	5.78	5.98	6.22	6.40	5.51	5.77	5.79
	Electrical Conductivity (dS/m)		Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.043	0.020	0.020	0.020	0.033	0.019	0.020
	Exchangeable Calcium	($cmol_+/kg$)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	4.2	2.9	3.5	3.6	0.78	0.48	0.41
		(kg/ha)		1,907	1,282	1,559	1,620	351	214	184
		(mg/kg)		851	572	696	723	157	96	82
	Exchangeable Magnesium	($cmol_+/kg$)		2.5	2.0	4.6	5.0	1.8	1.1	2.0
		(kg/ha)		676	552	1,264	1,373	482	301	532
		(mg/kg)		302	247	564	613	215	134	238
	Exchangeable Potassium	($cmol_+/kg$)		0.39	0.15	0.16	0.16	0.19	0.30	<0.12
		(kg/ha)		344	129	141	139	168	261	<112
		(mg/kg)		154	58	63	62	75	117	<50
	Exchangeable Sodium	($cmol_+/kg$)		0.17	0.18	0.29	0.35	0.32	0.21	0.24
		(kg/ha)		85	91	152	181	163	108	122
		(mg/kg)		38	41	68	81	73	48	55
	Exchangeable Aluminium	($cmol_+/kg$)	**Inhouse S37 (KCl)	0.11	0.37	0.32	0.30	1.3	1.2	1.1
		(kg/ha)		22	74	64	61	254	250	229
		(mg/kg)		9.7	33	28	27	113	111	102
	Exchangeable Hydrogen	($cmol_+/kg$)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	0.06	0.06	0.06	0.04	0.08	<0.01	<0.01
		(kg/ha)		1.2	1.3	1.4	<1	1.9	<1	<1
		(mg/kg)		<1	<1	<1	<1	<1	<1	<1
	Effective Cation Exchange Capacity (ECEC) ($cmol_+/kg$)		**Calculation: Sum of Ca,Mg,K,Na,Al,H ($cmol_+/kg$)	7.5	5.6	8.9	9.5	4.4	3.3	3.8
	Calcium (%)		**Base Saturation Calculations - Cation $cmol_+/kg$ / ECEC x 100	57	51	39	38	18	14	11
	Magnesium (%)			33	36	52	53	40	33	51
	Potassium (%)			5.3	2.6	1.8	1.7	4.4	8.9	2.3
	Sodium - ESP (%)			2.2	3.1	3.3	3.7	7.2	6.3	6.2
	Aluminium (%)			1.4	6.5	3.5	3.2	29	37	30
	Hydrogen (%)			0.74	1.0	0.70	0.39	1.9	0.16	0.21
	Calcium/Magnesium Ratio		**Calculation: Calcium / Magnesium ($cmol_+/kg$)	1.7	1.4	0.75	0.72	0.44	0.43	0.21
	Emerson Aggregate Test (EAT)		**AS1289.3.8.1-2017	04	03	03	03	03	02	03
	Moist Munsell Colour		**Inhouse Munsell Soil Colour Classification	5 YR 2.5/1 Black	7.5 YR 2.5/2 Very Dark Brown	10 YR 3/2 Very Dark Grayish Brown	10 YR 5/2 Grayish Brown	10 YR 2/2 Very Dark Brown	2.5 Y 3/1 Very Dark Grayish Brown	10 YR 6/1 Gray
	Mottles Munsell Colour			..	..	..	..	..	..	..
				..	..	..	..	..	..	..
	Degree of Mottling (%)			..	..	..	..	..	..	..

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingw
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. National Environmental Protection (Assessment of Site Contamination) Measure 2013, Schedule B(1) - Guideline on Investigation Levels for Soil and Groundwater. Table 5-A Background Ranges.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil re
10. Conversions for 1 $cmol_+/kg$ = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimat
13. ** NATA accreditation does not cover the performance of this service.
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17. This report was issued on 21/12/2022.

Quality Checked: Kris Saville
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AGRICULTURAL SOIL ANALYSIS REPORT

28 samples supplied by SLR Consulting Australia Pty Ltd on 13/12/2022. Lab Job No.N5636
Analysis requested by Murray Fraser. Your Job: SLR 630.12117.003 Hillview Quarry
10 Kings Road NEW LAMBTON NSW 2305

	Parameter		Method reference	Sample 15	Sample 16	Sample 17	Sample 18	Sample 19	Sample 20	Sample 21
	Sample ID:			H5 0-10	H5 10-20	H5 50-60	H6 0-10	H6 20-30	H6 50-60	H7 0-10
	Crop:			N/G	N/G	N/G	N/G	N/G	N/G	N/G
	Client:			Hillview	Hillview	Hillview	Hillview	Hillview	Hillview	Hillview
				N5636/15	N5636/16	N5636/17	N5636/18	N5636/19	N5636/20	N5636/21
	pH		Rayment & Lyons 2011 - 4A1 (1:5 Water)	5.74	6.15	6.27	5.95	6.36	7.15	5.81
	Electrical Conductivity (dS/m)		Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.038	0.017	0.046	0.026	0.017	0.031	0.036
	Exchangeable Calcium	(cmol$_+$/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	1.6	1.1	3.1	2.0	1.3	1.5	2.3
		(kg/ha)		697	486	1,385	910	598	655	1,038
		(mg/kg)		311	217	618	406	267	292	463
	Exchangeable Magnesium	(cmol$_+$/kg)		1.4	1.2	9.4	2.0	2.2	6.6	2.3
		(kg/ha)		391	332	2,567	552	607	1,784	617
		(mg/kg)		175	148	1,146	246	271	796	275
	Exchangeable Potassium	(cmol$_+$/kg)		0.19	<0.12	0.22	<0.12	<0.12	<0.12	0.22
		(kg/ha)		170	<112	193	<112	<112	<112	196
		(mg/kg)		76	<50	86	<50	<50	<50	88
	Exchangeable Sodium	(cmol$_+$/kg)		0.23	0.21	1.6	0.32	0.30	0.84	0.21
		(kg/ha)		116	108	849	165	155	432	110
		(mg/kg)		52	48	379	74	69	193	49
	Exchangeable Aluminium	(cmol$_+$/kg)	**Inhouse S37 (KCl)	0.37	0.27	1.7	0.44	0.26	0.09	0.16
		(kg/ha)		74	54	351	89	52	19	33
		(mg/kg)		33	24	157	40	23	8.4	15
	Exchangeable Hydrogen	(cmol$_+$/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	0.10	0.09	0.14	0.07	0.10	<0.01	0.06
		(kg/ha)		2.3	2.0	3.2	1.6	2.2	<1	1.3
		(mg/kg)		1.0	<1	1.4	<1	<1	<1	<1
	Effective Cation Exchange Capacity (ECEC) (cmol$_+$/kg)		**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol$_+$/kg)	3.9	2.9	16	5.0	4.3	9.0	5.2
	Calcium (%)		**Base Saturation Calculations - Cation cmol$_+$/kg / ECEC x 100	40	37	19	41	31	16	44
	Magnesium (%)			37	42	58	41	52	73	43
	Potassium (%)			5.0	2.4	1.4	2.1	1.3	0.79	4.3
	Sodium - ESP (%)			5.8	7.2	10	6.4	7.1	9.3	4.1
	Aluminium (%)			9.5	9.1	11	8.8	6.0	1.0	3.1
	Hydrogen (%)			2.7	3.0	0.89	1.5	2.3	0.00	1.1
	Calcium/Magnesium Ratio		**Calculation: Calcium / Magnesium (cmol$_+$/kg)	1.1	0.89	0.33	1.00	0.60	0.22	1.0
	Emerson Aggregate Test (EAT)		**AS1289.3.8.1-2017	03	03	02	04	03	02	03
	Moist Munsell Colour		**Inhouse Munsell Soil Colour Classification	7.5 YR 2.5/3 Very Dark Brown	7.5 YR 3/4 Dark Brown	7.5 YR 4/3 Brown	10 YR 2/2 Very Dark Brown	10 YR 4/2 Dark Grayish Brown	2.5Y 5/4 Light Olive Brown	7.5 YR 2.5/2 Very Dark Brown
	Mottles Munsell Colour			..	..	2.5 YR 8/2 Pinkish White	..	..	..	..
	Degree of Mottling (%)			..	..	2.0	..	..	..	..

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingw
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. National Environmental Protection (Assessment of Site Contamination) Measure 2013, Schedule B(1) - Guideline on Investigation Levels for Soil and Groundwater. Table 5-A Background Ranges.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil re
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Quality Checked: Kris Saville
Agricultural Co-Ordinator

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AGRICULTURAL SOIL ANALYSIS REPORT

28 samples supplied by SLR Consulting Australia Pty Ltd on 13/12/2022. Lab Job No.N5636
Analysis requested by Murray Fraser. Your Job: SLR 630.12117.003 Hillview Quarry
10 Kings Road NEW LAMBTON NSW 2305

	Parameter		Method reference	Sample 22	Sample 23	Sample 24	Sample 25	Sample 26	Sample 27	Sample 28
		Sample ID:		H7	H7	H7	H8	H8	H8	H8
		Crop:		N/G	N/G	N/G	N/G	N/G	N/G	N/G
		Client:		Hillview	Hillview	Hillview	Hillview	Hillview	Hillview	Hillview
				N5636/22	N5636/23	N5636/24	N5636/25	N5636/26	N5636/27	N5636/28
	pH		Rayment & Lyons 2011 - 4A1 (1:5 Water)	6.04	7.42	8.11	5.61	6.15	6.28	6.07
	Electrical Conductivity (dS/m)		Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.025	0.060	0.107	0.065	0.025	0.018	0.028
	Exchangeable Calcium	(cmol$_+$/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	1.8	6.4	6.7	4.7	5.1	4.1	7.5
		(kg/ha)		790	2,868	3,009	2,113	2,283	1,829	3,361
		(mg/kg)		353	1,280	1,343	943	1,019	817	1,500
	Exchangeable Magnesium	(cmol$_+$/kg)		2.0	12	13	2.5	2.0	1.8	7.0
		(kg/ha)		535	3,150	3,519	682	548	489	1,907
		(mg/kg)		239	1,406	1,571	304	245	218	851
	Exchangeable Potassium	(cmol$_+$/kg)		0.12	0.42	0.22	0.85	0.45	0.16	0.34
		(kg/ha)		<112	372	193	743	392	142	301
		(mg/kg)		<50	166	86	332	175	63	134
	Exchangeable Sodium	(cmol$_+$/kg)		0.22	1.2	1.9	0.17	0.11	0.09	0.41
		(kg/ha)		116	641	1,002	89	55	45	213
		(mg/kg)		52	286	447	40	25	20	95
	Exchangeable Aluminium	(cmol$_+$/kg)	**Inhouse S37 (KCl)	0.23	0.02	0.02	0.12	0.07	0.09	0.86
		(kg/ha)		47	4.1	3.3	24	15	17	173
		(mg/kg)		21	1.8	1.5	11	6.6	7.7	77
	Exchangeable Hydrogen	(cmol$_+$/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	0.04	<0.01	<0.01	0.12	0.01	0.25	<0.01
		(kg/ha)		<1	<1	<1	2.8	<1	5.5	<1
		(mg/kg)		<1	<1	<1	1.2	<1	2.5	<1
	Effective Cation Exchange Capacity (ECEC) (cmol$_+$/kg)		**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol$_+$/kg)	4.3	20	22	8.5	7.7	6.4	16
	Calcium (%)		**Base Saturation Calculations - Cation cmol$_+$/kg / ECEC x 100	40	33	31	56	66	63	46
	Magnesium (%)			45	59	59	30	26	28	43
	Potassium (%)			2.8	2.2	1.0	10	5.8	2.5	2.1
	Sodium - ESP (%)			5.2	6.3	8.9	2.0	1.4	1.3	2.6
	Aluminium (%)			5.3	0.10	0.08	1.4	0.95	1.3	5.3
	Hydrogen (%)			1.0	0.00	0.00	1.5	0.14	3.8	0.00
	Calcium/Magnesium Ratio		**Calculation: Calcium / Magnesium (cmol$_+$/kg)	0.90	0.55	0.52	1.9	2.5	2.3	1.1
	Emerson Aggregate Test (EAT)		**AS1289.3.8.1-2017	03	03	02	04	03	02	03
	Moist Munsell Colour		**Inhouse Munsell Soil Colour Classification	10 YR 3/2 Very Dark Grayish Brown	10 YR 4/4 Dark Yellowish Brown	10 YR 4/4 Dark Yellowish Brown	2.5 YR 2.5/1 Reddish Black	2.5 YR 2.5/2 Very Dusky Red	7.5 YR 3/4 Dark Brown	10 YR 4/4 Dark Yellowish Brown
	Mottles Munsell Colour			..	10 YR 7/2 Light Gray	10 YR 7/2 Light Gray	..	..	..	10 YR 2/2 Very Dark brown
	Degree of Mottling (%)			..	2.0	1.0	..	..	..	30.0

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
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3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
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Quality Checked: Kris Saville
Agricultural Co-Ordinator

GRAIN SIZE ANALYSIS (hydrometer and sieving techniques)

28 soil samples supplied by SLR Consulting Pty Ltd on 13th December, 2022 - Lab Job No. N5636
Analysis requested by Murray Fraser. Job Ref. SLR 630.12117.003 Hillview Quarry
10 Kings Road NEW LAMBTON NSW 2305

SAMPLE ID	Lab Code	MOISTURE CONTENT (% of water in sample)	TOTAL GRAVEL > 2 mm (% of total oven-dry equivalent)	GRAVEL > 4.75 mm (% of total oven-dry equivalent)	GRAVEL 2.00-4.75 mm (% of total oven-dry equivalent)	COARSE SAND 200-2000 µm (0.2-2.0 mm) (% of total oven-dry equivalent)	FINE SAND 20-200 µm (0.02-0.2 mm) (% of total oven-dry equivalent)	SILT 2-20 µm (% of total oven-dry equivalent)	CLAY < 2 µm (% of total oven-dry equivalent)
H1 0-10	N5636/1	9.9%	22.0%	14.8%	7.2%	29.7%	21.7%	12.0%	14.6%
H1 20-30	N5636/2	8.4%	12.6%	7.8%	4.8%	32.1%	25.3%	16.3%	13.7%
H1 50-60	N5636/3	7.6%	50.7%	41.6%	9.1%	17.5%	12.4%	10.0%	9.4%
H2 0-10	N5636/4	8.7%	17.9%	12.2%	5.7%	41.7%	16.7%	13.3%	10.5%
H2 20-30	N5636/5	10.1%	9.2%	2.3%	7.0%	41.1%	20.5%	13.4%	15.7%
H2 50-60	N5636/6	9.5%	14.3%	1.4%	12.9%	52.2%	12.1%	8.8%	12.7%
H2 60-70	N5636/7	9.6%	24.5%	6.8%	17.8%	42.1%	11.0%	8.7%	13.7%
H3 0-10	N5636/8	9.7%	12.5%	2.8%	9.7%	32.5%	28.0%	14.1%	13.0%
H3 20-30	N5636/9	9.7%	16.0%	7.1%	9.0%	30.4%	26.2%	12.9%	14.4%
H3 50-60	N5636/10	10.1%	25.5%	5.1%	20.4%	36.9%	14.1%	8.7%	14.8%
H3 70-80	N5636/11	9.2%	35.7%	12.4%	23.3%	35.0%	12.7%	4.6%	12.0%
H4 0-10	N5636/12	9.5%	10.2%	4.1%	6.1%	45.1%	20.3%	13.0%	11.4%
H4 20-30	N5636/13	10.6%	27.4%	20.9%	6.5%	30.7%	17.0%	13.3%	11.6%
H4 50-60	N5636/14	9.9%	4.5%	0.0%	4.5%	45.2%	21.1%	16.6%	12.6%
H5 0-10	N5636/15	8.5%	11.1%	5.6%	5.5%	28.7%	34.2%	12.3%	13.7%
H5 10-20	N5636/16	5.9%	4.9%	0.0%	4.9%	33.4%	40.1%	10.7%	11.0%
H5 50-60	N5636/17	15.5%	16.5%	3.0%	13.5%	35.5%	10.9%	6.1%	31.1%
H6 0-10	N5636/18	13.0%	15.7%	7.1%	8.6%	32.4%	24.7%	14.0%	13.2%
H6 20-30	N5636/19	11.3%	13.2%	3.7%	9.5%	33.0%	24.6%	16.2%	13.0%
H6 50-60	N5636/20	14.8%	2.0%	0.0%	2.0%	30.4%	28.2%	17.7%	21.8%
H7 0-10	N5636/21	8.3%	10.9%	3.8%	7.1%	32.2%	28.1%	13.4%	15.5%
H7 10-20	N5636/22	7.0%	22.2%	9.9%	12.4%	28.7%	27.4%	8.9%	12.8%
H7 50-60	N5636/23	17.5%	3.9%	0.0%	3.9%	28.2%	22.5%	11.6%	33.9%
H7 60-70	N5636/24	14.3%	2.5%	0.0%	2.5%	33.5%	18.7%	8.1%	37.3%
H8 0-10	N5636/25	10.2%	11.3%	5.8%	5.5%	37.1%	28.2%	11.7%	11.6%
H8 10-20	N5636/26	9.9%	25.4%	18.4%	7.0%	28.2%	24.4%	11.0%	11.0%
H8 30-40	N5636/27	9.5%	8.2%	5.8%	2.3%	39.9%	27.2%	12.4%	12.4%
H8 60-70	N5636/28	14.1%	11.2%	0.0%	11.2%	38.4%	12.0%	4.5%	33.9%

Note:

1: The Hydrometer Analysis method was used to determine the percentage sand, silt and clay,
modified from SOP meth004 (California Dept of Pesticide Regulation), using method of Gee & Bauder (1986),
in *Methods of Soil Analysis. Part 1* Agron. Monogr. 9 (2nd Ed). Klute, A., American Soc. of Agronomy Inc., Soil Sci. Soc. America Inc., Madison WI: 383-411.

2: Australian Standard 1289.3.8.1-1997 (see attached)

3. Analysis conducted between sample arrival date and reporting date.

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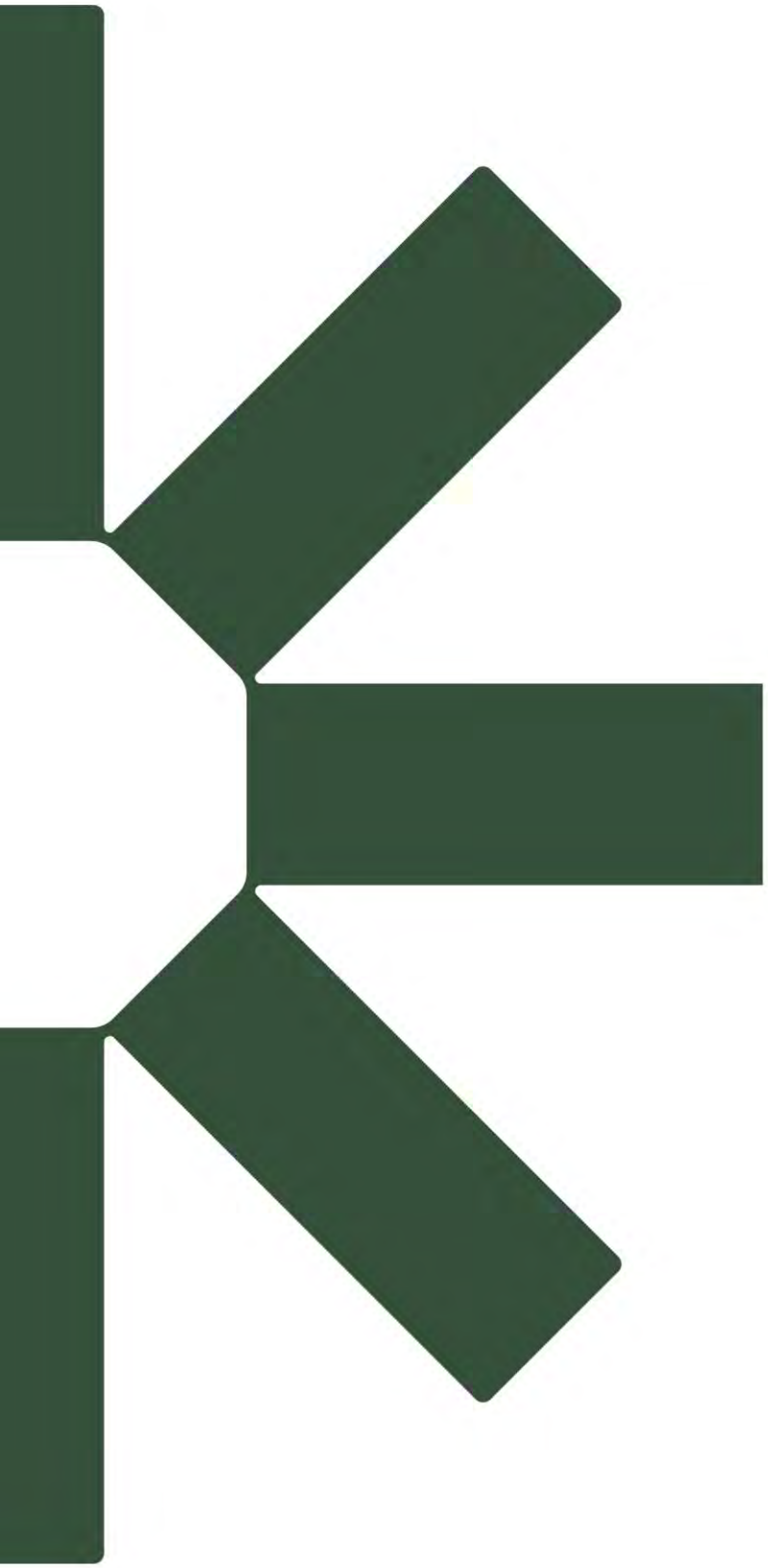
5. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions (refer scu.edu.au/eal).

6. This report was issued on 21/12/2022.

Environmental Analysis Laboratory, Southern Cross University,
Tel. 02 6620 3678, website: scu.edu.au/eal

checked: .....
Graham Lancaster (Nata signatory)
Laboratory Manager



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